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Research Article

Toys for children with the concept of STEM: study of the result from children's playing activities

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Abstract

This research aimed to examine the result from toy invention with the concept of STEM. The testers comprised 36 people who were the parents and children aged between five to seven years old that used the service of a child development center in Buriram Municipality in Thailand. Additionally, they were selected by purposive sampling that used multiple regression analysis to show the result from the testing of the newly designed toys as the concept of STEM. The results found that the toys had a satisfaction level of the Good (mean=4.333; S.D.=0.652) with the regression equation $\hat{Y}$ = 0.234 + [0.741 X1] + [0.106 X2] + [0.049 X3] + [0.071 X4] to explain the changing of the level of satisfaction to be 72.73% (r^2=0.7273). Research of the playing design as the concept of STEM at this time, Able to meet learning goals based on STEM concepts to an excellent level.

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Introduction

The 21st century is considered as the era of globalization (Hearn & Bridgstock, 2010). Moreover, it comprises a society with the movement of technologies and rapid news that has affected humans to experience severe accelerated changes. Similarly, it contributes to opportunities for the transfer of feelings from the application of human forces to global development (National Research Council, 2010). Thus, it is essential to use a high level of thought to potentially create an ideal world based on the concepts of integration, flexibility, applied thinking, etc. Additionally, this could be generated to become stimulation skills so to have creative thoughts, also called as the intellects of the world, in the 21st century. This would result from the creative thoughts being integrated with a creative economy (Tae, 2015), which would humans in the 21st century world (Flew, 2005). As a consequence, the preparation of children's thoughts should have learning support with increased knowledge with high effectiveness from the daily life of children, including the continuous development of knowledge for children through the integration of learning between their playing activities until gaining knowledge from the so-called activities. This development would be aimed at the integration of applying the concept of STEM, which would consist of the knowledge creation of four sciences; namely, science, engineering, technologies and mathematics resulting in toy invention (Rubin & Howe, 1985). Furthermore, for children aged five to seven years old, this would depend on the integration of learning during the playing activities to stimulate them by gaining multiple learning procedures as a real situation that would be tested and learned at the same time. Similarly, the knowledge from playing would aid the children to apply this learned knowledge for use in their daily life; such as, dressing, understanding technologies, bringing knowledge to apply in their daily life, etc.

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Hence, this could be designed as toys for children aged between five to seven years old by using the concept of STEM and providing the opportunity to promote intellectual knowledge in multiple ways, as well as offer the appropriate development for children in the future (Guba, 1990). Therefore, this could promote intellectual knowledge through the activities of playing with children's toys to stimulate knowledge through the various conditions without any stress. Moreover, this would provide benefits to the learning and understanding of the contents through suitable playing activities that would be accountable as an appropriate learning method procedure for future generations.

From the results of various research studies in many countries, it was found that nowadays the proactive learning pattern had a higher level of effectiveness than the defensive learning pattern, especially for children to have the high flexibility of their cognitive skills. Furthermore, this was relevant to the thinking frame, as there was a less level of original thought. Therefore, learning as a playing pattern has focused on the using of the senses with the building of children's knowledge to create opportunities of imaginary thoughts integrated with various other thought patterns. In this case, this could be considered as the stimulation for gaining the requirements of regular learning for children, (Liquin & Lombrozo, 2020) and creating an integrated learning pattern based on relational reasoning for children to gain knowledge and understanding with multiple views as the skills for human groups of children (Holyoak, 2016). Moreover, this could become the learning skills for children to have the readiness for the ever-changing global situation in the mid-21st century (Runco & Beghetto, 2019).

Provided that this could generate the designed playing attributions to encourage various kinds of knowledge while the children play, this might be able to build the skills that could conform to the future lifestyles (Guffey, 2014), as well as be vital knowledge for children to create thoughts as a relationship to link with knowledge (Penn, 2011). Significantly, this would not only represent the learning and development guidelines for children's playing during childhood, but also aim to memorize learning for building the integrated knowledge in several fields (Papandreou & Tsiouli, 2020). As a result, in supporting children to gain knowledge from activities and problem-solving skills, this could generate a new children's playing style in each pattern (Valkonen et al. 2020), as well as build up knowledge differently with playing goals for each pattern.

