

Gamifications: Lexical and trajectory image methods as cognitive intervention in numeracy

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ABSTRACT

This paper describes a study with the goal of exposing children to gamification activities in teaching and learning numeracy based on the lexical method by implementing a trajectory image (image representator). Early childhood learning difficulties in understanding abstract and symbolic numerical concepts and procedures have been identified as an issue that needs to be addressed and acted as a starting point in the effort to shape the transformation of early childhood mathematics both in teaching and learning. Therefore, this study would like to inspect the role played by language as the medium used in translating the concept of numeracy whether it is applied contextually or in a variety of contexts. The respondents selected for this study were 10 teachers and 50 preschool children and a numeracy module instrument based on the numeracy comprehension level model framework (MPKN) was chosen and applied to students by using lexical and image methods called trajectory image or image representator. Findings have shown that the understanding of preschool children related to previous aspects of numeracy is still at level 1 and level 2. It clearly stated that children are still unable to grasp the concept of numeracy in detail. This study has introduced the MPKN and LexsMath gamification products that have successfully provided a clear understanding to children regarding the in-depth understanding of numeracy aspects from level 1 to level 4 and also have shed some light on more effective teaching methods that can be employed in the aspect of numeracy teaching and learning.

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1. INTRODUCTION

Teaching and learning strategies in the 21st century is an approach that is deemed to be “flexible” as teachers are required to understand the knowledge or subject matter which needed to be adapted or altered at different contexts by formulating, constructing, organizing, modifying and understanding information that leads to a meaningful learning experience [1]. To satisfy these needs and criteria, the most suitable method of teaching and learning that can be highlighted is the gamification approach. The gamification approach refers to game-design elements and game principles in non-game contexts. According to Zichermann [1] the gamification approach can be defined as a process of using games to solve problems. It is a relatively new term, but not a new concept. Historically, it is originated from the digital media industry and began with the

term "fun ware" in 2008. Based on these aspects, it can be concluded that gamification is an experiment that utilizes 'power' in games. According to Dicheva *et al.* [2], games do not only impart knowledge but also expose students to essential skills such as problem-solving, creating collaboration, and communication from an education perspective. Geelan *et al.* [3] also state that gamification can create autonomy and self-efficacy by providing students' control as well as an effective tool that will encourage problem-solving depending on students' input or knowledge [4].

Game designers should have the ability to deliver these needs that are aligned with the gaming environment, which enable to satisfy players concurrently. In the context of education, teachers are required to have the competency as well as the ability in conducting meaningful learning and teaching despite the constraints in the environment such as obstacles in the coronavirus disease-19 (COVID-19) pandemic that prevent teachers from administering face-to-face teaching methods due to day-to-day movement control orders (MCO) and conditional movement control orders (CMCO) [5]. Therefore, this article attempts to examine the educational needs inclusively involving school children residing in hospitals. This programmed suggested an alternative approached to give chance to school children residing or living in hospitals to learn effectively despite the constraints that they faced. The implementation of this type of educational needs is done to fulfill the government's intention in offering education to children which acted as a therapy as well as in realizing that their learning process has been delayed due to diseases that require long-term treatment in hospitals. Therefore, it is hoped that learning by gamification method can help children in the hospital schools to acquire knowledge similarly to their counterparts in a typical schools' environment.

2. GAMIFICATION AS AN APPROACH TO BE UTILIZED IN HOSPITAL SCHOOLS

In line with the aspirations of the United Nations Educational, Scientific and Cultural Organization (UNESCO), namely education for all (EFA) and continuous education, Malaysia has created another dimension in national education by creating schools in hospital (SDH). The main purpose is to ensure that educational services are accessible to all children and adolescents who are still within school age regardless of circumstances and conditions including pupils receiving treatment in the hospital. The establishment of SDH is a collaboration between the Ministry of Education Malaysia (MOE), Ministry of Health Malaysia (MOH), and Non-Governmental Organizations (NGOs) in order to provide education for students in hospitals with the willingness to learn [6].

