

## Gamification Psychology ~~in~~ Education: A Procedure ~~For~~ Teaching ~~And~~ Learning Numeracy ~~Based-based ON LEXICAL~~ on Lexical ~~And~~ Trajectory Image (Image Representation) Method

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### ABSTRACT

This research explores the application of gamification in teaching and learning numeracy, incorporating the lexical method and Trajectory Image. With the introduction of the "BaseMath" application, which integrates gamified elements into basic mathematical operations, the study aims to combat student disengagement, especially in the

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context of post COVID-19 online learning. By drawing on principles from gamification psychology, BaseMath aims to create an enjoyable learning environment that enhances students' learning outcomes through the use of rewards, competition, and immediate feedback. Moreover, BaseMath encourages flexible and active participation, both within and beyond the traditional classroom setting. The study employs the "numeracy understanding" model to assess pupils' numeracy levels through four key stages: decoding, meaning-making, using, and analysis. Recognizing the pivotal role of numeracy in mathematics and everyday applications, the research emphasizes the significance of mastering numeracy at an early stage as it significantly influences academic excellence and real-life problem-solving skills. Furthermore, this research contributes to a deeper understanding of the psychological impact of gamification in numeracy education. By shedding light on the interplay between gamification elements and learners' cognitive processes, emotions, and motivation, the study informs the development of engaging educational strategies that effectively motivate learners. The insights gained from this research hold the potential to enhance the design and implementation of future gamified approaches in numeracy education, ultimately fostering a more enjoyable and effective learning experience for students.

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**Keywords:** Trajectory Image, BaseMath, Numeracy, Trajectory Image (Image Representator), de- coding.

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## INTRODUCTION

Teaching and learning strategies in the 21st century is an approach that is deemed to be "adaptable". Whereby, teachers need to understand the knowledge and discipline that needs to be adapted in different contexts by formulating, constructing, organizing, transforming and understanding information so that it is understood as meaningful knowledge (Hajimia et al., 2019a, 2019b, 2022). One of the teaching and learning methods or approaches that can be emphasized in order to cater these characteristics is an approach that refers to playing games for non -game activities. According to Zichermann (2010), defined as a process that uses games that utilizes thinking skills to solve problems. It is a relatively new term, but not a new concept. From a historical point of view, it is originated from the digital media industry and started with the term "funware" in 2008. Therefore, Zicherman who started using this term has defined it as

*"Funware is the art and science of turning your customer's everyday interactions into games that serve your business purposes "*

(Zichermann & Linder, 2010)

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Thus, it involves the participation of individuals in the game world for the purpose of problem- solving. According to McGonigal (2010), ~~There there~~ are several aspects that can encourage players involvement in participating in the activities, such as;

1. Urgent Optimism - desire to act and belief in achieving success.
2. Social Fabric - the ability to trust and form a strong social bond through games.
3. Blissful Productivity - the belief that a task performed by a player is meaningful, is determined by dedication towards the game.
4. Epic meaning - a strong attachment and admiration for the story inside game.

Based on these aspects, it can be concluded that gamification is an experiment that harnesses the 'power' of the game. According to Diechiva et al. (2015), in education perspective, it is not only imparting knowledge but also promotes important skills such as problem-solving, creating collaboration, and communication. Geelan (2015) added that giving students a sense of control over their actions might foster autonomy and self-efficacy. Depending on the students' input or information acquired, effective games will encourage students to solve problems (Langendahl et al., 2016; Hajimia, H. 2020). Moreover, Geelan (2015) also stated that, one can create autonomy and self-efficacy by providing students a sense of control in doing something. Effective games will promote problem-solving skills among students depending on the input or knowledge gained by them (Langendahl et al., 2016; Hajimia, H. 2020).