Aim of Study

- To study the guidelines and playing design for supporting the imagination with the concept of science, technology, engineering, and mathematics (STEM).
- To assess the activities from the new form of designed playing.

Method

Research Model

For the designing step to encourage the children's development, it would be relevant to design the toys based on the concept of STEM. In addition, this would consist of a summary of the results from the brainstorming to search for a suitable toy design for the children by selecting purposive sampling informants. Thus, this would depend on the specific knowledge quantification with the newly designed children's toys of the informants with the case study.

Participants and Data Collection Tools

For the designing step to encourage the children's development, it would be relevant to design the toys based on the concept of STEM. In addition, this would consist of a summary of the results from the brainstorming to search for a suitable toy design for the children by selecting purposive sampling informants. Thus, this would depend on the specific knowledge quantification with the newly designed children's toys of the informants with the case study. This was as follows:

➢ The population was composed of eight teachers and eight caretakers of the child development center located at Mueang Municipality of Buri Ram province, Thailand.

➢ The group sampling was selected by using purposive sampling that had a reliability level of 95% (Yamane, 1973).

➢ The data collection tool was a structured interview with determined questions by using Cronbach's alpha coefficient to assess 30 testers with the value of 0.91 that was more than 0.70, and it was applied and analyzed by using the mean and standard deviation (Streiner & Norman, 1995).

For the assessment of the activities, this involved playing with the newly designed toys as per the concept of STEM. In addition, the newly designed toys were tested before playing, and an imaginary role play was created for the children groups and the families who joined in this research.

From the real testing step with the group sampling, this presented that the researcher had applied the empirical experiment to check for the suitability of STEM and art. Then, children aged between five to seven years were tested with the new designed toys with the babysitters and parents joining in by giving an assessment by expressing their opinions together in this empirical experiment:

- The population was children aged between five to seven years and the parents who used the service of a child development center located in Mueang Municipality in Buri Ram province of Thailand. There was a total of 39 people who lived in the service area, where families have children aged between five to seven years according to a survey conducted in the year of 2020.
- Group sampling was the children aged between five to seven years and the parents who used the service of a child development center located in Mueang Municipality in Buri Ram province. There was a total of 36 people, who were selected by applying purposive sampling that had a confidence level of 95% (Yamane, 1973).
- The research tool was a structured questionnaire that had questions for determining the suitability assessment criteria of the knowledge, such as, in the fields of science, technology, engineering, mathematics, and arts. Additionally, from the questionnaire, it was found that there were the values of Cronbach's alpha coefficient with the questions to be assessed from the testing group of 39 people who were not in the group sampling, who had the values of 0.97, which was more than 0.70. Furthermore, it could be considered that the questionnaires could be applied in a real situation by applying multiple regression analysis (Streiner & Norman, 1995).

Framework

This research had various knowledge integration for the toy invention for children. Moreover, it was considered as an important subject that affected the effectiveness for stimulating their interest (Wolfberg & Schuler, 1993). This also contributed to the activities for stimulating the imagination development, which included mathematics, languages, technologies, engineering, and science. As a result, all fields were connected based on the design of the toy for children as per the concept of STEM that was applied with the research framework (Figure 1).