Based on the principle outlined by UNESCO which is EFA every child, adolescent, and adult should be given basic education. For example, Malaysia is one of the countries which give supported to every child in all ethnic minorities. It is evident that, the easy accessibility in education by Malaysian government can lead to a better life for these children despite the setback and circumstances that occur.

Learning in SDH is oriented towards an entertaining and flexible learner approach in a conducive environment. It is indirectly a therapy that can help the recovery process from health problems borne by the pupils. Therefore, in order to encourage SDH teachers to implement more creative and innovative teaching and facilitation in T&L, thinking strategy in basic operations that is more efficient should be emphasized so that the level of understanding among pupils can be clearly verified simultaneously. This thinking strategy accentuates that learning takes place in a combination of various levels (multi-grade) and is guided by the teacher as a facilitator. Learning attributes were conducted based on self-directed learning, self-accessed learning, and self-paced learning. This is parallel with the aspirations of Malaysia education plan 2013-2025 which is to provide an equal access to quality education.

Malaysia has taken various initiatives to expand access and equity in education as well as improving its quality in alignment with the Minister of Education recommendations in the conjunction with the UNESCO Malaysia day celebration [7]. It is evident that, Malaysia has provided pupils with the essential intellectual, affective and psychomotor skills in a holistic and integrated manner to produce individuals who are intellectually, physically, emotionally and spiritually balanced and functionally literate. Therefore, a method of learning and assessments especially the element of improvement in thinking strategies is necessary for basic operations while focusing on 21st-century skills as well. Thus, a thinking strategy based on the numeracy comprehension level model framework (MPKN) has been developed with the intention that teachers should be able to determine the level of understanding of students in basic operations and the learning process can be conducted in an entertaining manner [8]. The findings of this study are expected to introduce a module for the purpose of understanding the level of basic operational skills among SDH students in order to produce high-level thinking students (HLTS), attain soft skills, and foster self-learning.

It is undeniable that education is the most important asset in the development of individuals and countries. The national education philosophy (FPK) also clearly shows the role and importance of education as a continuous effort in producing Malaysians who are knowledgeable, responsible, and capable of achieving personal well-being and contribute to the harmony and prosperity of society and country at large. One of the critical factors that need to be considered is high-quality education that can contribute to e security

in life [9]. This is relevant in terms of improving life quality for all and in turn, stimulates the development of the country. In compliance with the recommendations of the UNESCO which contested EFA where educational opportunities are provided from early childhood to lifelong education in adulthood, the MOE also took the initiative and undivided commitment in providing education to all regardless of race, religion, gender, level, and background [10].

In the spirit to expand access and equity in education as well as to enhance its quality, various comprehensive strategies have been planned and implemented by MOE. In this regard, MOE also cooperates with other agencies and ministries in ensuring children and adolescents have the opportunity to experience normal education, especially special group students, namely students with special needs and health problems. Recognizing this fact, MOE in collaboration with the MOH and Yayasan Nurul Yaqeen (YNY) has established a specific educational system to cater to students with health problems who received long-term treatment in hospitals through the SDH in 2011. Based on the data derived from the MOH, the total admission of patients aged between 5 to 19 years is 239,075 people which is equivalent to 9% from 2, 159, 919 patients in that particular year [11]. These figures clearly show that the number of students who are unable to continue normal schooling due to hospitalization is quite enormous. Therefore, this program was created to provide formal and structured education in a conducive environment for students treated in the hospital in order to avoid dropouts. Currently, there are 15 SDH Programs in Malaysia until April 2018 [12].