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Dicheva et al. (2015) have listed game design and principles that have been practiced in education, along with some effective implementation towards these practices, namely:

- Goals: should be clear and visible as well as changes in the level of difficulty
- Challenge and quests: need to be clear, concrete, learning tasks that can be implemented with the increasing of complexity
- Customization: should provide a personalized experience to learners, with adaptive difficulty, challenges tailored to the player's skill level, or increase in the level of difficulty along with player improvement

- Progress: students should be able to see, visualize and assess their progress up to the level of mastery.
- Feedback: Students need to get an immediate feedback and reward.
- Identity engagement (social engagement) should be included in some form, either through competition or cooperation.
- Accrual grading: Instead of a grade representing points subtracted from a perfect score (i.e. receiving 75 out of 100), students can begin from the foundation level and build points that will shape their grade
- Visible status: Students must be given a good reputation, credibility of identity or receiving recognition in some way.
- Access / unlocking content: Students should be able to show some level of mastery on the task or the axial of their eyes to access new features or unlock new content.
- Freedom of choice (freedom access): There are many paths that can be followed to achieve success. Students should be able to choose their own sub-goals in more challenging assignments
- Freedom to fail: There should be a low risk in connection with a particular submission, students should be given more attempts to succeed.
- Story telling: A narrative approach should be used in the game to create "meaning" that encourages them to keep playing.
- New identities: Students can play the role based on the story, or build a new identity for themselves.
- Onboarding: Students should be exposed to game mechanics with duties.
- Time restriction: Games should be scheduled with well - students will be able to complete the quiz as well quest within the time frame given.

Based on these principles, something constructed can be both mechanical and dynamic in nature (Nah *et al.*, 2014). Mechanics are methods and techniques used, while dynamics in turn refers to the motivation that can be received through game mechanics. Game designers should acquire the knowledge the requirements needed in a gaming environment, in addition to being able to satisfy players. The correlation between mechanics and dynamics can be shown in Figure 1 below:

Game Mechanics	Human Desires					
	Reward	Status	Achievement	Self Expression	Competition	Altruism
Points	●	●	●		●	●
Levels		●	●		●	
Challenges	●	●	●	●	●	●
Virtual Goods	●	●	●	●	●	
Leaderboards		●	●		●	●
Gifting & Charity		●	●		●	●

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Challenges	●	●	●	●	●	●
Virtual Goods	●	●	●	●	●	
Leaderboards		●	●		●	●
Gifting & Charity		●	●		●	●

Correlation between mechanics and dynamics  
(Adapted from Olga Beza, 2011)

Based on the idea of correlation of this approach, it can be concluded that the application of this method has been considered as a practice in fostering learning known as "serious game" as well interactive and contains soft values.

According to Sarudin *et. al.* [2019], Kilpatrick [2001], learning in education perspective can occur whether game content is integrated with learning or vice versa. Learning [process](#) in the [real realm](#) of games can [be happened occurred](#) based on the feedback received from [the](#) students. Therefore, in this context, the terms "Game Based Learning" and "Learn Based Gaming" should be targeted in the process. If it is intended for game-based learning, then the concept of "Game Based Learning" will be applied throughout the implementation. However, if the focus is on learning-based games, then the concept of "Learn Based Gaming" will be emphasized.

[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, 2010), 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, (2015) and Hajimia et al., (2022), 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. Also, Geelan et al., (2015) also states that gamification can create autonomy and self-efficacy by providing students' control as well as an effective play that will encourage problem-solving depending on students' input or knowledge (Langendahl et al., 2016; Hajimia et al., 2019a). In order to satisfy those needs as well as criteria, the most prominent method of teaching and learning that can be implemented is a specific approach, namely the gamification approach. It is an approach that deals with game design elements and principles in a non-game context. According to (Zichermann, 2010), the gamification approach can be defined as a learning process using games to solve problems. This is evident with the enhancement of technology in this decade as the concept of learning using games is not new but the term used to describe this learning process is relatively new. In fact, the origins of this term are derived from the digital media industry which started with the term 'fun ware' back in 2008. Therefore, by looking at these aspects, it can be concluded that gamification is experimentation that utilizes the 'power' in games for learning purposes. Dicheva (2015) and Hajimia et al., (2022), has agreed upon that games do not only impart knowledge but also has the ability to enhance specific skills namely problem solving, creating collaboration as well as communication skills in an educational setting. Besides that, Geelan et al., (2015) also state that gamification has the tendency to create autonomy and self-efficacy by providing students control as well as a compelling play that will encourage problem-solving depending on students' input or knowledge (Langendahl et al., 2016; Hajimia et al., 2019a).