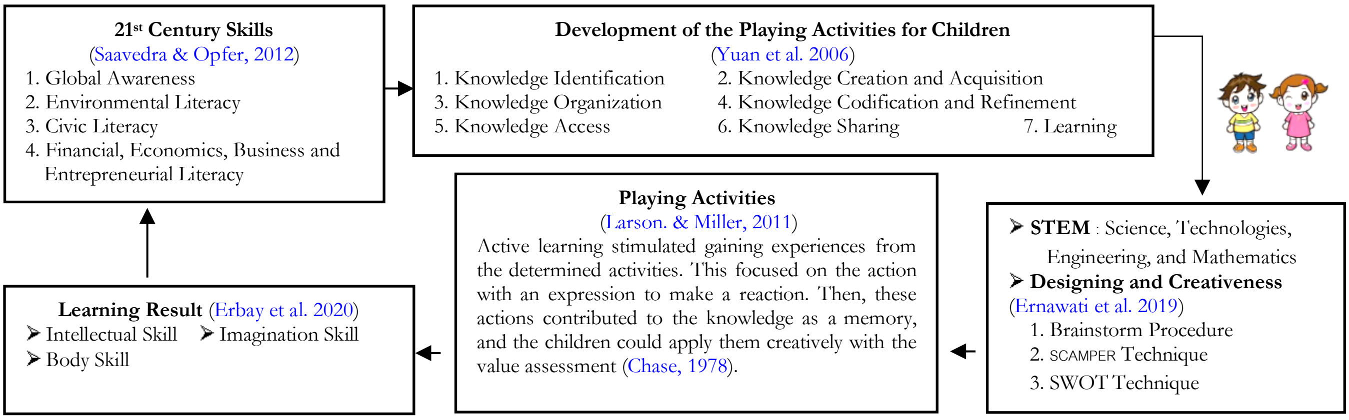

Figure 1.
Research Framework

From the former research, it was found that children's playing was considered as the basic behavior that every child could express (Kelsey et al. 2020). However, children's playing could relieve the mind, and during this relaxed condition, it would assist them to gain higher effectiveness on learning as being the environment to boost up their intelligence skills (Wu & Rao, 2011).

In this case, from the application of the playing characteristics between the children and the parents in their families, this was considered to be a relationship that was linked to be an important part of gaining a good thinking system and positive emotions for children (Amodia-Bidakowska et al. 2020). Furthermore, this research was relevant to applying the concept to be integrated with the toy design by building up multiple knowledge for the children. Thus, the researcher aimed at building the playing knowledge for the children by designing the toys to stimulate them to gain the feeling like "Wow, I did it!", and the successful feeling from the children's action would congruently explore the playing characteristics to encourage the sustainable learning of the children (Doan et al. 2020).

From the playing characteristics and learning, these were considered as an inseparable characteristic with the intelligence building for children aged between five to seven years. Likewise, this learning pattern was integrated with playing to stimulate gaining creative ideas, analytical thinking, and synthesis thinking (Hassinger-Das et al. 2020; Pramling Samuelsson & Johansson, 2006). Additionally, this research used the learning theory of the Froebel Model for kindergarten children to be applied with the toy designing step as a new concept for STEM (Vogt et al. 2018). Thus, this was based on the building requirements of the toys to build up knowledge with the children's playing activities of the Froebel Model, so that it could create happiness during the learning while being noticed by the teachers and the parents to boost the children's knowledge (Colliver et al. 2021).

Brainstorming (Fig. 2) was conducted to determine the guidelines for the toy activities for children aged between five to seven years old based on the teacher groups and carers to present the ideas of the intellectual skill by supporting the imagination and body skills (Burns & Grove, 1993). This was concerned with the concept of STEM as a new pattern for toy invention that would develop the children's skills.

Figure 2.
Brainstorming between the Teachers and Carers

Results and Discussion

The brainstorming of the teacher groups and the experienced carers enabled stimulating the children aged between five to seven years old with the essential learning interests. The components were as follows:

- Integrated the mathematics skill, languages, and daily life skills with the toy invention to increase the learning interest through the playing activities with funniness and happiness.
- Played with amusement and happiness to effectively contribute to receiving a good memory.
- Blended the practicing skills to control the children's muscles and hands to be appropriately developed with the daily life skills.
- The playing of toys with the role-playing style stimulated the children's imagination during and after playing.
- The integration of playing with learning aided the children to feel relieved, including stimulated the children's brain cells for secreting the endorphin hormones during the play and created a good opportunity to develop the brain by continuously secreting the neurotransmitters, as well as gained thoughtful activities or brain exercises in the same way (Jirojanakul & Skevington, 2000).
- The playing generated an increased level of the children's happiness, especially when they undertook the playing activities with their parents or a family member for the high development of the emotional quotient (EQ).

The conclusions of the brainstorming about the concept by 16 child development experts were used to determine the children's playing activities and to design the intellectual development toys that would be appropriate with the goals of the concept of STEM and Art in terms of regulating the guidelines (Table 1) (Batlolona & Souisa, 2020).