In order to ensure the learning process in SDH programs was done appropriately, teachers involved are selected based on certain criteria or characteristics and they have undergone several courses so as to make certain that they are qualified to serve in SDH. The specific training has to be done in order to make sure these teachers are capable to educate students with health problems in the hospital. The foremost challenge faced by SDH teachers is the adaptability to new environments and situations as it is different from the typical school environment. Thus, this study aims to assist teachers by developing a module for teaching and learning sessions in SDH. Due to the conditions of the students, an entertaining learner approach is used as it can help in dealing with these students who suffer health problems in a hospital environment. The effectiveness of this learning approach will depend on the commitment and dedication as well as teachers' attitudes towards their duties or responsibilities. In short, teachers who uphold these attributes will show better performance in this challenging environment.

The main objective of SDH program is to ensure that hospitalized students' learning process is not affected or disrupted. This is equivalent with the goal of EFA championed by UNESCO [13]. The curriculum is an important aspect to be considered in ensuring that an educational program can be implemented effectively. National curriculum is used in the implementation of SDH program, in executing the teaching and learning process (T&L) which includes five cycles, namely heart-to-heart sessions, T&L planning, T&L implementation, reflection and rehabilitation, strengthening, and styling [7]. The T&L process is usually carried out in groups in the classroom or individually in the ward. As SDH agents, teachers involved should be creative and wise in choosing appropriate approaches to cater to the needs of students with various levels of schooling and health conditions. In ensuring that the T&L process implemented in SDH takes place in a fun and meaningful setting, the entertainment-oriented learning approach has been outlined as the T&L method to be utilized in SDH [10].

T&L which uses a gamification approach has the characteristics of fun learning sessions because it contains elements of relaxation, entertainment, and is full of various interesting activities that are able to increase student's involvement in the learning process. However, one of the obstacles that can be seen is teachers are unable to apply game-based T&L while implementing the T&L process simultaneously as it needs to be executed in a combination of multi-tasking, multi levelling, and multi-grading. Besides the setback, this type of T&L if it is successfully conducted, can enhance students learning process as it is more interactive and student-centered.

The gamification-based approach does not only sparks student's interest in learning, but it can also be a form of therapy in relieving boredom as well as pain while training their psychomotor skills as well as developing creativity. Most children in SDH suffer from emotional problems and have low concentration [11]. This is the starting point of health problems experienced by children which in turn contributes to the discomfort in following the T&L process. One of the roles played by SDH teachers is to ensure that these emotional problems are reduced. In order to grasp this role, teachers need to have a clear understanding that this problem is closely related to the aspects of child management which includes the implementation of heart-to-heart sessions and child welfare. However, a study has shown that teachers do not ponder on the aspects of psychomotor and cognitive readiness in providing T&L activities, especially in the ward which leads to a lesser impact while conducting SDH program [12].

In terms of teaching aspects, it is found that SDH teachers are prepared to teach, unfortunately, there are some teachers are unable to diversify the T&L method as it has to be aligned with the learning needs of children with various health problems and age levels. So as to ensure the effectiveness of SDH programs,

teachers are encouraged or advised to employ entertaining learning methods during T&L process. SDH program caters to an approach that is educationally oriented and flexible in a conducive environment for the continuation of human capital development beyond conventional school practices [13]. In short, T&L which uses an entertaining learner approach has the characteristics of a fun learning session as it contains the elements of playing games. In line with the objective of the SDH establishment in preparing formal and structured education in a conducive learning environment (fun learning) for hospitalized children, this type of education is provided to sick children through various approaches as a form of therapy to all ages of schooling regardless of place and limitations, as well as supporting and stimulating children to continue learning so as not to drop out of school.

Evidently, this article attempts to examine the implications of T&L towards children by focusing on the specific teaching context which is numeracy teaching. Numeracy can be defined ability to do basic calculations, comprehension in number systems, the ability to solve problems quantitatively, and the understanding of data collection along with the ability to interpret it into tables, graphs, and diagrams. MOE defines numeracy as the ability to read, write, count and arrange numbers up to a thousand, as well as efficient in basic mathematical operations such as adding, subtracting, multiplying, and dividing and can apply it in money, time and length measurement operations [14]. With this regard, the MPKN module is essential to be utilized in order to determine the level of numeracy comprehension for each student [15]. Moreover, the approach or method used in this module is in the form of structured games whereby this can attract students to learn mathematics in a "fun learning" setting.