Game designers should have the ability to deliver these needs that are aligned with the gaming environment, whereas able 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 COVID-19 pandemic that prevent teachers from administering face-to-face teaching method due to day-to-day Movement Control Orders (MCO) and Conditional Movement Control orders (CMCO). With this regard, this chapter attempts to examine the educational needs inclusively involving school children resided in hospitals. The implementation of this type of educational needs is done to fulfil the government's intention in offering education to children which acted as a therapy as well as to realize their learning process that is 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 counterpart in a typical schools' environment. Indeed, game designers should be able to effectuate these needs that are aligned with the gaming environment. This is essential as it will lead to the feeling of satisfaction among the players simultaneously. In the context of education, the competency of teachers is deemed to be very crucial in conducting classes with meaningful learning and teaching in spite of the obstacles or constraints in the environment such as the eruption of the COVID-19 pandemic that eventually has prevented teachers from administering face-to-face teaching method due to day-to-day Movement Control Orders (MCO) and Conditional Movement Control orders (CMCO). In regard to this situation, this chapter aims to examine or investigate the educational needs involving school children residing in hospitals inclusively. The implementation of this type of educational need is utilized to fulfill the government's intention in offering education to children which acted as a therapy due to the realization that their learning process is interrupted and delayed as a result of the sickness that required long-term treatment in hospitals. Therefore, using gamification in the learning process is the most appropriate method as it can assist these children to learn better in hospital schools as well as experienced similar knowledge and experience in the typical school environment.

#### BaseMath Using Gamification Approach

BaseMath is an application that contains solution stages that are used to determine students' understanding in answering and solving mathematical problems. This application is built based on the Numeracy Comprehension

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Tool Model (won ITEX Gold 2016 and PECIPTA silver 2013). BaseMath has been utilized by Bachelor of Mathematics Education students which covered topic on Calculus at the university level. In short, this application was adapted from the previous model of numeracy comprehension level. Model of the stage of the numeracy understanding is introduced to identify the primary schools' pupils across the country achieve the targeted numeracy level. In line with the ever-increasing educational challenge, the model is able to identify the extent to which each student's numeracy level. ~~The uniqueness of BaseMaTh is that it can assists in deciding the level of understanding of the numeracy of every understudy in which each level contains its own qualities to encourage to know their individual level of comprehension of numeracy. By using BaseMath games students can learn at home using only a mobile phone and can learn to withstand their abilities. Based on the model of the stage of the numeracy understanding it will be able to identify the extent to which each student's numeracy level. The model can help the government, especially the Ministry of Education so that an evaluation process, especially in the field of literacy and numeracy can be realized in line with the competency level thinking of the next generation. The researcher see momentum instructive changes to the time of globalization and learning without limits, so the researcher came up one application using a cell phone called e-Numeracy. The e-Numeracy application made by this researcher is utilized as a part of learning as per the most recent discovering that is towards the 21st century. The primary concern to take gander at is from parts of evaluating and understanding the numeracy of student numeracy comprehension. This model demonstrate the utilization of the implicit e-Numeracy programming and students can learn beyond the classroom. The most prominent and unique features of BaseMaTh is that it can assists in deciding the level of numeracy understanding of every understudy as each level contains its own qualities or features. These qualities or features can be employed to gauge the individual understanding of numeracy. Students can utilize BaseMath using only a mobile phone at home as well as learn to withstand their abilities. Based on the model of numeracy understanding, each of students' numeracy level can be identified easily. Therefore, this model can assist the government, especially the Ministry of Education in the evaluation process, specifically in the field of literacy and numeracy so it is aligned with the level of competency of new generations. Moreover, the researcher sees a drastic change due to the enhancement of technology whereby learning can be performed without limits, in regard to this, the researcher has able to create one application that can be used with cell phone known as e-Numeracy. E-Numeracy was created as a learning tool as the 21st century because of the emergence of technology with the main purpose is to evaluate students' numeracy understanding. Moreover, this model also demonstrates the application of the implicit e-Numeracy programming in which students can learn beyond the classroom setting.~~

