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Research Article

Teachers' perspectives on optimizing manipulatives in teaching 21st century skills in kindergarten

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Abstract: Kindergarten teachers optimize manipulatives in teaching young children. These manipulatives can be tools in developing essential skills needed to meet the demands of 21st century society. A descriptive mixed method design was employed in this study. Qualitative data were gathered using interviews and classroom observations, while quantitative data were extracted from questionnaire and classroom inventory checklist. Quantitative data were analyzed using descriptive statistics, whereas qualitative data were transcribed, coded, and categorized by themes. Research respondents were the 25 kindergarten teachers from public schools (n=8) and private schools (n=3) in Pulilan, Bulacan. Results showed that teachers use manipulatives in the teaching and learning process as these provide many opportunities for children to learn and acquire different skills. Several manipulatives develop more than one skill, depending on their characteristics and nature. Moreover, skill development varies depending on the activity and type of manipulatives used. The research finds that manipulatives continue to be relevant and can be used to develop 21st century skills in kindergarten. However, teachers need to undergo training on the optimization of manipulatives that are readily available in the kindergarten classroom. Furthermore, there is a need for schools to invest in different manipulatives for use in kindergarten.

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Introduction

The invention of manipulatives or maneuverable objects that appeal to different senses has revolutionized the teaching process. Originally designed for teaching mathematical concepts, manipulatives have advanced into other subjects over the years. In kindergarten, the application of manipulatives in teaching started when Friedrich Wilhelm August Fröbel (1837), known as the "Father of Kindergarten," developed different types of objects to help his kindergarteners recognize patterns and appreciate geometric forms found in nature (Silber, 2015). Manipulatives were further emphasized in the early 1900s when Italian educator Maria Montessori advanced the idea that manipulatives are essential tools in education (Lillard, 2013). She designed many materials to help preschool and elementary school pupils discover and learn basic math and other subjects.

The child's development in mathematics starts at a young age during the child's early years in school. The use of manipulatives in the classroom – such as counters, blocks, geoboards - helps the young learners achieve a greater understanding of mathematical concepts, as indicated by the study of D'Angelo & Iliev (2012). Being able to touch and maneuver manipulatives connects the child's senses and boosts their stronger retention of information. Such experience is related to experiential learning.

Moyer (2001) put a definition of manipulatives when she stated that manipulatives are 3-

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dimensional objects that learners use to increase their understanding of and connection between concepts. With the advent of digital technology, Moyer brought into focus the use of virtual manipulatives as a take-off from traditional manipulatives. Learners can use manipulatives in a hands-on approach to learning (Cockett & Kilgour, 2015; Larbi & Mavis, 2016) as these serve as valuable tools to help students construct an understanding of concepts through meaningful investigation. As we enter modern society, the curriculum is not the only thing that has changed but the intended outcome of what children are expected to know and do. Communication and collaboration, critical and creative thinking, information media and technologies, and lastly, life and career are the skills that the 21st century society would like to impose on every learner (Ross, 2017). These 21st century skills are what the children need to become successful in the global economy – and be prepared for college and eventually for their entry into the labor force.

The active participation of learners through the use of various materials cannot be undermined. Czerkawski (2014) states that deeper learning encourages learners to be active in the learning environment to continuously explore, reflect, and produce information to build complex knowledge structures. It involves the interplay of the cognitive, intrapersonal, and interpersonal skills necessary for the teachers to incorporate into the students' learning experiences.

In the Philippines, the teachings of 21st century skills are strongly emphasized starting at a young age, and laws have been enacted to meet this thrust. The right of all citizens to quality education at all levels is provided by the 1987 Philippine Constitution, where sections 1 and 2 of Article 14 on the Education, Science, and Technology, Arts, Culture and Sports, specifies that the State shall take appropriate steps to make education accessible to all Filipinos. The law also creates an integrated system of education relevant to the needs of the people and society. A system of free public education in the elementary and high school levels is, thus, provided under the Constitution.

To enable the country to become globally competitive, further improvements in the educational system through the Enhanced Basic Education Act of 2013 (Republic Act 10533) were enacted. The law expands primary education from 10 years to 12 years. Before this law, Republic Act 10157 was signed in 2012, institutionalizing kindergarten education into the primary education system. The compulsory kindergarten is in line with the Millennium Development Goals (MDGs) on achieving Education for All (EFA) by 2015. Thus, the State is committed to make accessible kindergarten education that effectively promotes physical, social, intellectual, emotional, and skills stimulation and values formation to sufficiently prepare young learners for formal elementary schooling (Lewin, 2007; Britto, 2017).