Table 1.
The Results of the Brainstorming of the Playing Activities for the Concept of STEM

STEM	Playing Activity/Learning	Toy Playing Pattern
Science	➢ Wearing casual clothes. ➢ Calling the names of stars in the English and Chinese languages.	➢ Using the role as an astronaut by wearing a pilot's suit with learning involving equipment for daily life.
Technology	➢ Star system and world. ➢ Colors on the stars.	➢ Placing into order the stars in the solar system as a pair matching game. ➢ Placing into order the numbers to connect between the colors of the stars and colors of the numbers.
Engineering	➢ Space shuttle and space. ➢ Travelling into space by human beings.	➢ Placing into order the sizes of the rockets and space shuttles as jigsaws in pictures. ➢ Using the role as an astronaut to travel to the stars.
Mathematics	➢ Number counting and number grouping.	➢ Playing in groups and adding numbers with English and Chinese fonts.
Art	➢ Drawing to support imagination.	➢ Drawing with imagination as stories in various situations.

The playing patterns could be classified into seven subjects that could be used for promoting the well-being of the brain. These were as follows:

- Stimulated the children aged between five to seven years with a playing activity method to support them by using the bodily senses (multisensory method).
- Stimulated the bodily movement and thought movement inside the brain, including arousing the left and the right brain as the brain cell stimulation of the hippocampus and frontal lobe. This was a high and basic thinking procedure for growth with good potential that was used as a brain exercise.
- Stimulated non-movement playing with quickness by focusing on the slow movements with high accuracy as the stimulation of the neurotrophins to be a natural neural growth factor for developing the brain growth in children.
- Stimulated playing as integration of the brain working with the bodily movement as a whole system combined with thoughts, movements, emotions, and the environments to continuously secrete the neurotransmitters. Then, this would affect the practicing of the body for controlling the neurotransmitter to have effectiveness in the future when the children have grown.

Finally, the guidelines of the creative design were used for the inventive playing activities with the active learning pattern. Then, this could stimulate the children to do the activities with their parents and in the surrounding environments by applying the intellectual learning of long-term memory as creative guidelines by using the technique of SCAMPER (Table 2) (Eberle, 1996).

Table 2.

Creative design procedure for children's toys with the SCAMPER technique.

Creative Process	Designing Procedure for the New Toy Category	
1) Data Processing 	Brought the concept and inspiration to be used for creating the design with four main words as the creative works: "*CCBS*" or Childlike (cute as a child), Cheerful (cheerfulness), Brain fitness (good brain) and Sustainable (sustainability). These key words of the designed concept were applied with the creative procedure as the concept of STEM (English & King, 2015).	
2) Concept 	Created the stimulation to gain interest with the funniness of the children for promoting the brain and the body's development as the concept of STEM, including the intellectual development of Mathematics, Technology, Engineering, and Science with humanity and society in arts for using the children's imagination by brainstorming to search for the guidelines to solve the problems with data analysis (Ting-Ting & Yu-Tzu, 2021).	
3) Idea Development 	Brought the SCAMPER technique as the toy designing step (Omorog, 2020) for classifying the ideas prior to considering the seven components; adapted the integration similar to the old styles by modifying some parts, including improving, extending, and cutting the opposite sides or altering the method with the working procedures and bringing the result to effectively make the toy product guidelines with the promotional development of the children.	
4) Applying the Principle with the SCAMPER Technique 	Used the development of the draft idea by selecting three toy product patterns for children as the concept of STEM through brainstorming and considering the relationship of the design by taking the result of the assessment in the selection with the designed principle from bringing the two patterns for the model product development in the final level before testing with the children group and the parents who were interested in the promotional development of the children as the concept of STEM+A (Art) (Davidesco, 2020; Smith et al. 2013).	
Playing Activities with the Concept of STEM + A(Art)	**First Toy Pattern**	**Second Toy Pattern**
 		

