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Teaching Strategies Utilized by Mathematics Teachers in the 21st-Century

Jonathan Campilla[a]*, Vener Abiett Castañaga[b]

[a]*Calegu Integrated School, Catablan, Urdaneta City 2428, Philippines*
[b]*Urdaneta City University, San Vicente West, Urdaneta City 2428, Philippines*
[a]*Email: nathancampilla@gmail.com,* [b]*Email: venerabiettlcastanaga4ucu@gmail.com*

Abstract

Due to the increasing demands of the twenty-first century work environment, education system must reflect those skills essential for success. Through the development of the 21st-century standards for teachers and students, the Philippines education system has begun the reform process to initiate change towards addressing these new skills. It is through the introduction of various strategies and innovative materials in the teaching-learning process aligned with the development of the 21st-century skills. This study dealt with the teaching strategies utilized by mathematics teachers in the 21st-century in the Schools Division of Urdaneta City during the S.Y. 2019-2020. A total of one hundred two (102) secondary mathematics teachers of the SDO Urdaneta City served as the respondents. Data were obtained using a researcher-designed questionnaire checklist which was validated by experts in the field. Results showed that the least utilized 21st-century teaching strategy by the mathematics teachers is multimedia-based. Thus, a gamified PowerPoint presentation to support the application of multimedia-based strategy was developed. Interestingly, this study found significant differences in the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school. Moreover, findings revealed that significant relationships exist between the extent of utilization of the teaching strategies by mathematics teachers and the profile variables age, sex, relevant training at the national level, and type of school. It was recommended that Mathematics teachers should be encouraged to utilize the gamified PowerPoint template to supplement the teaching-learning process in Mathematics.

Keywords: Teaching strategies; multimedia-based; manipulative-based; game-based; contextual learning strategy.

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* Corresponding author.

1. Introduction

As the world changes, how and what to teach in the educative process must also be reshaped to respond to the needs and keep up to date with the growing demands of society; learning has been changed enormously over the last decade due, in part, to the technological revolution [1]. There is no one way to acquire knowledge, skills, and understanding in classrooms that use instructional approaches and strategies aligned with 21^{st}-century skills development, which are the capacity to collaborate, create, critically think, and communicate interactively, as well as independently [2]. Although creativity, critical thinking, communication, and collaboration are not new to education, they are fundamental prerequisite skills in the 21^{st}-century work environment [3]. It is a challenge, therefore, for the 21^{st}-century mathematics classrooms to make students create their thinking and apply their knowledge in various ways. Students learn by doing hands-on activities, project and problem-based learning, collaboration within-group, and using technology for productivity, communication, and creativity. Likewise, mathematics instruction must emphasize mathematical processes such as critical and logical thinking, reasoning, communication, making connections, and problem [4]. In the Philippines, mathematics is one of the main priorities in terms of time allocation per class. The Department of Education (DepEd) mandated a 50-minute time allocation every day in the Revised Basic Education Curriculum and 1 hour for four days in the K to 12 Basic Education Curriculum. Additionally, mathematics is one of the subjects included in evaluating students' achievement in national-level competencies, like the National Career Assessment Examination (NCAE) and the National Achievement Test (NAT). Likewise, to develop mathematical skills, to promote collaboration among students, and to establish a strong rapport between teachers and students, various training for students and teachers are held, such as the Mathematics Teachers Association of the Philippines (MTAP) training and the Mathematics Trainers' Guild aside from the different mathematics enrichment programs advocated by public and private schools nationwide [5]. However, given the consideration that the Philippine education system is dedicating to Mathematics, there are still issues, concerns, and difficulties in teaching and learning the subject. There was a report that ever since the introduction of mathematics in the curriculum, students viewed it as a problem area due to its complexity and abstractness [6]. In addition to that, during the 2003 Trends in International Mathematics and Science Study (TIMSS), the Philippines ranked 23^{rd} in Grade 4 out of 25 participating countries and 41st in Grade 8 out of 45 participating countries [7]. Moreover, a report of the Department of Science and Technology (DOST) said that the 6601 Filipino students who took the TIMSS 2000 ranked 36^{th} in both science and mathematics tests out of a field of 38 countries. The report also revealed that the Filipino participants garnered 349 and 350 in science and mathematics, respectively, which were significantly below the international average of 489 points in both subjects. Filipino students did best in Data Representation, Analysis, and Probability, and lowest in Algebra [8]. Further, the result of the 2018 Programme for International Student Assessment (PISA) reflected that the Philippines ranked as the second-lowest in mathematics among the 79 participating countries and economies, wherein Filipino students achieved 353 points, which were significantly lower than the international average of 489 points [9]. The results served as evidence that Mathematics instruction in the Philippines needs an overhaul. The main reason why students are performing poorly in mathematics is that they still have a hard time understanding the importance of the subject in their lives [10]. Students are aware of the use of basic mathematical concepts in their daily lives; however, when it comes to challenging concepts and skills, and whenever students are experiencing difficulties, they begin to question its essence and application. Accordingly, teachers find ways to make their classes love mathematics. They are trying out new techniques and methodologies, which would make students interested and engaged. In a 21st century classroom, a mathematics teacher must integrate technology and non-traditional strategies, which contrasts from the traditional method of teaching mathematics, which consists of rote memorization, lack of manipulation, use of worksheets, drill-and-kill, and is usually teacher-centered, when teaching to provide a stress-free and learner-centered environment, as well as interactive lessons where students believe they can easily express their ideas without negative consequences for mistakes [11]. As [4] stressed that the students should learn the subject with understanding, actively building new knowledge from experiences and prior knowledge, mathematics teachers should uplift the interest, motivation, and dedication of students in learning the subject. Hence, teachers need to enhance better their competence in teaching Mathematics. It is also equally important that they find the appropriate 21st-century teaching strategies to teach their students how the mathematical concepts could improve, not only their economic well-being. Also, it will enable them to become productive members of their respective communities and eventually help in the development and growth of society. The researcher believes that applying the right 21st-century teaching strategies in Mathematics can help to remove the anxiety and respond to the needs of the students towards the subject, thus increasing their academic performance. With this belief, this study has been conceptualized. The purpose of this study was to determine the extent of utilization of the teaching strategies by the mathematics teachers in the Schools Division Office (SDO) Urdaneta City, Pangasinan during the S.Y. 2019-2020. More specifically, it sought to find out:

1. The profile of the mathematics teachers.
2. The extent of utilization of teaching strategies by mathematics teachers.
3. If there are significant differences in the extent of utilization of teaching strategies by mathematics teachers across sex and type of school.
4. If there are significant relationships between the extent of utilization of teaching strategies by mathematics teachers and their profile variables.
5. The instructional material can be developed to support the utilization of 21st-century teaching strategies in Mathematics.

1.1. Mathematics Instruction

Students are raising their hands to respond to the questions asked, obediently taking down notes, passive recipient of knowledge, and use of traditional teaching methods, such as rote memorization of mathematical concepts and drill and kill, describe how the teaching and learning Mathematics took place over the past centuries [12]. This method of mathematics instruction would continue day after day. Over the past decades, however, a debate has taken place over how to teach math effectively and interactively and whether the traditional method is as effective as it once was. The skills required from the 20th century are different from the skills required of students in the 21st-century. With this change in skill requirements, there is a need to improve the content, assessment methods, and strategies used in teaching [13]. The rapid development of technology drives teachers to encourage learners to widen their horizons as members of a global community. Teachers of the 21st-century must act as facilitators of learning who teach students how to think critically, do tasks collaboratively, communicate effectively, and create their knowledge based on their previous experiences.

Twenty-first-century teachings must integrate technology, such as the internet, video, print, media, and television. At present, mathematics teachers are everywhere, helping students to understand and make sense of mathematics. Teachers of mathematics in 21st-century classrooms implement the use of varied instructional strategies and resources to encourage the active participation of learners. They are working to bring students into the learning process and utilized authentic assessment methods to help the students communicate what they understand and collaborate with their peers. Further, 21st-century strategies in mathematics are different from the traditional teaching of the subject in that students collaborate and construct their understanding based on experiences. Students can communicate their thinking processes, and this exchange of ideas provides the foundation for an understandable representation of mathematical concepts [13].

1.2. Multimedia Based Strategy

Technology assumes a significant job in 21st-century learning environments and practices. Utilizing multimedia as a learning tool, teachers are engaging students, promoting higher-level thinking, and developing essential skills for the future [14]. The advancement of technology has made the world rapidly changing, which is affecting the academic community positively. It significantly changes the classroom learning environment where it can invite students' attention and engage them during the lesson, in contrast to a passive classroom environment, which cannot help in learning and retention. Multimedia as a teaching strategy refers to a computer-controlled integration of content, visuals, illustrations, videos, graphic interchange format, animation, audio, etc., where every type of information can be represented, stored, transmitted, and processed digitally. It is all about communicating in several ways. The use of multimedia in mathematics plays an essential role in education in making the teaching-learning process more interactive and engaging. It helps teachers to connect math in reality and facilitate understanding among students. The advantages of utilizing multimedia-based strategy are not limited to the ease of teachers' work alone. It also supports constructive concept development and helps the teachers to be more focused on teaching and the students to have a comprehensive understanding of the concept. Also, it helps to ease learning by empowering students to learn at home, which improves students' learning abilities. It also promotes reflective thinking among teachers and students [15]. Technology gives transformational approaches to take part in 21st-century learning. A few advantages of utilizing technology are active student response, individualized and differentiated instruction, increased motivation, and resources for classroom management [16]. Although there are numerous advantages to utilizing technology in 21st-century classrooms, there are a few downsides. Teachers must be prepared to utilized technology and need to take the time to teach students the importance of their digital footstep while using the internet.