Despite these policies, there have been concerns about the quality of Philippine education. The National Achievement Test (NAT) and the National Career Assessment Examination (NCAE) results in 2014 showed that students' performance in both exams was way below the target mean score. Also, the completion rate for primary school remains low (at around 30%) in such areas as Mindanao and Eastern Visayas. Another challenge faced by the Philippine educational system is budgetary allocation. While the Philippine Constitution mandates the government to allocate the highest proportion of its yearly budget to education, the Philippines has the lowest budget for education among ASEAN countries. Shortage of teachers in kindergarten due to lack of budgetary allocation from the national government for teachers' salary and training and an insufficient allocation for educational materials are also affecting the quality of education, according to a statement by Act Phils (2012).

Rationale of the Study

Over the years, the use of manipulatives in teaching young learners has gained acceptance. The National Council of Teachers of Mathematics, the world's most extensive mathematics education organization in the United States, has encouraged the use of manipulatives in teaching a wide variety of topics in mathematics such as in sorting, ordering, distinguishing patterns, recognizing shapes, and understanding relationships among them, making measurements, using both nonstandard and standard units with application to both two and three-dimensional objects, understanding the system, comprehending operations, recognizing the relationships among operations, exploring and describing spatial relationships, identifying and describing different types, among others (Heddens, 1986; Sebesta, &

Martin, 2004; Sulistyaningsih et al., 2017). This has led to manipulatives being introduced to learners as young as those in kindergarten as part of their educational activities.

Nevertheless, the use of manipulatives has also gained acceptance in subjects other than mathematics. For instance, reading-based manipulatives help students learn concepts ranging from letter-sound correspondence to abstract grammatical concepts. In science, manipulatives are being used to make abstract information easier to understand (Berkseth, 2013).

As the world enters the 21st century, specific skills are needed in order for an individual to adapt to the changing socio-economic environment and become globally competitive. Often referred to as 21st century skills, these are specific core competencies such as collaboration, digital literacy, critical thinking, and problem-solving that schools need to teach to help students thrive in today's world (Rich, 2010). The composition of 21st century skills is best summarized by Trilling and Fadel (2009) using the following formula: 3Rs x 7Cs = 21st Century Learning. The more traditionally established skills of "Reading", "wRiting" and "aRithmetic" are represented by the 3Rs, while the modern key component, the 7Cs, stands for:

- Critical thinking and problem solving,
- Communication, information and media literacy,
- Collaboration, teamwork, and leadership,
- Creativity and innovation,
- Career and learning self-reliance,
- Cross-cultural understanding and
- Computer and ICT literacy.

21st century skills aim to create an individual who can contribute and become a productive member of his family, community, and country. This was emphasized by United Nations Children's Fund (UNICEF, 2013) when the organization stated that Early Childhood Development is one of the most cost-efficient investments in human capital that leads to a country's sustainable development. Economic analyses from the developed and developing world are converging on a set of conclusions, with the main idea being that investing in the earliest years leads to some of the highest rates of return to families, societies, and countries. As a result, governments started to put early childhood education into their agendas, especially after it was proven that good quality of early education has long-lasting effects on the children's later life productivity for the society.

As stated earlier, Republic Act 10533, or The Enhanced Basic Education Act of May 15, 2013, was enacted in response to the trend of developing skills for Filipinos to become globally competitive. This provision cites that the State shall create a functional basic education system that will develop productive and responsible citizens, equipped with the essential competencies, skills, and values for lifelong learning and employment. According to the Department of Education (2012), the K to 12 frameworks of the program puts in place a curriculum geared towards the development of 21st century skills among the students such as effective communication skills, learning, and innovative skills, information, media, and technology skills and life and career skills.

This study identified the general characteristics of kindergarten pupils and the commonly used manipulatives by teachers in their lessons with a view of relating these to how the 21st century skills can be taught to pupils in kindergarten. Figure 1 shows the conceptual framework and variables that were under study.

It is worth noting that the current 21st century learning environment combines physical and digital infrastructures to support learning. The seamless integration of face-to-face and online learning is essential in the present situation where digital technology is rapidly gaining popularity in the educational system. In this scenario, the utilization of manipulatives – both physical and virtual – has been made possible.