#### Methodology

This model consists of five tasks and on each task, there are three activities to be done by each pupil. Through to clinical interviews pupils will be interviewed based on the given task. Each activity on all tasks contains the four stages of the numeracy understanding. Through this interview, it can identify the extent to which pupils' numeracy level whether they achieve the first stage: de-coding, second stage: meaning making, third stage: using and fourth stage: analysis. BaseMaTh is a digital game that is an advancement made in accordance with educational modules in Malaysia. This game is one of the branches of "thinking strategy" in creating students and is in line with the use of School-Based Assessment (SBA) that has been implemented now in all primary and secondary schools.

BaseMaTh ~~to has able to~~ create a new perspective of Mathematics subject as well as provide a conducive and attractive learning environment. ~~is used to determine the level of students' numeracy understanding based on the results obtained for each question. Moreover, This this~~ apps ~~is also can be~~ used to identify the numeracy level of each ~~pupitstudent~~. There are four stages ~~involved in order~~ to achieve numeracy understanding: - de-coding, meaning-making, application and analysis. ~~Besides that, BaseMaTh are applicationsis an application~~ for learning the basics of mathematics. This application contains the solution stages to determine the students' level of

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understanding in answering the questions. This app is created to attract students to enjoy their learning apart from they can answer the questions in or outside the classroom.