Table 3.
Selection of the Procedure of the Toy Product Patterns Prior to Testing

Playing Activities with the Concept of STEM + A(Art)	First Toy Pattern		Second Toy Pattern		Comparison	
	Mean	**S.D.**	**Mean**	**S.D.**	**t**	**Sig.**
1. Science	3.75	0.58	3.81	0.66	-0.286	.388
2. Technology	4.31	0.60	4.75	0.45	-2.333*	.013
3. Engineering	4.44	0.51	4.38	0.50	0.349	.365
4. Mathematics	4.13	0.72	4.25	0.58	-0.542	.296
5. Art	3.88	0.81	4.06	0.85	-0.639	.264
6. Children's Body	4.00	0.63	4.50	0.52	-2.449*	.010
7. Holistic Thinking Skill	3.75	0.45	4.31	0.60	-3.000*	.003
8. Social Skill	3.50	0.82	4.13	0.62	-2.440*	.010
Total	**3.97**	**0.70**	**4.27**	**0.65**	**-3.618***	**.000**

The result of the assessment conformed to the concept of STEM + A (Art). Moreover, it was found that both the first and second toy product patterns had consistency at an excellent level ($\bar{X}$=3.97; S.D. =0.70) ($\bar{X}$=4.27; S.D. =0.65), respectively. However, the second toy pattern had consistency with the concept of STEM + A (Art) at a higher level than the first pattern that had a level of significance of .05 prior to producing the second toy pattern as the model for testing (Figures 3-4).

Figure 3.
Toy product model for children as the concept of STEM.

Figure 4.
Additional Skill Playing Activities for Children as the Concept of STEM

After applying the testing procedure for the children's toys with the concept of STEM +A (Art), this developed suitable environments for the learning and feeling stimulation to gain the funniness and happiness of the children (Table 6).

Table 6.

Coefficient of the Decision (R^2) for the Components as the Concept of STEM Affecting the Satisfaction of Newly Designed Toys by Using the Assessment from the Real Testing of the Group Sampling

	n=36			
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
Testing	0.852	0.727	0.692	0.311

Table 6 represents the factor testing that found the coefficient of the decision or known as the factor testing (R^2), which had the value of 0.852 and affected the satisfaction of the group sampling. This testing could explain about the changing of the level of satisfaction of 72.73% or r^2=0.7273 by bringing the components as the concept of STEM that affected the satisfaction of the new toy patterns to be determined with the regression equation as $\hat{Y}$ = 0.234 + [0.741 $X1$] + [0.106 $X2$] + [0.049 $X3$] + [0.071 $X4$].

Table 7.

Relationship Analysis between the Newly Designed STEM Components with the Satisfaction

Testing	SS	df	MS	F	Sig.
Regression Equation	8.001	4	2.000	20.672	0.000
Deviation	2.999	31	0.097		
Total	11.000	35			

As shown in Table 7, the analysis depended on the predictors, which were 1.Science, 2.Technology, 3.Engineering, and 4.Mathematics.

This had the dependent variable; such as, the satisfaction of the toy's application for children as the newly designed concept of STEM. Thus, according to the analysis result, this represented the F-test = 20.672 > F-table = 2.690, and it was found that at least one independent variable or X had a relationship with the dependent variable or Y.

Table 8.

The Coefficient of the Multiple Linear Regression with the Prediction Variables for the New Pattern of Children's Playing Activities Satisfaction Affecting the Component of STEM

Prediction Variable	*b*	*S.E.b*	*B*	*T*	*P*
Constant	0.234	0.790		0.297	0.769
X1) Science	0.741	0.091	0.802	8.143	0.000
X2) Technology	0.106	0.120	0.091	0.886	0.382
X3) Engineering	0.049	0.111	0.044	0.438	0.664
X4) Mathematics	0.071	0.071	0.099	0.997	0.327

As seen in Table 8, the coefficient of the multiple linear regressions for the prediction variable with the satisfaction of the children and parents affected the newly designed toys developed from the concept of STEM. In addition, it was found that variable 1 or science had a relationship with the satisfaction of the toy as the concept of STEM as well as variable 2 or technology, variable 3 or engineering, and variable 4 or mathematics that had no relationship with the satisfaction of the toys as the newly designed concept of STEM.

Variable 1 represented science with multiple linear regression and was found to be equal to 0.741. Furthermore, if increased importance was given to the learning of science by one unit, this would represent the children's and parents' satisfaction and would affect the newly designed toys to gain an increased chance with 0.741 units.