1.3. Game-based Strategy

One best teaching strategy to facilitate an effective teaching-learning process in mathematics is incorporating games in the subject. [17] affirmed that students were more motivated and more involved when learning could occur through game playing. Similarly, [18] added that teachers need to give mathematical circumstances for the students to tackle through games and exercises that challenge their brains. There is a group of research to support the potential of utilizing games as an interactive teaching strategy [19, 20], and to complement traditional lectures for enhancing students' learning [21, 22, 23]. Past research demonstrates that games can bring students into a more interactive learning process [24, 25, 26]. The utilization of games can likewise provide teachers with an interactive and meaningful way for imparting knowledge that is important for teaching cause and effect [24, 27]. Finally, as a teaching strategy, games can connect with and motivate students, and the learning acquired from games is more meaningful and more likely to be retained [19, 20, 28]. Games are fun, stimulating, fascinating, and empowering way of teaching [20]. They likewise express that games can teach complex new information to students. Also, both academic performance and social relationships are likely to be enhanced using games. Various researchers have revealed the benefits of utilizing games in the classroom. As indicated by [29], games can give involvement with investigation, experimentation, trial and error, imagination, role play, and simulation, and that the challenge that lies ahead for educators is to draw on strategies to transform traditional approaches into a new learning model that infuses the use of educational games in the formal curriculum. Past researches have drawn attention to the potential of games to support the learning of competencies, collaboration, and participation in practice [30]. An examination in Chile by [31] assessed the impacts of utilizing instructive computer games on students' learning, inspiration, and classroom dynamics, using 1274 first and second elementary grade students. The results showed that there is a significant improvement on learners' participation, engagement, and learning outcomes compared to traditional teaching. In any case, Reference [32] stressed that when utilizing games as an instrument for learning, teachers and curriculum developers should specify the learning outcomes that are related to it and reinforce the relevance of the game to the students. Reference [32] also suggested that students must be encouraged to reflect on their learning during and after the game-playing experiences. As affirmed by [33] games have continuously played a significant role in mathematics and its learning. They encourage critical and logical thinking, problem-solving, communication; and contribute to the development of knowledge. It also increases the level of learners' motivation and interest in mathematics. There are three classifications of games that can use by teachers in the classroom. These comprise (1) commercially made games such as Connect Four, Mastermind, Tangrams, and other card or board games; (2) computer-based games that are readily accessible on the internet; and (3) games made by both the teachers and students. Reference [34] commented that play performs significant roles in a child's emotional, social, and cognitive development. Also, studies have shown the instructional effectiveness of computer games. Reference [35] also affirmed that teachers' and students' created games generate students' interest, enthusiastic participation, and motivation. Relative to the utilization of games instructional strategy in Mathematics [33], found out that games provide students greater motivation and desire to learn more about mathematics and increased awareness of the practical use of the concepts learned from the subject in their lives. Students enjoyed the challenge and motivation provided by the games as it boosts their confidence in Mathematics. Reference [33] also reported that some students did not even realize that they were learning because they were having so much fun. Games enable the students' interaction with the environment, as it provides an opportunity for the students to communicate. The use of games affects the way how students perceived mathematics. It has an essential role in developing students' thinking on numbers and initiating and maintaining mathematical communication [36]. More importantly, games also improve communication, social interaction, creative thinking, critical thinking skills, and problem-solving skills of the students. Likewise, games can increase teaching effectiveness by generating a collaborative learning environment [37] Games also increases students' consciousness about Mathematics. Reference [38] affirmed that utilizing game-based approaches in classrooms will increase the mathematical awareness of students. Moreover, the students can enhance the mathematical knowledge they have acquired through games if it involves problem-solving process since there is a significant relationship between the students' creating new information with various materials during the game and their ability to think, explore, and understand the world around them [39]. Further, computer-based games have become a part of learners' game world. Teachers started using technology-assisted games in the learning process to meet the demands of the learners in the 21st-century. Learners will be more likely to learn real-life situations and experiences using technology-based games. They can both learn and practice their skills. Likewise, teachers can explain complex topics more easily in mathematics [40]. The use of games as a 21st-century teaching strategy enhances students' attitudes towards mathematics [41]. Reference [17] examined the impact of games in the mathematics classroom. According to [17], games could facilitate understanding of the concepts of mathematics, enhance problem-solving and algebraic reasoning skills. Also, the results revealed that the students performed better on the assessment after they had played games. Reference [17] also mentioned other positive effects of game playing, including higher engagement of students, enhanced self-confidence, and improved communication. It also develops more positive views of mathematics. Playing games also established a more comfortable classroom environment. They provided the students with an opportunity to innovate and learn independently. Study shows that using games as a 21st-century teaching strategy in mathematics increases both student performance and engagement.

1.4. Manipulative-based Strategy

Another teaching strategy to improve mathematics achievement is the use of manipulatives. Reference [42] defined mathematics manipulatives as "Physical objects students can manipulate to explore and develop an understanding of a mathematical concept." Manipulatives make mathematical lessons more concrete as it provides a hands-on learning experience. Prominent manipulatives are decimal blocks, spinners, number lines, geoboards, integer tiles, measuring devices, fraction tiles, geared clocks, and graphing mat. The use of these manipulatives gives concrete ways for students to understand abstract mathematical ideas. Reference [43] discussed the impact of manipulatives on students' learning that a page of abstract thoughts and symbols, no matter how simplified, cannot provide hands-on experiences to the students the way concrete materials can. Like games, studies shown that the use of manipulatives as a teaching strategy could improve students' achievement and motivation in mathematics [44]. In the research conducted by [45], findings revealed that manipulatives improved students' engagement and a powerful tool to understand abstract mathematical concepts. Reference [46] conducted a study investigating issues in utilizing manipulatives as a 21st-century teaching strategy. They explained that the students need to be monitored time by time on using manipulatives in the classroom. Teachers should be aware of how students interpret the materials and how they translate this interpretation into the understanding of concepts. They also suggested that using manipulatives should start with activities that allow them to explore the materials freely to know more about them. Reference [47] conducted a study on the effectiveness of an abacus as a manipulative in teaching the addition of integers. Findings revealed that the use of the abacus significantly improved the performance of students in mathematics. Better retention of skills and self-confidence of the students were also evident. Thus, the use of manipulatives promotes cognitive, affective, and psychomotor learning.