Learning mathematics can develop students' cognitive potential for future thinking. Therefore, this knowledge needs to be honed and sharpened from an early stage to produce competent and skilled students in this field. According to Aunio and Niemivirta [16], early mathematical skills are strong predictors of future mathematical abilities. This illustrates that early mathematics education is essential in order to provide optimal learning opportunities. As facilitators, teachers can include class discussions as a platform for children to explain, defend, draw conclusions, predict, and adapt the way they learn mathematical concepts. Besides that, encouragement from teachers is also important in order to verify the level of understanding among students by exposing them to different ways of presenting their views as well as enhancing students' critical thinking skills at the same time.

Therefore, positive relationships need to be developed by teachers while conducting learning sessions as well as providing ample space and opportunities for children to express their personal views using mathematical concepts. The relationship between language and mathematics has been widely discussed in previous studies as literature findings showed that there is a positive relationship between mathematical mastery and language [17]–[22]. One of the issues that have been discussed is learning constraints among preschoolers. Pre-schoolers or preschool children have faced difficulty in understanding abstract and symbolic numerical concepts as well as procedures due to several causes. This constraint acted as a starting point in the effort to shape the transformation of mathematics teaching and learning of preschool children. This constraint is projected through the failure of teachers in delivering conceptual teaching according to mathematical terminology and procedures such as the concept of numeracy by using language efficiently that fades children's interest and mastery in this field. In short, this weakness stems from teachers' failure to understand mathematical goals, children's mathematical development, incompetent mathematical activities, mathematical tests that do not help children's natural thinking development, and the form of concepts applied in teaching. Therefore, this study would like to examine the what extent language plays a role in translating numerical operations and terminology applied contextually or in a variety of contexts.

3. THE MPKN

There are four levels or stages in the MPKN module, namely code interpretation (de-coding), knowledge acquisition (meaning-making), application (using), and analysis (analyzing) [23], [24]. MPKN is adapted from a critical numeracy study model [25], [26] that can be employed in order to identify children's numeracy comprehension levels. There are four levels that were emphasized in the MPKN module in which contains certain characteristics that need to be achieved by each child. When all these levels of numeracy comprehension can be mastered by children, it can be concluded that they have fully reached the level of numeracy comprehension or understanding. This model has several important elements that can be used in developing numerical understanding among children. Firstly, provide children the opportunity to understand the concept of numeracy that will lead to complex thinking. Secondly, provide opportunities for exploration with others by working in pairs, in groups, or take part in whole-class discussions, whereby different views can be gathered. Finally, it also gives children the opportunity to produce an idea that uses their new knowledge, especially explaining the results to their peers, as well as preparation for answering exam questions [27].

Hence, by executing MPKN, children can unearth ideas and associate relationships between those ideas to solve a given problem [28]. It can also be used as a checklist for both teachers and children to verify their understanding of the topic or subject matter that has been implemented and also explore other types of thinking skills by analyzing the questions given. MPKN makes it easier for children to express their thoughts and apply them in daily life [29]. This checklist provides questions as: i) What thoughts have been made?; ii) Do other types of thinking need to be explored?; iii) What happens when analyzing a question?

MPKN was created to ensure children are able to write and express their thought at various levels easily. In addition, each idea can be categorized according to its respective levels and the children will have the opportunity to contemplate various strategies used according to the set levels. At this stage, it is crucial for children to familiarize all the elements as it is quite difficult to adapt to the learning process at the beginning but it will eventually become easier at times. Besides numeracy, children can also use this module for other subjects.