Variable 2 represented technology with multiple linear regression and was found to be equal to 0.106. Additionally, if increased importance was given to the learning of technology by one unit, this would represent the children's and parents' satisfaction and would affect the newly designed toys to gain an increased opportunity with 0.106 units.

Variable 3 represented engineering with multiple linear regressions and was found to be equal to 0.049. Likewise, if increased importance was given to the learning of engineering by one unit, this would represent the children's and parents' satisfaction and would affect the newly designed toys to gain an increased opportunity with 0.049 units.

Variable 4 represented mathematics with multiple linear regression and was found to be equal to 0.071. Moreover, if increased importance was given to the learning of mathematics by one unit, this would represent the children's and parents' satisfaction and would affect the newly designed toys to gain an increased opportunity with 0.071 units.

Thus, it could be concluded that the prediction equation of the toy product design had the concept of STEM as follows:

- According to the regression equation as a standard score pattern, this represented $Z = .802\,Z_1 + .091Z_1 + .044Z_3 + .099Z_4$.
- According to the regression equation as raw scores, this represented $\hat{Y} = .234 + .741X_1 + .106X_1 + .049X_3 + .090X_4$.

From the results of the satisfaction of the toys for the concept of STEM, the assessment was taken from the expression behavior of the children's playing activities and was based on the parents' satisfied behavior according to the newly designed playing activities (Table 9).

Table 9.

Satisfaction of the Children and Parents Affected by Playing Under the Newly Designed Concept of STEM.

Component of STEM to be Designed	Mean	S.D.	Satisfaction Level
Satisfaction of the Playing Activities	4.500	.561	Very Good
Satisfaction of the Science Knowledge	4.444	.607	Good
Satisfaction of the Technology Knowledge	4.667	.478	Very Good
Satisfaction of the Engineering Knowledge	4.167	.507	Good
Satisfaction of the Mathematics Knowledge	3.889	.785	Good
Total	4.333	.652	Good

According to the parents who noticed the children's playing activities as the newly designed concept of STEM, it was found that the overall satisfaction result was at the Good level ($\bar{X}$=4.333; S.D. =0.652). As such, this could represent the requirements of the parents and children groups for bringing the children into the knowledgeable world with the funniness of science, technology, engineering, and mathematics by integrating new playing patterns in a suitable way. This was also promoted with arts knowledge or appropriate playing activities without much quickness for stimulating the children's brain by secreting the neurotransmitters on the alpha brain waves. Furthermore, this stage was ready for the children to gain their knowledge as a super learning circle for stimulating relaxation plus funniness, happiness and eagerness to study and other related factors, which could fulfill the values for playing as newly developed toys that would be suitable for the requirements of the parents and the children.

The first rank showed the satisfaction of the technology knowledge of the parents and the children at the most level of satisfaction ($\bar{X}$=4.667; S.D. =0.478). This represented the aspects of most parents to give importance to additional skills as technology knowledge for children as the most important part, including the knowledge contribution that conformed with the trends of the current changing world and the future world where technology would give good advantages with human lifestyles at a high level.

The second rank demonstrated the satisfaction of the playing activities for the parents and the children at the most level of satisfaction ($\bar{X}$=4.500; S.D. =0.561). This represented the requirements of the parent groups for the children to play learning activities integrated with studying and playing.

The third rank displayed the satisfaction of the science knowledge of the parents and the children at an excellent level of satisfaction ($\bar{X}$=4.444; S.D. =0.607). This represented the importance that the parents needed to increase the satisfaction result of new developments by aiming at the importance of science in people's daily life as close stories for small children and future generations. Therefore, they should gain the science skill as basic knowledge to apply in their life in the future in a suitable way.

The fourth rank showed the satisfaction of engineering knowledge of the parents and children at an excellent level of satisfaction ($\bar{X}$=4.167; S.D. =0.507). This represented the result that the parents had gained more specific knowledge requirements in learning about engineering to stimulate the children to have more opportunities to create innovations for the future progress of human civilization.