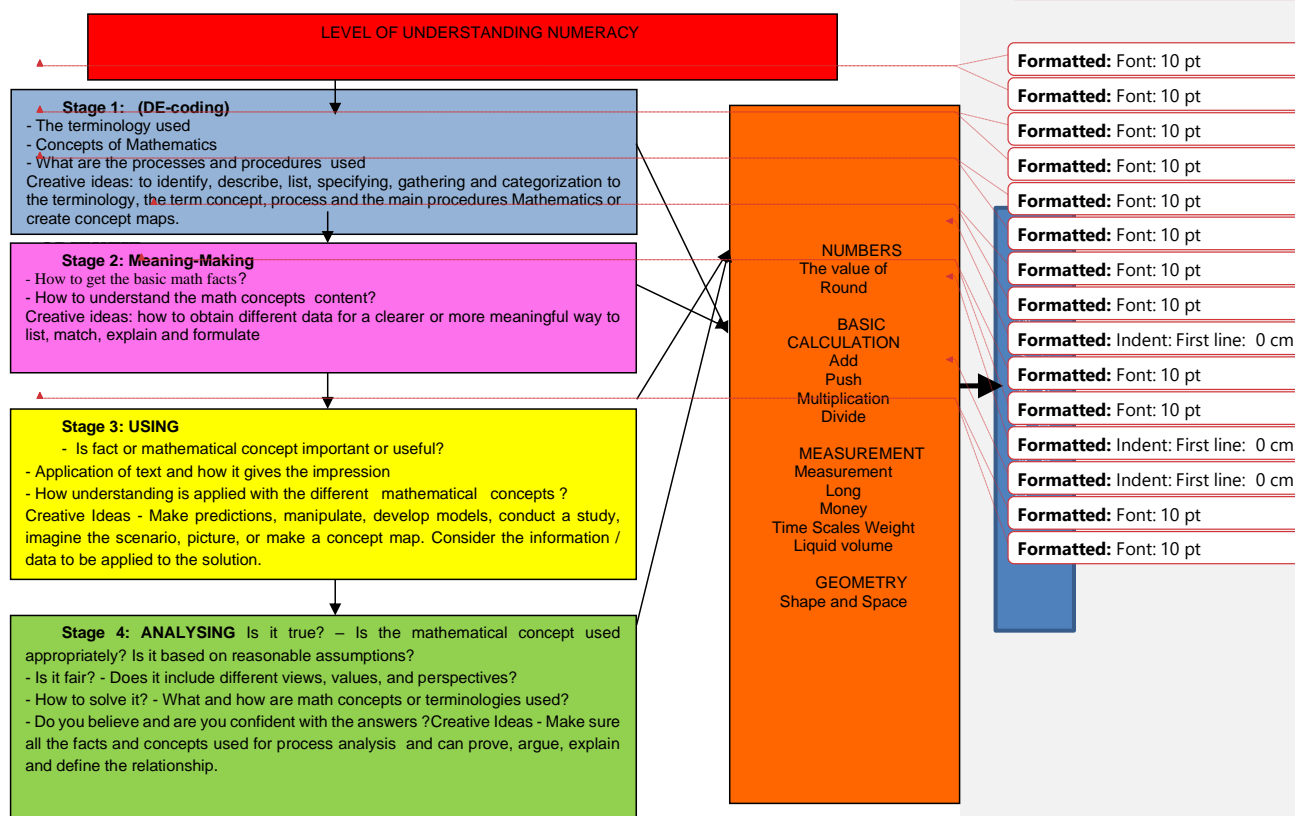


Figure 1: Framework adapted research model framework "Four Resource Model of Critical numeracy" by Luke and Freebody, 2009)

### Objective

The model of the stage of the numeracy understanding is to identify the level of numeracy understanding possessed by the pupils in the primary schools and how the pupils in the primary schools understand the numeracy.

### Innovation

The model of the stage of the numeracy understanding is an innovation in as part of branch of in the thinking strategies method and which is in line with the implementation of School Based Assessment (PBS), which that was carried out now in all primary and secondary schools.



There are 4 stages contain the specific characteristics:

- Stages 1 : De-coding
- Stages 2 : Meaning making
- Stages 3 : Using
- Stages 4 : Analysing

The activity can be conducted in group or individually. Facilitate the teachers to know the student's level of numeracy understanding because it has its own characteristics in every ~~stagesstage~~. The uniqueness of MPKN is that it can assists ~~in-decidingin deciding~~ the level of understanding of the numeracy of every under study in which each level contains its own qualities to encourage to know their individual level of comprehension of numeracy. The uniqueness ~~of BaseMaThof BaseMaTh~~ is that it can assists in deciding the level of understanding of the numeracy of every understudy in which each level contains its own qualities to encourage to know their individual level of comprehension of numeracy. By using BaseMath games students can learn at home using only a mobile phone and can learn to withstand their abilities.

Based on this innovation, it is hoped to create excitement while learning calculus. The students will continue to be able to know their level of ~~understanding-whichunderstanding which~~ they obtain directly. BaseMath has the potential to be one of the alternative materials for teaching and learning. It is also hoped to be an alternative in the future to support learning activities as well as a medium of information delivery. This BaseMaths also implies the need to improve the understanding level of numeracy among the students in higher learning institution who are taking the ISMP Mathematics course specifically and generally all courses offered at the higher learning institutions. Based on this innovation, it is hoped to create excitement while learning calculus. The students will continue to be able to know their level of understanding which they obtain directly.