1.5. Contextual Learning Strategy

Another teaching strategy to improve mathematics achievement is contextual learning strategy or integrating the subject into the real-life situations. According to [48], without real-world application, students can find mathematics abstract, uninteresting, and hard to understand. Thus, the real-world application makes mathematics more engaging and more relating to the students. Reference [18] stressed that teachers need to teach mathematics based on learners' experience. For this reason, learners will have a greater appreciation of the subject. Similarly, [48] affirmed that students get more interested and motivated in mathematics when integrated into real-life situations. Additionally, [18] explained the importance of math learning opportunities present in classrooms, homes, and local communities, such as field trips to local grocery stores, simulation, and role-playing, to learn mathematical concepts. Moreover, many teachers have connected specific mathematical topics to real-life applications, including measuring the classroom area, the perimeter of a fence and calculating expenses and savings using the four fundamental operations. Integrating mathematics in real-life scenarios engages students in the class to explore, learn, and do better.

2. Materials and Methods

This study utilized descriptive survey and descriptive-developmental research designs. The respondents were the 102 Mathematics teachers from the ten (10) clusters of the Division of Urdaneta City, Pangasinan. The instrument used for this study was a questionnaire checklist on the teaching strategies utilized by mathematics teachers in the 21st-century. The questionnaire checklist has two parts. Part I dealt with the profile of the respondent teachers, which included age, sex, civil status, highest educational attainment, number of years of teaching Mathematics, number of relevant training attended, and type of school. Part II dealt with the extent of utilization of the teaching strategies by Mathematics teachers, along with multimedia-based strategy, game-based strategy, manipulative-based strategy, and contextual learning strategy. It had a 4-point Likert-type scale of *Always (4), Sometimes (3), Seldom (2), and Never (1)*. The extent of utilization of teaching strategies by mathematics teachers was interpreted as follows: *Very Extensive (VE:3.27-4.00), Extensive (E:2.52-3.26), Slightly Extensive (SE: 1.76-2.51), and Not Extensive (NE: 1:00-1.75)*. The questionnaire checklist was validated by five (5) experts in mathematics education. After refining and finalizing the research instrument, the researcher secured a permit to float them from the office of the Schools Division Superintendent. Eventually, the researcher administered the questionnaire to the teachers using a google form. It was the best option for collecting the needed data for this study in the current situation of the Covid-19 pandemic. It was to avoid face-to-face interaction of the researcher in gathering responses from the respondents. The researcher also coordinated with the Education Program Supervisor in charge of Mathematics for the link of the google form. The data collection started on November 5, 2020, and ended on November 30, 2020. The data gathered were treated using various statistical techniques using the frequency counts and percentages, weighted mean, t-test and Pearson-r.

3. Results

3.1. Profile of the Respondents

Table 1 presents the distribution of respondents according to their profile variables. Age. The cliché tells that the older the teacher, the more wisdom he has. It means that a teacher with vast experiences learns more. As such, the researcher considered the difference in ideas and thinking of a younger teacher to an older teacher making age one of the variables used in this study. The table shows that majority of the mathematics teachers belong to the age bracket 31-40 years old that is 34.3 percent. It could mean that most of the respondent teachers are just in their prime age of maturity suited for active and effective teaching and learning process in Mathematics. Further, the table shows that 18 or 17.6 percent belong to the age bracket 20-30 years old, 20 0r 19.6 percent belong to 41-50 years old, and 29 or 28.4 percent belong to the age bracket 51 years old and above. Sex. The same table shows that majority of the respondents are females that are 60 or 58.8 percent, while 42 or 41.2 percent are males. It implies more females than males teaching Mathematics, considering that teaching is a female-dominated profession, as observed in the different public schools in the country. Civil Status. The table shows 74 or 72.5 percent married respondents, and 28 or 27.5 percent are single. It means that majority of the respondent teachers are married. At a certain point, the status of being married, having a family, and enjoy a stable life is a source of feeling secured, self-fulfillment, and inspiration in life, such being the case marital status can contribute an impact to work performance.