The fifth rank displayed the satisfaction of mathematics knowledge of the parents and children at an excellent level of satisfaction ($\bar{X}$=3.889; S.D. =0.785). This represented the result for creating the basic calculation for the children to conduct activities with toys as the concept of STEM, but now, it still appeared as the result of the increase in the mathematics skill without the connection of involving skills affecting the reduced satisfaction level as the newly designed concept of STEM.

From the results of the relationships between the satisfaction values of the new toys and the suitability values from science, technology, engineering and mathematics, it was found that there was harmony in a positive direction for children by finding suitable knowledge in the four fields through increasing ways. Thus, this resulted in the satisfaction of the children and the parents to the newly designed toys to be at an increased level with the $\bar{X}$=4.333; S.D. =0.652. In this case, this conformed with the research objective of the testing requirement of bringing the learning concept of STEM to be applied with the children's playing activities (Colliver & Veraksa, 2019). Moreover, this conformed with the concept of the Froebel Model that stated that the best form of learning for children was to play by expressing themselves with freedom until gaining positive experiences from the playing activity with their suitable development in each age level (Smedley & Hoskins, 2020). In the same way, it should have the integration from these two concepts for designing the toys to increase the playing requirements of the children and allowing them to express themselves with their bodies in various activities to learn new things: 1. Technology, 2. Playing activity styles, 3. Science, 4. Engineering, and 5. Mathematics.

Significantly, according to the testing to apply the newly designed toys, it was found that this could confirm the result of the concept of STEM with the learning theory of the kindergarten students from the Froebel Model. Therefore, provided that this could be integrated from these two concepts of the designing of the toys for children according to their ages, this would stimulate the children to participate in the learning activities regularly and in harmony with the development of the children's age (De Souza et al. 2020).

Conclusion and Recommendations

The research goals were relevant with the creative requirements of a new playing pattern to build up knowledge of science, technology, engineering, mathematics, and art. Therefore, this enabled building up the intelligence of children aged between five to seven years by gaining playing activities, and newly designed developed toys that always resulted from the stimulating requirements of children to feel "Wow, I did it!". Furthermore, this was considered as a form of integration of knowledge in the pattern of STEM that had a high level of effectiveness, (Keung & Fung, 2020) as well as made the new toys to ideally conform to be a concept that could focus on knowledge contribution with funniness and safety to be product designs for children (Nuri & Kursat, 2020).

In this case, when the children saw the new developed toys as the concept of STEM, they were often more interested in the playing pattern with the playing requirements in the activity areas. Furthermore, this was under the characteristic of modeling the situations with imagination building for children to play easily by conceiving the knowledge from the shape of the characteristics, and they could understand about the playing methods by using their own past experiences to be the expected thoughts for playing with new toy patterns (Richards et al. 2020). After that, when the children had tried to play with the toys, it was found that more than 90% of them could tell stories from their own imagination through the playing roles. This also included the satisfaction between the children and the parents to the designed toys as the concept of STEM that had an excellent level and was noticed from the playing behavior from the parents expressing knowledge to the children during the playing activities:

a) This presented that the children had bodily interaction at an increased level by using various parts of the body; such as, hands, arms, body, and legs while they were playing. Then, during this time, it enabled them to integrate between the learning and the playing based on the toys to stimulate the children to express themselves with positive behavior through the touching of their own bodies (Ledford et al. 2020).

b) This presented that the children had science knowledge from learning about the arrangement of the planets in the solar system, so they could tell about the shape attributions with colors, and the arrangement of each planet in the solar system, including memorizing about the planet's knowledge by using the knowledge modeling; they imagined they were astronauts flying in space and could see the stars in the universe that could increase their memorizing to be easier than the normal way (Zhang, et al. 2020).

c) The children had mathematics knowledge from the integrated learning of counting numbers by using the arrangement method of the stars in the universe; this used Arabic numbers to be integrated with the playing method in the characteristic of building the rocket base with the stimulation to increasingly interest the children, and this could be considered as a problem-solving method of basic calculation that could be applied suitably with the children's knowledge (Lin et al. 2020).

d) The children had engineering knowledge from learning about the components of the space shuttle and the solar system to use as stories and become the skills conforming with the world in the 21st century. The solar system and universe were much closer to them more than in the past, so they could memorize the information and answer questions about the universe or the world for conceiving the real knowledge in a concrete way (Moreno, 2016).