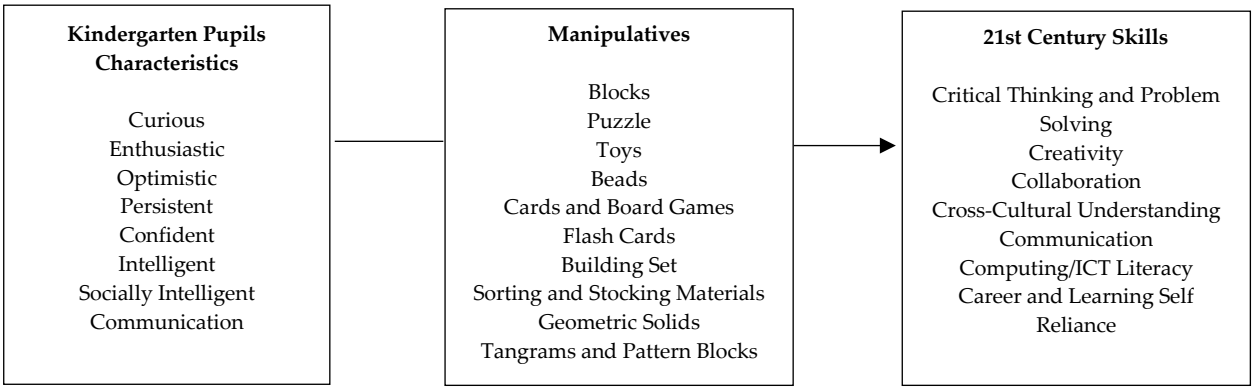

Figure 1. Conceptual Framework

However, the study was conducted before the coronavirus pandemic; hence, the results used physical manipulatives while inside the classroom. As stated earlier, the popularity of manipulatives as tools to aid in teaching starting from the earliest years of the child's education has led to various types of manipulatives being present in the classrooms and used by teachers to teach essential skills. Hence, this study aims to identify the manipulatives available in kindergarten classrooms and observe how teachers optimize the use of manipulatives in kindergarten. This study aims to meet the following objectives:

1) Identify the available manipulatives being utilized by teachers in kindergarten classes;

2) Determine how 21st century skills can be developed using the different manipulatives; and

3) Describe how children exhibit the acquisition of 21st century skills through the use of manipulatives.

Methodology

Research Design

A descriptive mixed-method research design was employed in this study using secondary materials as references, while primary data sources included interviews, checklists, and on-site or classroom observation. The design of the study is non-experimental, as factual information is derived from the teachers on the manipulatives they use in teaching pupils in the kindergarten classroom and how these enable the learners to develop 21st century skills.

Sampling Procedure and Participants

The study is participated by 25 kindergarten teachers from selected schools in Pulilan, province of Bulacan. This location is one of the biggest towns in the province, with relatively bigger kindergarten schools. The study also took into account that only few researches were done regarding kindergarten schools in Pulilan. The teachers were selected based on their years of experience in teaching children at the kindergarten level.

The researchers excluded teachers' sex or gender as a consideration because the majority of teachers are female. The 25 teachers/respondents work at 11 schools, eight of which are public schools supervised and funded by the government, and three of which are private schools controlled by private people or businesses. The schools were purposefully chosen depending on the kindergarten enrollment and the accessibility of manipulatives in the classroom. Prior to conducting the study methods, the researchers sought formal approval from the school administration or principal of each school. Kindergarten instructors were informed of the research aims and methods following approval. After being informed of the study's objective, kindergarten instructors volunteered to participate. It was agreed upon confidentiality that no name of the teachers or schools would be made mentioned in the study.

Data Collection and Analysis

The researchers interviewed 25 kindergarten teachers in 11 schools in Pulilan, province of Bulacan, to determine the classroom's availability and commonly used manipulatives.

There were two stages in the data collection:

- The first stage involved distributing a checklist to each of the 25 kindergarten teachers to identify the types of manipulatives they use in their classrooms. After teachers completed the checklist, they were questioned to determine how they use manipulatives in their classrooms and what they believe are the 21st century abilities that can be taught using specific manipulatives. The researchers determine the frequency with which manipulatives are found in the classroom based on the teacher's responses. The mean score was calculated and ranked according to the manipulatives most frequently seen in kindergarten classrooms. Additionally, throughout the interviews, teachers were asked to identify barriers and concerns related to obtaining and utilizing manipulatives in their classrooms. Classification, analysis, comparison, and grouping were utilized to organize the data obtained from the interviews.
- The second stage involved the researchers observing the actual classes to see how the manipulatives are utilized during classes, how the learners behave towards manipulatives and the potential 21st century skills that can be developed. A total of 15 different sessions were observed and after each session, the researchers noted down their observations. The observations were categorized according to the four skills: effective collaboration, learning and innovations, information, media and technology, and life and career. These observations corroborated the replies of the teachers in the interviews conducted.