It is quite difficult to identify what needs to be done and how the process takes place [30]. There is difficulty in identifying the next step to develop children's sense of understanding on certain subject matter [27]. Numeracy involves different ways of solving problems. So, there is not just one way to get the right answer and children find it useful to discuss the types of strategies that they use in real life [27]. Therefore, MPKN also helps children to provide evidences and present arguments for each reason or answer given. The implementation of the module can assist children in building and boosting their self-confidence as well as acquire the ability to defend ideas so that they are able to recognize what they are expressing. So as this will produce children with a high confidence level as well as able to argue with the reasoning in decision-making. For each numeracy question, the solution step must follow the procedures and characteristics that have been set based on the levels in the MPKN. This simplifies the process of identifying each child's level of numeracy comprehension based on the answers to each question posed. The framework of this model also gives children the opportunity to learn in a constructivist approach, which involves the application of new knowledge to the existing knowledge, building their own understanding, and creating new meaning.

Apparently, this model uses a lexical and image method called trajectory image or image representator. lexical and trajectory image or image representator methods includes lexical representations and symbolism of objects in numeracy teaching. Based on the MPKN framework, children can nurture numerical understanding through the environment. This will help children develop intelligence which will lead to socially and economically balanced decisions and apply them in daily life. The model on its own can act as a transformation tool for teachers in changing the traditional ways of teaching. However, this model needs to be practiced in teaching and learning in order to gain compatibility with children. A child's understanding of the aspects of numeracy will increase if he or she recognizes the features of numeracy in everyday situations more comprehensively [31].

Moreover, this model can assist children in building and understanding numeracy concepts more effectively as they can bring their existed knowledge as well as ideas that they have in their schemata. Besides that, it also has the ability to identify children's schemata or existing knowledge by means of early exploration, brainstorming, challenging questions, and quizzes. The implementation of this model also can enhance student's ability to think creatively and critically. So, the main role of a teacher is to investigate children's early understanding by conducting some early activities that can help them stay focus on the task and to remind them of their existing knowledge. Other than that, teachers can utter some questions for them to think about, explore some different phenomena, and ask them to contribute ideas.

The MPKN framework can be used to generate numerical ideas based on the various topics in mathematics more extensively. For example, children were given some questions to familiarize themselves with assistance from these stages: de-coding, meaning-making, application, and analysis [24]. It is evident that, MPKN is designed to overcome students' problems in understanding numeracy. This is due to frustration borne by teachers towards the T&L as children are facing difficulty in understanding the concept as well as unable to grasp information conveyed.

Therefore, in order to ensure the effectiveness of the module in the T&L, the right ideas need to be unearthed and the ability to draw solid conclusions based on mathematical reasoning should be implemented. It is called critical numeracy which has been defined [32]. There is a clear analogy regarding critical numeracy, which involves the realization that all texts represent different views of the world [33].

4. THE MPKN: AN APPLICATION

This article attempts to demonstrate a game-based educational project in numeracy operations for preschool children in a fun learning setting. A module called "fun learning with numeracy" has been established as an approach to address the ambiguity of numeracy understanding. The MPKN is written to introduce a method of teaching and learning mathematics at the school level in hospitals by integrating the

four levels of numeracy comprehension, namely code interpretation, knowledge acquisition, application, and analysis. Materials and activities provided can be utilized both by children as well as school mathematics teachers in hospitals in terms of constructing and understanding the numeracy concept whether specifically or generally. This module is also suitable for all mathematics educators for training purposes as it can produce more creative and innovative educators or teachers to come up with teaching and learning activities that prioritize high-level thinking.

In general, this module can trigger the idea of numeracy comprehensively by referring to the basic operating topics in the KSSR syllabus. Children were given some examples of non-routine questions related to real-life to help them become familiar with the four levels of numeracy comprehension. The activities planned in this module able to provide an opportunity for children to practice constructivist learning approach that involves relating new knowledge to their existed knowledge by building their own understanding with new meaning. In addition, this module also helps to build children's self-confidence as it will develop children's ability to argue and explain in detail the decision that they agreed on in a fun manner.