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#### Description of BaseMath Apps

~~BaseMath is~~BaseMath is a mobile application to create a new perspective of Mathematics subject as well as provide a conducive and attractive learning environment. BaseMath links as below: [https://simmer.io/@a\\_kewmie/basemaths](https://simmer.io/@a_kewmie/basemaths). Student can access BaseMath Apps via the link given. BaseMath is used to determine the level of students' calculus understanding based on the results obtained for each question. It's also to identify the calculus level of each student. There are four stages to achieve numeracy ~~understanding:-~~ understanding: - de-coding, - meaningcoding, meaning-making, application and analysis. This innovation was invented based on Numeracy Level of Understanding Module (Siti Rahaimah *et. al* 2013; Ali, 2014; Ali & Idris, 2013; 2014, Ismail *et al.*, 2021), Ismail *et. al.*, 2023, Sarudin *et al.*, 2020).

#### Materials

One of the examples of the interview questions to identify the level of understanding of each pupil numeracy. There are five tasks each task there are three activities. Based on the five tasks assigned, students can be identified at the level where they earn, for example:



(T1A1) Some cards are dealt		Stage 1: De-coding	Explain how you do
	4 + 5	11 + 9	- How to identify the problem there
	3 + 12	342 + 18	- List all the information you understand
	8 + 7	342 + 13	- Give new ideas and existing knowledge to solve a given problem.
	3 + 5	□ + 16	
(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.	5 + 3		
		Stage 2: Meaning-making	Can you explain
			- Match the various concepts you use
			- Define / its own based on your understanding
(T1A3) A black box is provided and pupils are required to take what is in the box.		Stage 3: Using	- Summarise how you understand the mathematical concept based on questions given
			Apply with different concepts
			- Complete in accordance with your understanding
			- Relate the concept of numeracy in everyday life
			- Determine the appropriate procedures.
(T1A4) A black box is provided and pupils are required to take what is in the box.		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.
(T1A5) 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
			- Give new ideas and existing knowledge to solve a given problem.
(T1A6) A black box is provided and pupils are required to take what is in the box.		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-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
(T1A7) A black box is provided and pupils are required to take what is in the box.			- Summarise 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.
(T1A8) A black box is provided and pupils are required to take what is in the box.		Stage 4: Analysis	Prove your answer
			- Describe the procedures use
			- Ensure that all facts and concepts used in the analysis
			- You trust and confidence in the answers .
(T1A9) 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.
(T1A10) A black box is provided and pupils are required to take what is in the box.		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 number -toothpicksusing toothpicks, what numbers can be formed.

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		<del>Can't number</del> 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 used - Describe the procedures used - Ensure that all facts and concepts used in the analysis. - You trust and confidence in the answers

#### Gamification Activities as An Approach ~~To~~ Be Utilized ~~In~~ Hospital Schools

~~In line with the aspirations of UNESCO, namely Education for all 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 students 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. The establishment of Schools in Hospital (SDH) by the Malaysian government with the aim to provide an ample educational setting to a specific group of students are in line with the UNESCO aspirations – Education for all and continuous education. In other words, this is to ensure that educational services are accessible to all children and adolescents who are still of school age regardless of circumstances and conditions including students receiving treatment in the hospital. This is a collaborative project 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 that are willing to learn even under such conditions.~~

Based on the principle outlined by The United Nations Educational, Scientific and Cultural Organization (UNESCO) which is "Education for All (EFA)" every child, adolescent, and adult should be given basic education. One of the six (6) internationally agreed educational goals is, "Ensuring that by 2015 all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to, and complete, free and compulsory primary education of good quality. "

~~Malaysia has taken various initiatives to expand access and equity in education as well as improving its quality as align with the Minister of Education suggestions in the conjunction with the UNESCO Malaysia Day celebration. Therefore, a method of learning and assessments especially the element of improvement in thinking strategies is necessary for basic operations as well as focusing on 21st-century skills. Thus, a thinking strategy based on the Numeracy Comprehension Level Model (MPKN) developed by Siti Rahaimah (2014) and Arora et al., (2021), so that teachers are able to determine the level of understanding of their students in basic operations and learning process can be conducted in an entertaining manner. In the conjunction with the UNESCO Malaysia Day celebration, Malaysian government has taken various initiatives to expand access and provide fairness in education. The improvement in the quality of education in general has also been emphasized in line with suggestions from Minister of Education. Hence, a method of learning and assessments especially the enhancement of thinking strategies is crucial for basic operations as well as focusing on 21st-century skills. Thus, a thinking strategy based on the Numeracy Comprehension Level Model (MPKN) developed by Siti Rahaimah (2014) and Arora et al., (2021) has been utilized, in order to ensure teachers are able to determine the level of understanding among students in basic operations and the learning process that takes place is conducted in an entertaining manner. 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 for students in SDH. Therefore, it is undeniable that education is the most important asset in the development of individuals and countries.~~