Table 1: Profile of the Respondents

Profile Variables		Variable Category	F	%
Age		51 years old-above	29	28.4
		41 years old-50 years old	20	19.6
		31 years old-40 years old	35	34.3
		20 years old-30 years old	18	17.6
Sex		Male	42	41.2
		Female	60	58.8
Civil Status		Single	28	27.5
		Married	74	72.5
Highest Educational Attainment		BSE/BSEED	3	2.9
		BS+16-32 Professional Units in Education	4	3.9
		MA Units	36	35.3
		MA Academic Requirements	42	41.2
		Master's Degree Holder	9	8.8
		Doctoral Units	4	3.9
		EdD/Ph.D. Academic Requirements	1	1.0
		EdD/Ph.D. Degree Holder	3	2.9
Number of Years Teaching Experience		Five years-below	25	24.5
		6-10 years	28	27.5
		11-15 years	15	14.7
		16 years-above	34	33.3
Relevant Trainings Attended	District	5-below	23	22.5
		6-10	41	40.2
		11-above	38	37.3
	Division	5-below	57	55.9
		6-10	41	40.2
		11-above	4	3.9
	Regional	5-below	90	88.2
		6-10	11	10.8
		11-above	1	1.0
	National	5-below	101	99.0
		6-10	1	1.0
Type of School		Mother High School	21	20.6
		189 Schools	81	79.4

Highest Educational Attainment. Continuing professional development increases teachers' motivation, work performance, confidence, and commitment to teaching. Teachers are facilitators and leaders who can enhance their professional careers by enrolling in graduate and post-graduate studies. As reflected in the table, 42 or 42.1 percent have earned their M.A. Academic Requirements, 36 or 35.3 percent have earned their M.A. units, 9 or 8.8 percent are master's degree holders, 4 or 3.9 percent have their doctoral units, another 4 or 3.9 percent of the respondents are unit earners, 3 or 2.9 percent are baccalaureate graduates which is the lowest educational attainment. At the same time, it is surprising to note that 1 or 1 percent have earned Academic Requirement in the doctorate program, and 3 or 2.9 percent have already finished their doctorate. The result gives the impression that the respondent mathematics teachers value education as a continuous learning process because the quest for knowledge is a distinguishing hallmark of a profound teacher. Number of Years Teaching Mathematics. The number of years teaching mathematics contributes to the teachers' competence to gain mastery and expertise in teaching. As revealed in the table that the highest group classification is 16 years and above with a frequency of 34 or 33.3 percent, while there are 15 or 14.7 percent have been teaching mathematics for 11-15 years, 28 or 27.7 percent have 6-10 years of teaching experience, and 25 or 24.5 percent have been teaching mathematics for five years and below. So that in terms of the number of teaching experience, most of the mathematics teachers in the secondary schools have been in their position long enough to have developed the skills, capabilities, and competencies of being a teacher. As expected, these respondents who have been in the service for several years have already mastered their craft in teaching mathematics and established themselves as effective and efficient teachers based on experience. Number of Relevant Training Attended. Training among teachers develop competencies and supplement the knowledge and skills in teaching mathematics, leading to better performance of students. Surprisingly, most mathematics teachers have attended below five training at regional, national, and international levels. However, in terms of division level, most respondents have already acquired more than six training, that is 79 or 77.5 percent. It can also be noted in the table that there are 41 or 40.2 percent have attended 6-10 training at the regional level, while 11 or 10.8 percent have undergone 6-10 training on the national level. It means that there is enough opportunity given to the respondent teachers to attend in-service training. Seminars, training, and workshops provide excellent avenues for professional growth. Type of School. As gleaned from the table that most of the respondents came from 189 Schools, that is 81 or 79.4 percent, while there is only 21 or 20.6 percent who came from Mother High School. The researcher attributed the result to the 23 secondary 189 schools in Urdaneta City Division.

3.2. The Extent of Utilization of Teaching Strategies by Mathematics Teachers

This section presents the extent of utilization of the teaching strategies by mathematics teachers along with multimedia-based, game-based, manipulative-based, and contextual learning strategies. Table 2 reflects the summary table of the extent of utilization of the teaching strategies by mathematics teachers. As revealed in the table, the extent of utilization of the teaching strategies by mathematics teachers along multimedia-based had an average weighted mean of 2.91, denoting an "Extensive" transmuted rating. Among the indicators, multimedia-based is the least utilized 21st century teaching strategy in Mathematics. This finding can be attributed to the limited number of multimedia devices in the school. [14] stressed that utilizing multimedia as a learning tool is an avenue for teachers to engage students, promote higher-level thinking, and develop crucial skills necessary for the future. On the other hand, the extent of utilization of the teaching strategies by mathematics teachers along game-based strategy obtained an average weighted mean of 3.28, indicative of a “Very Extensive” transmuted rating. The result indicates that the mathematics teachers utilized the game-based strategy to develop learners’ confidence to participate actively in the class discussion. Relative to this finding, [20] affirmed that the use of games is a fun, connecting, stimulating, fascinating, and empowering way of teaching. They likewise express that games can unlock critical thinking, creativity, and imagination among students, thereby creating an atmosphere conducive to learning situations to make classroom interaction meaningful.