In the context of the KSSR curriculum, Mathematics has been deemed to be the best platform to develop the intellectual expertise of individuals in making logical reasoning, spatial visualization, analysis, and abstract thinking. Through learning and application of mathematics, children are able to develop numeracy, reasoning, thinking, and problem-solving skills. Thus, this module is able to provide opportunities for children to perform creative tasks and gained fun experience as well as attained the feeling of excitement when performing activities that challenged their minds. Experiences like these can increase interest and motivate children to learn mathematics outside the classroom and at higher levels of difficulty. Specifically, the module is written to: i) Identify the level of understanding on numeracy among children; ii) Assist children in understanding numeracy concept easily; iii) Entice children in learning mathematics; iv) Provide meaningful learning experiences to children; v) build confidence among children in learning mathematics as well as making decisions; vi) Assist children in solving mathematical problems effectively; vii) Assist children in higher thinking order while learning mathematics; viii) Expose method used in understanding numeracy through the lexical method, i.e. children are able to translate the concept of numeracy using their own language; ix) Ensure the significance in understanding symbolically of an object referred to as a trajectory image or image representator in terms of applications by providing evidence.

One of the examples on the application of numeracy teaching based on the MPKN is this article will demonstrate the implementation of this model in the basic operations chapter such as addition. In 1323-1382, Kilpatrick [34] used a diagram that looked like an additional symbol taken in the proportion algorithmus believed to have been written between 1356 and 1361 which is an abbreviation for the word "et Latin" which means "and". The plus symbol appears in the manuscript of a work believed to have been written in the 14th century. In the 1456 manuscript written in German, the word "et" is used for addition and is usually written closely to resemble the + symbol.

The application of the MPKN Model will be shown in Figure 1. The figure explains the application of the MPKN which features four levels of numeracy comprehension based on lexical methods represented by words and images called trajectory image or image representator. Level 1 is the code interpretation, i.e., children will read and trace words in a mathematical sentence, stating the mathematical terminology used as the basis of calculation. At level 1 the trajectory image or image representator method is applied through word detection and image representation through their ideas on mathematical problems found in mathematical sentences.

Level 2 involves acquiring knowledge, which includes ways to get basic mathematical facts, explain the ideas and understanding of an object as well as define children's opinions on their ideas through their ways of thinking through lexical detection and terminology given to mathematical problems and translate mathematical problems through symbolism object, i.e., referred to as a trajectory image or image representator. Next, on level 3, the child then applies mathematical problems in daily life by explaining the concepts and features of numeracy that are understood in his life and are able to explain in detail an object that has the same properties as the mathematical concept. In this case, in Level 3 as well, the lexical method and trajectory image or image representator are applied.

Finally, at level 4, namely, analysis is that the child gives other evidence through words found in an environment that has the same concepts and characteristics as the numerical data are given. In this context, the numeracy method also uses the lexical method and the trajectory image or image representator. This gamification-based learning is a form of learning that adheres to a student-centered constructivist teaching approach that empowers children in combining theory and practice as well as applying knowledge and skills to find solutions. Based on previous study [35], game-based learning sessions are implemented in three steps: i) The child is given a problem; ii) Children enjoy learning while playing; and iii) Children can solve problems with critical ideas born orally and representation of objects applied from their living environment.