Results and Discussion

The data gathering process to determine the results led to the research meeting the three objectives of the study, namely: identify the available manipulatives being utilized by teachers in kindergarten classes; determine the 21st century skills that can be developed using the different manipulatives; and describe how children exhibit the acquisition of 21st century skills through the use of manipulatives.

Identification of Available Manipulatives in the Kindergarten Classrooms

From the checklists submitted by the 25 teachers and the results of the interviews conducted, it was found that that there are ten commonly used manipulatives in kindergarten classrooms as listed in Table 1, with blocks being present in all kindergarten classrooms. These blocks are usually made of wood or plastic, provided by the schools or purchased by the teachers. Likewise, these materials are readily available in the market, are inexpensive, and helpful in providing meaningful, relevant, and fun learning. This result was also observed in a study by Moyer (2001), stressing out that manipulatives like blocks can make teaching and learning 'fun' and promote the acquisition of different skills such as mathematics. Moreover, teachers have come to appreciate the learning opportunities that blocks offer, such as cognitive skills, social skills, language skills, and motor skills (Tunks, 2009).

Puzzles and toys ranked next in terms of popularity based on the answers in the checklist distributed and observed during the classroom visit. Toys were acquired through purchase and donations from pupils, parents, or other donors, while puzzles were provided by the Department of Education as part of the budgetary allocation for classroom learning materials. The absence of toys and puzzles in one classroom was due to a lack of supplies and donors. According to the comment of one teacher who participated in this study:

> The Department of Education does not provide any toys to our school. Sometimes, the teachers ask the pupils to bring toys so they will have something to use. However, the problem is that the pupils here belong to low-income families; that is why they could not give any for the school.

Table 1. Available manipulatives in kindergarten classrooms

Top 10 Manipulatives	Frequency	Mean Score	Rank
Blocks (woodblocks, plastic blocks)	25	1	1
Puzzle (jigsaw, wooden)	24	.96	2.5
Toys (stuffed, plastic, dolls, cars, etc.)	24	.96	2.5
Beads (small and big, plastic, wood, paper)	23	.92	5
Card and Board Games (indoor and memory)	23	.92	5
Flash Cards	23	.92	5
Building Set	22	.88	7
Sorting and Stocking Materials	17	.68	8.5
Geometric Solids	17	.68	8.5
Tangrams and Pattern Blocks	15	.60	10

Note: The identification of the top 10 manipulatives was based on the responses of 25 Kindergarten Teachers.

On the other hand, tangrams and pattern blocks were the least available in the classroom. Teachers answered that they are not familiar with tangrams and that tangrams have limited uses, as stated by one teacher, who said,

> In fact, I have seldom seen a school with tangrams. If ever we have, we could not learn how to use it because it does not apply to the lessons that we teach. Moreover, the use of tangrams for kindergarten is time-consuming and complicated.

Determining the 21st Century Skills Developed Using Manipulatives

Table 2 exhibits the 7C's Lifelong skills that Trilling and Fadel (2009) identified, summarizing the 21st century skills that a learner must acquire to be globally competitive. The table shows the tabulation of the submitted checklists and the interviews conducted with the 25 teachers/respondents indicating the different manipulatives available in the kindergarten classrooms and the teachers' perception of the skills acquired by the learner when using each manipulative.

The results in Table 2 show that classroom blocks have the highest potential in developing 21st century skills among kindergartens. Blocks are unstructured manipulative that are diverse in playability, simple in design, and are effective in stimulating and engaging children's imagination and creativity (Clavio and Fajardo, 2008). On the other hand, puzzles are the second most effective manipulatives in helping kindergarten develop the necessary skills for 21st century society. Puzzles can provide many skills and mental learning benefits and opportunities for kindergartens that increase visual-spatial awareness and grasping understanding correspond to cognitive development, problem-solving skills, decision making, and memory. Furthermore, puzzles can promote fine motor development, hand and eye coordination, socialization, self-esteem, and satisfaction (Aral et al., 2012). Observations of the classes where these manipulatives were used indicate the pupils' eagerness to participate in the learning process.

From the results, toys and flashcards ranked next in terms of potential for developing 21st century skills. Toys come in various forms and types and allow children their construction and organization of knowledge and making sense of their world. Toys invite children to create and use their imagination and can be the basis for socializing and establishing friendship. According to a study by Clavio and Fajardo (2008), playing with toys within a group helps children to gain self-confidence, their self-concept, and discover emotion. Flashcards are illustrated materials that can be used to teach various subjects. Beads, geometric solids, and building sets are next to have the potential to impart 21st century skills.