Table 2: Summary table on the extent of utilization of the teaching strategies by mathematics teachers

Indicators		AWM	TR
1.	Multimedia-based Strategy	2.91	E
2.	Game-based Strategy	3.28	VE
3.	Manipulative-based Strategy	3.25	E
4.	Contextual Learning Strategy	3.39	VE
OWM		3.21	E

Legend:

Mean Score Range	Descriptive Equivalent	Transmuted Rating
3.27-4.00	Always	Very Extensive (VE)
2.52-3.26	Often	Extensive (E)
1.76-2.51	Seldom	Slightly Extensive (SE)
1.00- 1.75	Never	Not Extensive (NE)

Moreover, the extent of utilization of teaching strategies by mathematics teachers along manipulative-based obtained an average weighted mean of 3.25, denoting an “Extensive” transmuted rating. The result means that the mathematics teachers are consistent in using/applying this strategy, which exposes learners to manipulatives to provide foundations and models for more abstract concepts. Reference [44] affirmed that using manipulative-based teaching strategy help improve learners’ engagement, achievement, and motivation in Mathematics. It is the most effective way to learn Mathematics with ease as it provides a link between concrete and abstract ideas, thereby developing students’ creativity and critical thinking. Further the extent of utilization of the teaching strategies by mathematics teachers along contextual learning strategy obtained an average weighted mean of 3.39, denoting a “Very Extensive” transmuted rating. It implies that the respondent teachers prioritize using contextualized materials and relating the lessons in real-life situations in developing the skills, concepts, and competencies in Mathematics. Relative to this finding, Reference [48] noted that using contextual learning will encourage students to process new knowledge with their reference to their memory of everyday life experience and instruct learners to make connections of lessons learned in Mathematics in real life for an effective achievement of curriculum objectives which is the emphasis of this teaching strategy. In general, as observed in the table, the overall extent of utilization of the teaching strategies by mathematics teachers obtained an overall weighted mean of 3.21, denoting an "Extensive" transmuted rating. This means that the mathematics teachers extensively utilized the 21st century teaching strategies to improve learning outcomes in Mathematics.

3.3. Differences in the Extent of Utilization of the Teaching Strategies by Mathematic Teachers across Sex and Type of School

Relative to the problem to determine the differences in the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school, the researcher utilized the *t*-test. It was to make a more in-depth analysis of data gathered in this study. Table 3.1 and 3.2 presents the group statistics and differences in the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school. As gleaned from table 3.1, the mean extent of utilization of the teaching strategies by male mathematics teachers is 3.2994, and that of the female is 3.1458, while for teachers from mother high school is 3.0750, and for teachers from 189 schools is 3.2438.

Table 3.1: Group statistics of the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school

			N	Mean	Std. Deviation	Std. Error Mean
The extent of utilization the teaching strategies by mathematics teachers	Sex	Male	42	3.2994	.36769	.05674
		Female	60	3.1458	.32372	.04179
	Type of School	Mother High School	21	3.0750	.37081	.08092
		189 Schools	81	3.2438	.33696	.03744

Moreover, table 3.2 shows that the t-test value of 2.229 assuming equal variances and 2.179 assuming unequal variances between male and female groups of mathematics teachers, and -2.004 assuming equal variances and -1.894 assuming unequal variances between mathematics teachers from mother high and secondary 189 schools. The *P*-values for Levene's test of equality of variance are 0.161 for sex and .777 for the type of school, which is greater than 0.05, which means that the variances of the two groups are approximately equal, so the *P*-value is 0.028, and 0.048 respectively will be considered. This value warrants that the mean difference in the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school is statistically significant at .05 level of significance. It means that sex and type of school influence how extensively mathematics teachers apply 21st-century teaching strategies.

Table 3.2: Differences in the extent of utilization of the teaching strategies by mathematics teachers across sex and type of school

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Sex	Equal variances assumed	1.994	.161	2.229	100	.028	.15357	.06889	.01689	.29025
	Equal variances not assumed			2.179	80.992	.032	.15357	.07047	.01337	.29378
Type of School	Equal variances assumed	.080	.777	-2.004	100	.048	-.16883	.08424	-.33595	-.00171
	Equal variances not assumed			-1.894	29.146	.068	-.16883	.08916	-.35114	.01348

3.4. Differences in the Extent of Utilization of the Teaching Strategies by Mathematic Teachers across Sex and Type of School

For further analysis of data gathered in this study, the researcher also determined the relationships between the extent of utilization of the teaching strategies by mathematics teachers and their profile variables using the Pearson-coefficient of correlation or Pearson-*r*. Table 4 shows such correlation results between the extent of utilization of the teaching strategies by mathematics teachers and their profile variables.

Table 4: Relationship between the extent of utilization of the teaching strategies by mathematics teachers and their profile variables

Profile Variables	Pearson Correlation	Sig. (2-tailed)
Age	.203*	.041
Sex	-.218*	.028
Civil Status	-.128	.200
Highest Educational Attainment	.192	.053
Number of Years teaching Mathematics	-.177	.075
RT_Division	.166	.096
RT_Regional	.103	.305
RT_National	.201*	.042
RT_International	.133	.181
Type of School	.197*	.048

*significant at .05 level of significance

As gleaned in the table that the Pearson-*r* and significant value of the extent of utilization of the teaching strategies by mathematics teachers when paired to profile variables such as civil status, highest educational attainment, number of years teaching mathematics, relevant training attended in division, regional and international level, do not bear any significant relationship. It means that such a profile of the respondents does not give any bearing on their extent of utilization of the 21st-century teaching strategies. In this regard, the null hypothesis that there are no significant relationships between the above-cited profile variables and the respondents' extent of utilization of the 21st-century teaching strategies at .05 level of significance is accepted. In other words, the respondents' extent of applying the 21st-century teaching strategies can be expected to be delivered regardless of the civil status, highest educational attainment, number of years teaching, and relevant training attended in the division, region, and international levels. On the other hand, the respondents' profile variables such as age, sex, relevant training on the national level, and type of school show significant relationships on the extent of utilization of the teaching strategies by mathematics teachers in the 21st-century. Therefore, the researcher rejected the null hypothesis. It means that these profile variables have a significant influence on the utilization of the teaching strategies by the mathematics teachers. Moreover, this finding implies that age, sex, relevant training on the national level, and type of school are determinant factors in the utilization of the teaching strategies by mathematics teachers in the 21st-century.