(T1A1) Some cards are dealt <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">4 + 5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">11 + 19</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3 + 12</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">342 + 18</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">8 + 7</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">342 + 13</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3 + 5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">□ + 16</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">5 + 3</div> </div>	Stage 1: De-coding	- Explain how you do - How to identify the problem there - List all the information you understand - Give new ideas and existing knowledge to solve a given problem.
	Stage 2: Meaning-making	- Can you explain - Match the various concepts you use - Define / its own based on your understanding - Summaries how you understand the mathematical concept based on questions given
	Stage 3: Using	- Apply with different concepts - Complete in accordance with your understanding - Relate the concept of numeracy in everyday life - Determine the appropriate procedures.
	Stage 4: Analysis	- Prove your answer - Describe the procedures used - Ensure that all facts and concepts used in the analysis. - You trust and confidence in the answers.
(T1A2) A container filled with marbles is provided, pupils are required to take the marbles and place them on the table (a container is provided so that no marbles rolls) without knowing the number of marbles.	Stage 1: De-coding	- Explain how you do - How to identify the problem there - List all the information you understand - Give new ideas and existing knowledge to solve a given problem.
	Stage 2: Meaning-making	Researchers make a circle on the number "5" and asked the students, how many marbles can your group formation of 30 marbles. Repeating steps to make a circle on the number "6". - Can you explain - Match the various concepts you use - Define / its own based on your understanding - Summaries how you understand the mathematical concept based on questions given
	Stage 3: Using	- Apply the last activity to repeat this activity with two-digit number of groups: the number "10" with different concepts - Complete in accordance with your understanding - Relate the concept of numeracy in everyday life - Determine the appropriate procedures.
	Stage 4: Analysis	- Prove your answer - Describe the procedures used. - Ensure that all facts and concepts used in the analysis. - You trust and confidence in the answers
(T1A3) A black box is provided and pupils are required to take what is in the box.	Stage 1: De-coding	- Explain how you do - How to identify the problem there - List all the information you understand, what is there in this box - Give new ideas and existing knowledge to solve a given problem.
	Stage 2: Meaning-making	Before doing the activity, pupils are asked how many matchsticks are there? A rod represents a digit number and the value of the home schedule is available, so you are required to design formation of some five-trunk number using toothpicks, what numbers can be formed Can't number "72" be formed by this tool and what is the highest number that can be formed?
	Stage 3: Using	- Apply with different concepts Complete according to your understanding, what is the number of designs can be produced - Relate the concept of numeracy in everyday life. Now how long of matchsticks. - How many matchsticks you have this, try to finish and determine the appropriate procedures.
	Stage 4: Analysis	- Prove your answer - Describe the procedures used - Ensure that all facts and concepts used in the analysis. - You trust and confidence in the answers

 MULTICONTEXTUAL
 IDENTIFY AND UNDERSTANDING THE PROCEDURE AND TERMINOLOGY CONCEPT AND TRAJECTORY IMAGE (IMAGE REPRESENTATOR)

Figure 1. Level of numeracy comprehension

5. COGNITIVE INTERVENTION IN TEACHING AND LEARNING NUMERACY

Once the engagement with gamification activities has been completed, children will reflect on their ideas and skills. The exploration activities are designed to provide a concrete experience for children to continue building knowledge and skills. This phase should be concrete and meaningful for children and ample time was given to explore their knowledge and skills. This phase may require children to identify new situations, learn new tasks, technologies, and procedures. As a result, children are mentally and physically involved in activities. The children are also able to build relationships, observe patterns, identify variables and adapt to the teaching needs. The teacher acts as a facilitator or coach. The teacher begins the activity and gives students time and opportunity to investigate objects, materials, and situations based on each child's idea of a scenario or problem. If necessary, the teacher will guide the children as they begin to present explanations or solutions. The use of highlighted materials and concrete experience is required in the exploration phase. The exploration phase may be central to cooperative learning. Opportunities for children to interact, discuss, and even argue in the environment will support student-centered activities based on children's skills that directly exhibit different communication styles and personalities. In addition, children will present their ideas in order to build a shared understanding of a problem and suggested solutions [35].

According to previous study [36], the phases of the constructivist instructional model from the aspect of 21st-century learning skills consist of: engagement phase (engagement); exploration phase; explanation phase; elaboration phase; and evaluation phase. In the engagement phase, students are involved in learning tasks. Cognitively, students have to focus on an object, situation, or event. This activity introduces a new problem that students need to solve. The activities loaded in this phase should have relevance to previous activities and future activities. This relationship is dependent on the learning task and maybe conceptual, procedural, or behavioral. The process of asking questions, defining problems, and drawing

image representations from their ideas in understanding and solving problems in the field of numeracy is a way that can draw children's attention to instructional activities. The role of teachers is to introduce the situation and identify their assignments and learning outcomes. In addition, teachers also set the rules and procedures of activities that are consistent with the operation, procedures, and terminology of numeracy. The experience should be short and concise. The success of children's involvement can be seen in which they are stimulated by problems and actively motivated in learning activities.