Therefore, from the invention of the newly designed toys as the concept of STEM at this time for children aged between five to seven years, it presented that they could join in the playing activities with funniness, and the parents could notice this from the children's playing in stimulated activities that allowed them to express ideas and interact using their body (Li & Schoenfeld, 2019). In this case, according to the result of the assessment from the children groups and the parents, it showed that the satisfaction was at an excellent level with the satisfaction from the most level to the least level being the technology knowledge, the funniness from the playing activity, the science knowledge, the engineering knowledge, and the mathematics knowledge, respectively. Thus, according to all five fields from the playing activity of children, it showed that the result of the playing as a concept of STEM from the new design could be the learning goals of STEM. In addition, this focused on the integration skills that could be applied in the daily life of children conforming with the current age and the future.

As a result, this should emphasize the development skills and thought creation from the real experiences of children by learning with their own senses until enabling them to stimulate this as memorizing knowledge at a sustainable level with high effectiveness; however, according to the research of the playing design as the concept of STEM at this time, it could be considered as a form of positive harmony with the learning goals as the concept of STEM at an excellent level (Takeuchi et al. 2020).

The world in the 21st century has changed to be the era of globalization (Postelnicu et al. 2015). However, now the situation has reversed to be one of severity because of the COVID-19 pandemic resulting in a downward trend of deglobalization. Therefore, this situation has affected the world's sustainability in the same way (Karunaratne, 2012). As such, humans in the new age must adapt themselves to give importance to the intellectual level by developing their potential to live in the future safely. This should also include not taking for granted the development of the thought system by applying the system of connected thinking, applied thinking and creative thinking (Khan & Riskin, 2001). Then, these thought systems would be based on flexible thinking skills to aid the new human age to live suitably in the future. Thus, the development of the intellectual level is called knowledge contribution in various ways (Li et al. 2020), and this involves technology, science, engineering, and mathematics as the concept of STEM to be the appropriate 21st century learning concept pattern that can be integrated with the learning guidelines for creating a sustainable intellectual level for children because they are considered as a significant human resource of the future (Bureekhampun & Mungmee, 2020).

Furthermore, the concept has been combined with the toys for gaining as knowledge from multiple sciences. Thus, this can contribute to the variety of knowledge by stimulating children to gain more flexible thinking skills, as well as developing them to gain knowledge that could be applied in their daily life in a suitable way. Therefore, playing by the new age children would stimulate gaining knowledgeable playing activities that would benefit people's future daily life.

Similarly, the designing of the toys would develop the imagination as per the concept of STEM by bringing the active learning pattern to be integrated with the toys' creation as part of the development of the children's stimulation. This could bring this subject to be utilized for creating toy product models by promoting the children's development as per the concept of STEM with two differentiating patterns for the children's playing activities. Therefore, this conformed with the conclusion that this must use active learning to be integrated with the successful result in a suitable way, and it would be essential to gain the learning attributes as a small group or lesser numbers of people to gain a better result (Freeman et al. 2014). From the result of the designing procedure as per the concept of STEM, this used pictures to develop the children's knowledge of mathematics, engineering, technology, and science that affected the second pattern of the toy products to have an excellent level of satisfaction for the teacher and carer groups. Hence, this conformed with the concept that these pictures could represent the language of communication to gain knowledge or the intellectual level with effectiveness (Rau, 2017).

Consequently, this would be capable of stimulating the children to gain creative ideas (Henriksen, 2014), and after bringing the model from the second concept to test for creating the children's playing activities, this represented that the children and parent groups had a level of satisfaction of the development of the stimulation and knowledge at an excellent level. Thus, this conformed with the concept of learning with the building of knowledge integrated with behavior stimulation while playing, as being the review and stimulation of an effective memory

(Chen et al. 2019; Vasquez & Comer, 2013). As a result, the result of the knowledge assessment occurred from the new design of the toys as per the concept of STEM and conformed with the satisfaction by ordering from the most to the least level as technology, playing activities, science, engineering, mathematics, and others, respectively (Özcan & Gülözer, 2020; Wullur & Werang, 2020).

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