3.5. Instructional Material that can be developed to support the Application of the 21st-century Teaching Strategies

Based on the result, multimedia-based is the least utilized strategy in teaching mathematics in the 21st-century. Considering that ICT competence is one of the essential skills in the 21st-century, it is indeed necessary that learners should be exposed to interactive lessons using ICT or multimedia to facilitate imagination, creativity, and critical thinking among students. Thus, the researcher developed a gamified PowerPoint presentation template to support 21st-century teaching strategies, particularly multimedia-based. As affirmed by [49], gamification is a process of creating multimedia content with the integration of interactive games using in a way that is both stimulating and useful to help learners retain information. The gamified PowerPoint template comprised activities that provide learners an opportunity to collaborate, communicate, think critically, and actively participate in class. Lessons presented through gamified PowerPoint results in high learners' engagement, which leads to better performance and higher retention of the concepts and skills learned from the discussion.

3.5.1. Game KNB? Classroom Edition

Game KNB classroom edition is an adaptation of a popular Philippine TV game show in early 2000. This gamified PowerPoint presentation is a quiz-format template that encourages students to learn, practice, and review concepts and skills in mathematics. It uses hyperlinks to make it more stimulating once presented to the learners. It also features an adapted soundtrack to make it more appealing and interesting. In that sense, it gives an additional excitement for the learners to learn new things in Mathematics.

3.5.2. Parts of the Template and Its Function

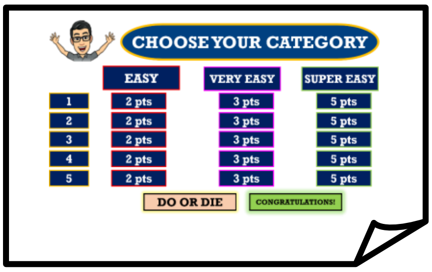
The following contains a discussion on the parts and functions of the gamified PowerPoint template (Game KNB? Classroom Edition).

TITLE SLIDE

It features the logo of the Game KNB Classroom Edition. Its purpose is to infuse thrill and excitement among the learners to participate actively in class.

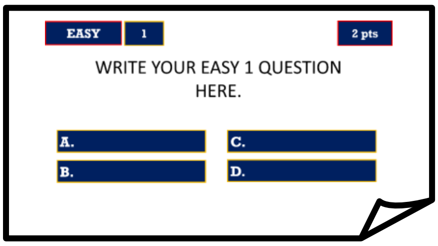
MECHANICS SLIDE

It is on this part that learners will be oriented on the rules, functions of each member of a team, and the scoring system of the game.



CATEGORY SLIDE

It provides an overview of the categories to be undertaken by the students in a specific topic which includes easy, very easy (average), and super easy (difficult).



QUESTION SLIDE

It contains questions and choices of the item chosen by the learners to answer.