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Recognizing this fact, MOE in collaboration with the Ministry of Health Malaysia (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 Hospital In-School Program (SDH) in 2011. Based on the data derived from the Ministry of Health Malaysia (MOH), the total admission of patients aged between 5 to 19 years is 239,075 people which equivalent to nine percent of 2, 159, 919 patients in that particular year, Yayasan Nurul Yaqeen, (2014) [6]. These figures clearly show that the number of students who are unable to continue normal schooling due to hospitalization is in large numbers. 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. At this moment, there are 15 SDH Programs in 15 hospitals in Malaysia until April 2018 (Special Education Division, 2018) (Ali, 2017).

The gamification-based approach does not only sparks children's interest in learning, but it can also be a form of therapy in relieving boredom as well as pain while training psychomotor skills as well as developing creativity. Most children in SDH suffer from emotional problems and have a low concentration (Lan, 2021; Hajimia et al., 2022). 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. Moreover, the gamification-based approach has the ability to spark or ignite children's interest to learn, as well as acted as a form of therapy that can alleviate boredom and pain while training psychomotor skills. It is known that; this approach can also develop creativity among children. It is the most appropriate approach as most children in SDH suffer from emotional problems besides having a low concentration in doing tasks (Lan, 2021; Hajimia et al., 2022). Health and emotional problems are the main issues experienced by children in the hospital that in turn contribute to the sense of discomfort in following the T&L process. Therefore, SDH teachers have the responsibility to ensure that these emotional problems are reduced. In order to realize 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 (Aida, 2014; Hajimia et al., 2019a).

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. As it involved T&L, methods of teaching used or employed during class in this kind of establishment are very important. So, in terms of teaching aspects, it is evident that SDH teachers are prepared to teach, however, there some teachers are unable to creatively diversify the T&L method as it has to be parallel with the learning needs of these children by putting in mind that they contracted various health problems as well as the difference in the age level. Therefore, in order to ensure the effectiveness of SDH programs, these teachers are advised to utilize learning method that is fun and entertaining during the 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 [10]. In short, T&L which uses an entertaining learner approach has the characteristics of a fun learning session as it contains the elements of the game. 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.

Apparently, this model uses a lexical and image method called Trajectory Image or Image Representator. The use of appropriate lexical elements in can stimulate human cognition towards a better understanding of a language. This model apparently employs a lexical and image technique known as Trajectory Image or Image Representator. The usage of suitable lexical components may stimulate human cognition to improve language comprehension. (Sarudin, et al. Sarudin, et al., 2019a, 2019b, b, Shanmugam et al, 2022, Sarudin et al, 2022 c) Lexical and Trajectory Image or Image Representator methods are lexical representations and symbolism of objects in the teaching of numeracy. Based on the NCM framework, children can nurture numerical understanding through the environment. This will help children develop intelligence which will lead to socially and economically balanced

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decisions and apply them in daily life. The model itself can act as a transformation tool for teachers in helping them to get out of the usual teaching box. 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 (Ministry of Education Malaysia, 2011; Cohns & Niklas, 2019; Hildenbrand et al., 2015; Niklas et al., 2015; 2016).

The BaseMath Apps consist of four levels which is Level 1 is the level of 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~~Representor 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, define children's opinions on their ideas through their 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~~Representor. 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 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~~Representor 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~~Representor.