Evidently, cognitive intervention is stimulated through the following phases: engagement phase; exploration phase; explanation phase; elaboration phase; and evaluation phase. Explanation means an action or process, that is, a concept, process or skill that becomes clear and easy to understand. This explanatory process provides children and teachers with common terms related to the learning experience. In this phase, the teacher draws the child's attention to specific aspects that match the experience. Besides that, the explanation phase also a way of organizing and giving common language to the exploration experience. For example, the specific skills that this teacher emphasizes. Teachers need to ensure that children's explanations are clearly linked to experiences in the engagement and exploration phases. The key to this phase is to present concepts and skills in a concise, simple, clear, and accurate manner before move on to the next phase.

The elaboration phase involves children's experiences in which they are encouraged to apply, develop, and detail relevant concepts or skills. An example of an appropriate detail phase for 21st-century skills is that children are involved in discussions and information-seeking activities. The goal of conducting group discussion is to identify and implement work-related approaches. During the group discussion, the children presented and defended their respective approaches related to the task. The outcome from this discussion is that the children able obtain a better definition of the task in terms of identifying and collecting information needed to complete the task successfully. Children acquire information from their peers, teachers, printed materials, experts, electronic databases, and experiments. As a result of engaging in group discussions, children are individually able to detail the concepts of assignments, the basics of information, and possible strategies for completing assignments. The interactions between children in groups are part of the detailing process. Group discussions and cooperative learning situations provide opportunities for students to express their understanding of the subject as well as receive feedback from others who have almost the same level of understanding as them. The detailed phase also gives children the opportunity to engage in new situations and problems that require them to apply the same explanation. The transfer of learning and generalization of concepts and skills becomes the main goal in the detail phase.

Finally, in the evaluation phase, the feedback was given to children on the adequacy of the explanations given as well as their abilities. Informal assessments can occur from the beginning of the instructional arrangement. Teachers can complete formal assessments after the detail phase. During this phase, teachers conduct tests to determine the level of understanding of each child, which is related to their skills and abilities. In short, it is a good opportunity for children to use the acquired skills in their daily life as well as it can also able to access children's understanding and present the solutions that they have generated.

6. CONCLUSION

Knowledge is deemed to be important as it needs to be imparted in an integrated manner into learning activities. In this regard, children with different learning needs should be given opportunities through a variety of learning techniques so that their potential can be optimized. Teachers play the main role in helping students to develop 21st-century skills through the use of methods that can enhance children's abilities. The integration of technology in the classroom routine is a crucial component that need to be practiced in every learning session. The integration between information technology and media as well as making it coincide with pedagogy and learning techniques will facilitate and support children to achieve improvement in their learning. Technology integration offers children the opportunity to master important skills in this era such as collaboration skills, information skills as well as self-learning.

Besides that, several criteria have to be considered such as content and learning standards, children's existing knowledge, resource preparation as well as the selection of appropriate combinations of strategies and skills in planning the lesson to use during teaching. Planning and implementing learning that meets the educational needs of the 21st century through interactive, interesting, and effective pedagogical practices should be a priority. In addition, learning process should be implemented meaningfully through learning by doing approach, i.e., children are stimulated to think as well as build their understanding of the subject matter. Pedagogy is used as a foundation in order to ensure teaching and learning carried out by teachers which include principles, techniques, and teaching processes are performed successfully. A systematic, interesting, and appropriate learning process can encourage children to be actively involved and maintain children's motivation throughout learning activities.

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