Table 2. Skills developed through the use of manipulatives as identified by the respondents

21st Century Skills	Manipulatives										
	Blocks	Puzzle	Toys	Beads	Cards and Board Games	Flash Cards	Building Set	Sorting and Stacking Materials	Geometric Solids	Tangrams and Patterns	TOTAL
Critical Thinking and Problem Solving	1	1		1	1	1	1	1	1	1	9
Creativity	1	1	1	1			1		1	1	7
Career Learning Self-Reliance	1	1	1	1		1	1	1			7
Collaboration	1	1	1		1	1				1	6
Cross-Cultural Understanding	1	1	1		1	1			1		6
Communication	1	1	1		1	1	1				6
Computing/ICT Literacy	1			1				1	1		4

Note: The 7C's Lifelong skills was from Trilling, B., & Fadel, C., 21st Century Skills: Learning for Life in Our Times, 2009.

It is worth noting that all respondents agreed that the available manipulatives could teach 21st century skills identified by Trilling and Fadel (2009). Critical thinking and problem-solving are being developed by 90% of all the manipulatives identified. By using the manipulatives, kindergarten pupils can work independently; hence, their critical thinking and problem-solving skills are enhanced. Creativity and Career Learning/Self-Reliance are 21st century skills that can be developed by 70% of the manipulatives identified, while three skills, namely, Collaboration/Cross-Cultural Understanding and Communication, can be developed by 60% of the manipulatives. The 21st century skills of Computing/ICT Literary are developed by 40% of the manipulatives identified.

Based on the findings of the study, not all manipulatives can develop all skills simultaneously. This is due to the differences in nature and characteristics of the manipulatives resulting in varied competency development. Results of this study can imply that a specific manipulative has its unique focus. Nevertheless, a combination of several manipulatives used by kindergarten pupils in their creative ways can maximize the development of 21st century skills. The results also indicate that kindergarten pupils become more proactive when manipulatives are used during their classes.

Interviews with the teachers also revealed some of their concerns about the use of manipulatives. These include:

- The need for continuous teachers' training on how they can maximize the use of manipulatives in their teaching;
- The availability of new and more advanced manipulatives – both physical and virtual – to meet the changing needs and interest of the young learners;
- Budget allocation for the purchase of modern manipulatives and reference materials on how to properly use these manipulatives in the classroom.

Children Exhibit Acquisition of 21st Century Skills through Manipulatives

The demand of society in developing individuals who are equipped with 21st century skills is very high. Even during the early year of schooling, children are provided with learning experiences that promote these essential skills. Teachers are using different materials, including manipulatives, to help children develop 21st century skills.

Based on the data gathered from the observations, manipulatives help children develop skills in four different skill categories. These are practical collaboration skills, learning and innovation, information, media and technology, and life and career. Under the effective collaboration skills, the highest frequency values were obtained in "develop language and vocabulary" and "enhanced relationship with peers," as

shown in Table 3. These findings reinforce the study of Felix-Aguelo (2017) that indicated collaborative learning improves the following skills of the learners: speaking, listening, reading, and writing. These are manifested when they are talking, asking, sharing thoughts, and working with each other. Meanwhile, "practice negotiation skills and team player" was observed minimally. Most of the classroom lessons and activities that use manipulatives were individualized, and there are very few instances where a child is guided to be a leader.

Table 3. Result on observation for effective communication skills

Specific Skills from using Manipulatives	Frequency	Verbal Interpretation
Develop Language and Vocabulary	0.66	Above average
Enhanced Relationship with Peers	0.80	Above average
Practice Negotiation Skills	0.46	Average
Team Player	0.53	Average

Note: The data was based on the results of classroom observations in 15 different sessions.

In Table 4, the *Learning and Innovation* capabilities developed through the use of manipulatives are shown. Topping the skills are critical thinking, learning through play, and enjoy and arouse interest with very high rating in the Likert Scale Interpretation. Indeed, manipulatives are exciting materials where children learn implicitly while engaged in playing and enjoying themselves. The skills that fall above-average rate are problem-solving, constructing their understanding and observing, questioning, experimenting, & exploring. The average rate is matching, sorting and classifying, team player, and creativity.