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 Niklas & Tayler, (2018) Niklas, & Schneider, (2017), Aunio & Niemivirta, (2010), usually, game-based learning sessions are implemented in four 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.

#### Discussion on gamification psychology

To enhance the learning experience, SDH teachers are encouraged to adopt creative and innovative teaching methods. By incorporating interactive and engaging activities, teachers can tap into students' intrinsic motivation and promote a positive attitude towards learning. Such learner-centric approaches are aligned with principles of educational psychology, which emphasize the importance of fostering students' active participation and interest in the learning process (Woolfolk et al., 2021). In terms of psychology in gamification, Woolfolk et al. (2021) has emphasized that SDH teachers should utilize unique and cutting-edge teaching strategies in order to improve the educational experience. Teachers can engage students' intrinsic drive and foster a love of learning by integrating interactive and interesting activities. These learner-centered strategies are in accordance with educational psychology concepts, which emphasize the value of stimulating students' active involvement and keen interest in the learning process.

Another psychological aspect emphasized in the discussion is the thinking strategy in basic operations. By focusing on more efficient thinking strategies, teachers can help students develop problem-solving skills and critical thinking abilities. This approach aligns with cognitive psychology, which underscores the significance of understanding how students process information, organize knowledge, and apply it in different contexts. The thinking strategy in fundamental activities is another psychological concept that is highlighted in the discussion. Teachers can aid students in developing problem-solving and critical thinking skills by emphasizing more effective thinking techniques. This strategy is consistent with cognitive psychology, which underlines the need of

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comprehending the manner in which students receive information, organize knowledge, and apply it in -various circumstances (Ormrod, 2020).

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The idea that learning takes place at various levels and is guided by the teacher as a facilitator reflects the socio-constructivist perspective of learning. According to this psychological theory, learners actively construct knowledge through interactions with their environment and peers, with the teacher playing a pivotal role in facilitating this process (Vygotsky, 1978). In the context of SDH, this approach allows for personalized and supportive learning experiences tailored to individual needs. The socio-constructivist view of learning is reflected in the notion that learning occurs at many levels and is facilitated by the teacher. This is supported by Vygotsky (1978), in which this psychological theory claims that students able to actively construct knowledge through interactions with their surroundings and peers, with the teacher being a key facilitator of this process. Therefore, this method enables supportive and individualized learning experiences that are catered to individual requirements in the context of SDH.

Zimmerman (2000) also mentioned that theories of self-regulated learning, in which students are given the authority to take control of their learning process, establish goals, and assess their progress, are in accordance with fostering self-directed learning. In short, this type of e-learning attributes are based on self-directed learning, self-accessed learning, and self-paced learning highlight the importance of promoting students' autonomy and agency in their learning journey. Encouraging self-directed learning aligns with theories of self-regulated learning, where students are empowered to take ownership of their learning process, set goals, and monitor their progress (Zimmerman, 2000).

Furthermore, the aspiration of providing equal access to international quality education, as outlined in the Malaysia Education Plan 2013-2025, is rooted in principles of educational psychology advocating for inclusive and equitable education for all students (Ormrod, 2020). Ensuring that students in SDH have access to quality education can foster a sense of belonging, self-efficacy, and motivation, leading to improved learning outcomes.

### Conclusion

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Based on the model of the stage of the numeracy understanding it will be able to identify the extent to which each student's numeracy level. In conclusion, this model has the ability to identify the extend of each student's numeracy level. In addition, learning in Schools ~~in~~ Hospital (SDH) is influenced by various psychological aspects. The entertaining and flexible learner approach, emphasis on efficient thinking strategies, and promotion of self-directed learning contribute to a positive and supportive learning environment for students undergoing medical treatment. By understanding and implementing these psychological principles, SDH teachers can enhance the learning experiences of their students and facilitate their academic and emotional growth. The model can help the government, especially the Ministry of Education so that an evaluation process, especially in the field of literacy and numeracy can be realized in line with the competency level thinking of the next generation.

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