Figure 1

3.5.3. Using the Template

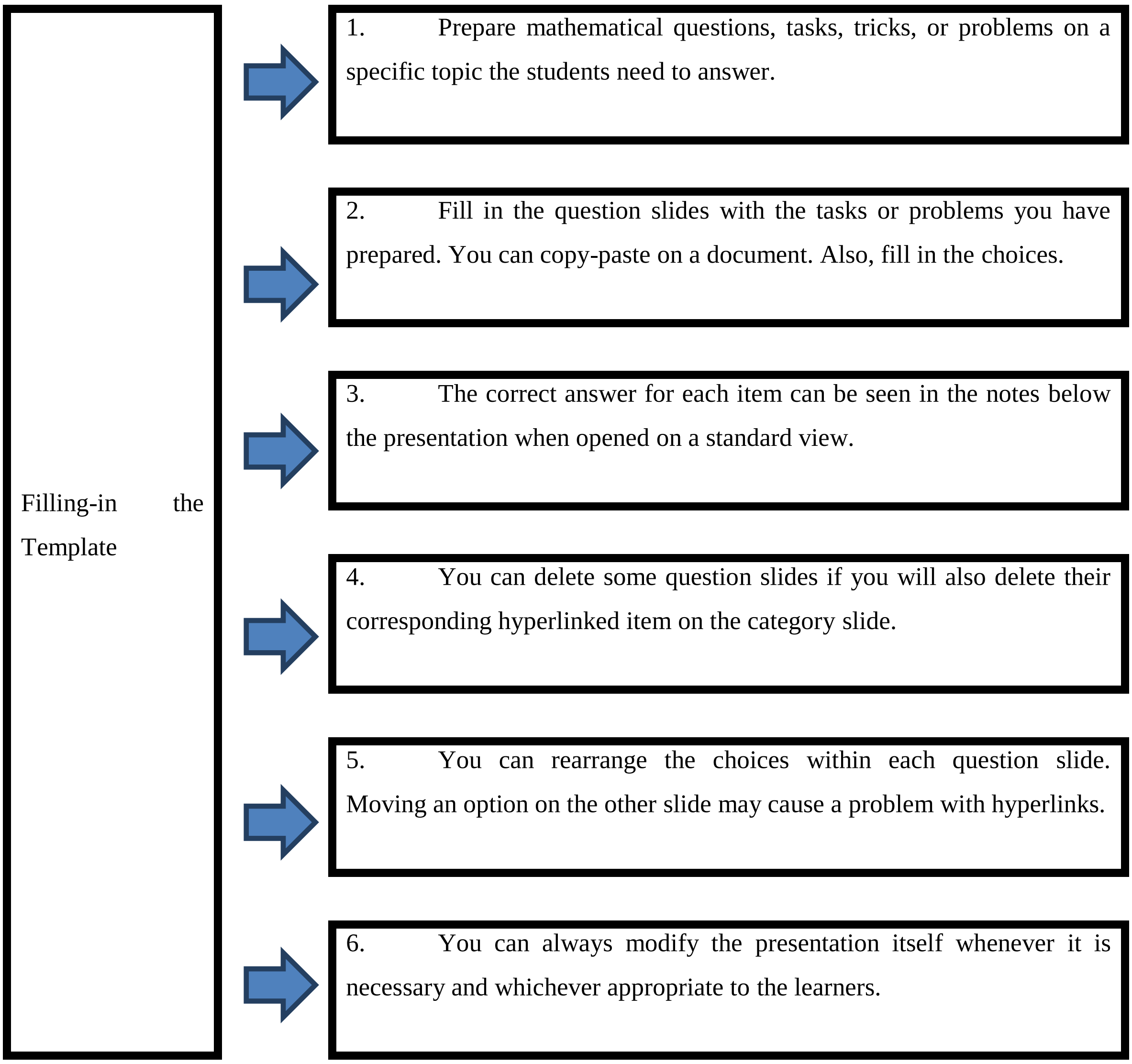


Figure 2

3.5.4. Starting the Presentation

Once the questions are all set, start the presentation, and click on the "How to Play" button for the mechanics of the game, then click the "Let's Play" button to go to the category slide. Ask one of the category pickers of the teams at random to choose a category. Any team may answer the question chosen, but they should use their buzzer signal. You may set a time limit for the students to answer the questions. Once the student/team has answered, click the option they have chosen on the slide to see if they are correct. Once the team got it correctly, award them a corresponding point based on the category. A rationale of the answer will be given by the team who got the item correctly. Click on the "Next" button to return to the category slide. The category previously chosen will disappear. Moreover, if the learners answer the question mistakenly, a "Try Again" button will appear; click that to return to the question being asked and give a chance to other teams to answer. Repeat until all questions have been answered or until the previously decided time limit is up. In cases of a tie, the teacher will administer a do or die question. Click on the Do or Die button for the question. No choices are given in this portion. The team who obtained the greatest number of points will get a reward at the teacher's discretion.

How to Play

1. Divide the class into a group of 5 members (maximum). In cases of a small class, students can play as individuals.

2. In a team, each member has a role such as a Signal Buzzer (Flag Raiser), Category Picker, Problem Solver, and others as helping members. Each time a question is posted, there will be a rotation of roles.

3. The point/s assigned to the item will be rewarded to the first team to answer correctly.

4. The team who answers the question correctly will give the rationale of the item.

5. The team that garnered the highest score will be declared as the winner.

6. The moderator (teacher) will administer a do or die question in case of tie.

Figure 3

4. Conclusion

From the results, it can be concluded that the secondary mathematics teachers of Urdaneta City are just in their prime age of maturity, equipped with relevant educational qualifications and training, and also been in the service for many years. They also extensively apply the different teaching strategies in the 21st-century in Mathematics instruction. However, multimedia-based strategy was least utilized, thus, the researcher developed a gamified PowerPoint presentation to support the application of this strategy. Further, the secondary mathematics teachers are comparable in their extent of utilization of the teaching strategies regardless of sex and type of school. As regards to the extent of utilization of the teaching strategies in the 21st-century by Mathematics teachers is associated with their profile variables age, sex, relevant training at the national level, and type of school. This implies that these profile variables significantly influence their utilization of the 21st-century teaching strategies in Mathematics.

5. Recommendation

Based on the findings and conclusions drawn from the study, the researcher recommended the following:

1. Since most of the respondent teachers have just earned their master's units, all concerned teachers are encouraged to enhance their professional growth by pursuing their graduate and post-graduate studies in a reputable institution.

2. Concerned teachers must upgrade their teaching performance in Mathematics by attending more relevant training at the regional, national, and international levels to further hone their knowledge and competencies, which will improve their craft in teaching Mathematics.
3. Mathematics teachers should level up their extensive application of teaching strategies in the 21st-century to make it very extensive to enhance learners' performance.
4. Mathematics teachers are encouraged to utilize the gamified PowerPoint template to supplement the teaching-learning process in Mathematics.
5. Future researchers should investigate more aspects of the teaching strategies utilized by mathematics teachers in the 21st-century in a broader scope.

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