Table 4. Results of observation on learning and innovation skills

Specific Skills from using Manipulatives	Frequency	Verbal Interpretation
Critical Thinking	0.86	Very High
Matching, Sorting, and Classifying	0.53	Average
Problem Solving Skills	0.66	Above average
Team Player	0.53	Average
Creativity	0.53	Average
Construct their Own Understanding	0.8	Above average
Enjoy and Arouse Interest	1.00	Very high
Learn Through Play	0.93	Very high
Observing, Questioning, Experimenting, and Exploring	0.80	Above average

Note: The data was based on the results of classroom observations in 15 different sessions.

The skills covered by *Information, Media and Technology* such as critical thinking, learning through play, enjoy and arouse interest, fine and gross motor skills come up with the best result (see Table 5). Fun while playing and learning was viewed during observation. Also, these enhance small and big muscles by just lifting, arranging, and playing with the manipulatives. Meanwhile, eye-hand coordination and problem-solving skills have an above-average rate. From the observation, as pupils use specific materials, they were able to learn through their discovery and solve and finish a given problem by themselves through their way.

Table 5. Results of observation for information and media technology skills

Specific Skills from using Manipulatives	Frequency	Verbal Interpretation
Eye-Hand Coordination	0.8	Above average
Gross and Fine Motor skills	1.00	Very high
Critical Thinking	0.86	Very high
Problem Solving	0.66	Above average
Enjoy and Arouse Interest	1.00	Very high
Creativity	0.53	Average
Learn Through Play	0.93	Very high

Note: The data was based on the results of classroom observations in 15 different sessions.

Last, included in *Life and Career* capabilities as top skills from the use of manipulatives are fine and gross motor skills, helping to clean up, and initiative and self-direction (see Table 6). We observed that,

aside from the cognitive part, the psychomotor domain was also enhanced by manipulatives, through and with the help of the teacher's instruction. The children know what to do with the materials after they finish using them. This provides early training to form the habit of organizing or packing away their stuff correctly after use. The last skill, leadership, has the lowest rating among all the skills as students work alone and do not do much of group or teamwork wherein they can guide and lead a group.

Table 6. Result of observation for life and career skills

Specific Skills from using Manipulatives	Frequency	Verbal Interpretation
Gross and Fine Motor Skills	1.00	Very high
Eye-Hand Coordination	0.80	Above average
Decision Making Skills	0.66	Above average
Self Confidence	0.8	Above average
Help to Clean-up	0.93	Very high
Leadership	0.13	Low
Initiative and Self Direction	0.86	Very high
Productivity	0.80	Above average

Note: The data was based on the results of classroom observations in 15 different sessions.

Conclusions and Recommendations

Manipulatives are today's well-known tools for teaching kindergarten pupils. This study found that there are manipulatives used by kindergarten teachers that are effective tools for teaching and imparting 21st century skills to young learners. The manipulatives are directly applied and used by the pupils and have the potential to raise the level of interest of learners to engage in the lesson. The manipulatives available in kindergarten schools are appropriate in helping 5-year-old children develop the 21st century skills required because they match the child's characteristics.

The type of manipulative aids the teacher in achieving the goal of early childhood education within the 21st century context. There are various types of manipulatives currently being used, and these have provided opportunities for learners to develop one or more skills depending on their characteristics and the functions of the manipulatives. The study also found that skills development may vary depending on the activity and type of manipulatives utilized. However, distinct observation has verified that manipulatives directly contact pupils and give them first-hand learning, leading to the effective development of 21st century skills among kindergarten pupils.

Various types of manipulatives are available today in both private and public schools. However, there is a need for teacher training to optimize manipulatives because not all kindergarten teachers today are Early Childhood Education graduates. Also, this study perceives that not all of the manipulatives are present in kindergarten classrooms. Teachers make improvised materials to achieve the same purpose or rely on donations from their pupils or outside sources.

Based on the results and conclusion of the study, the following recommendations are hereby extended:

The study suggests that teachers be encouraged to promote creative teaching strategies using materials aligned to the philosophy, context, and goals of the K-12 curriculum. These teachers must have access to training to maximize the use of manipulatives and be instructed to let the pupils use the materials instead of keeping the materials inside the cabinet or putting them on display.

This study also recommends for the schools to be allocated with sufficient annual budget to support the acquisition of manipulatives for all kindergarten classrooms. The effective manipulatives found in other countries should also be made available in Philippine schools to implement effective use of teaching materials to achieve efficient learning and holistic development of a growing child in order for him to acquire the 21st century skills needed to bring him at par with his counterparts in other countries.

Declarations

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