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Research Article

Off-Classroom Mathematics Teaching and Learning Using Text-Messaging Approach

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ABSTRACT

Text messaging is the quickest and easiest way to transmit information to anyone anytime and anywhere. This mode of communication is prevalently used even in the academic arena. In this paper, Mathematics teaching-learning has gone beyond the four walls of the classroom. Text messaging was utilized in the teaching-learning process. The teacher sent concepts and illustrative examples to the students via SMS. The students interacted with the teacher and learned a new lesson through this mode of communication. A quasi-experimental research design was utilized to establish the impact of teaching-learning mathematics beyond the four walls with the aid of Text messaging. The study revealed that the experimental group performed equally with the controlled group, which revealed that the teaching-learning mathematics beyond the fours wall with the aid of Text messaging is effective. It is because the experimental group did not undergo an actual classroom teaching-learning compared to the controlled group. Further results of the investigation are presented in this paper.

Keywords: *Teaching-Learning Mathematics, Short Messaging Support (SMS), Text-Messaging, Mathematics Education, Experimental Study.*

Introduction

In this modern world where technology has played an essential role in today's generation, many people have instantly grown accustomed to sending and receiving information. Many people have been very dependent on it. The best example of this quick exchange of information is through Text messaging. With a few swipes, taps, and type on the mobile device, one can easily send and receive information. The ubiquitous use of text messages has been a part of every person's lifestyle, especially in the present generation.

Text messaging has changed the perspective of most people today. It also changed how the youth of this present generation use their mobile devices and coordinate their lives. It has offered a more convenient way for the youth at present to communicate. Teenagers have

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grown accustomed to the use of Text messaging. Indeed, Barks, et.al. (2011) mentioned that Text messaging is a common form of daily communication and is convenient when the environment is too noisy for an auditory conversation. It allows one to quickly question and receive a concise response without the usual conversational formalities.

The emerging use of Text messaging in the present generation has also been a learning material. Balasundaram and Ramadoss (2007) focused on using SMS for answering 'short words-answers' types of questions and evaluating them using a simple matching process, providing enough feedback. The results proved that SMS could be used as an aid for answering the short-answered type of questions. Shih and Mills (2007) combined an innovative learning model for mobile learning with an established literature class, and the results proved that this model was effective for the teaching-learning process. Many institutions, schools, and teachers have also implemented Text messaging to disseminate school-related works. Many studies have found and proven the effectiveness of Text messaging. Caudill (2007) proposed three possible models of information exchange via SMS, one that involves the educational institution sending out information about their schedule, one in which the student requests information as they need it, and third where the student is involved interactively with the learning environment. In the study of Shah (2009), it was found out that mobile learning can improve the entire distance education by enhancing ways of communication among distance learners, tutors, and supporting staff. The essential advantage of this technology is that it can be used anywhere, anytime, and its usage is easy to access to a more significant number of distance learners. It was shown that SMS could be successfully used in group discussions, be it in schools or businesses. It preserves anonymity, allowing people to articulate their views without fear of being criticized and relatively easy to use (Kadirire, 2005).

These findings have led the researcher to implement Text messaging in the teaching-learning process. This research aimed to evaluate the implementation of text-messaging in Mathematics teaching-learning beyond the four walls.

Definition of Terms

This paper applies street language terminologies that the students commonly adopted. These terminologies were used in this research as a label of certain activities underwent in this study. This section provides the operational definition of the terminologies used in this study.

Text Concepts – Set of lessons/concepts and examples sent via text message by the teacher. When the students have some confusion/clarifications on a specific lesson/concept, they will reply to the teacher as a typical text message to ask some questions. Likewise, the teacher will explain just like a typical text message to explain/clarify the concept.

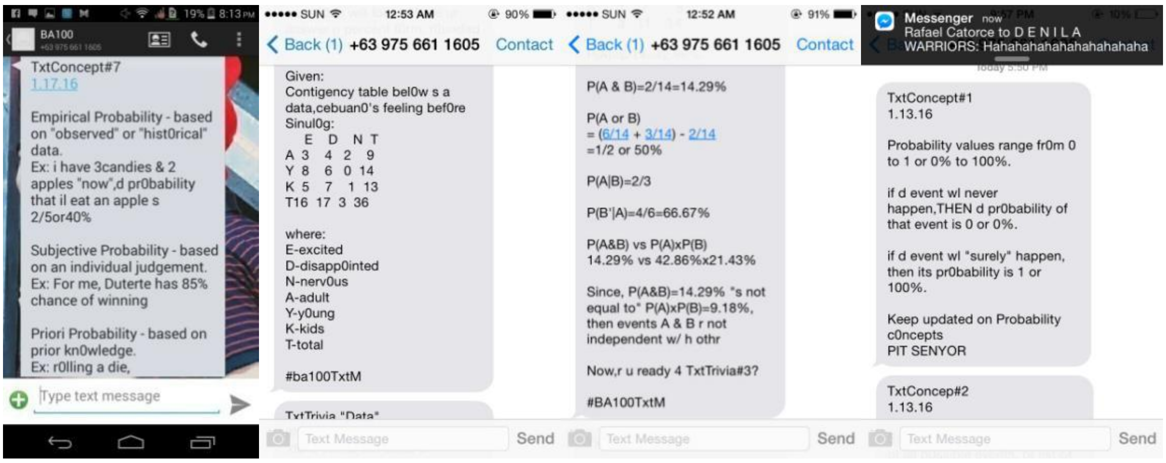

Figure 1. Sample Lessons sent as Text-Messages

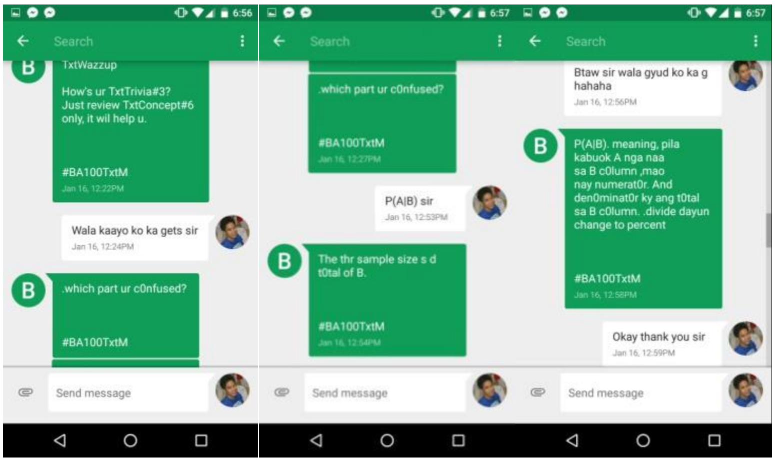

Figure 2. Sample Text-Conversation on Clarifying the Lessons

Text Trivia–Set of exercises related to the concept sent via text message by the teacher. The students will reply their answers to their teachers via text message. Every answer to the question corresponds to specific points recorded by the teacher in his class record. It measures whether the students understood the Text Concepts they received, which scores do not *a*ffect the students' grades. The student is given within 24 – 30 hours to answer the Text Trivia. Wrong answers will receive immediate feedback so that students will be motivated to learn the concept better. Points for the correct answers vary according to the period they sent their answers. In this activity, the students were secretly grouped into five. The groupings are changed in every Text Trivia sent.

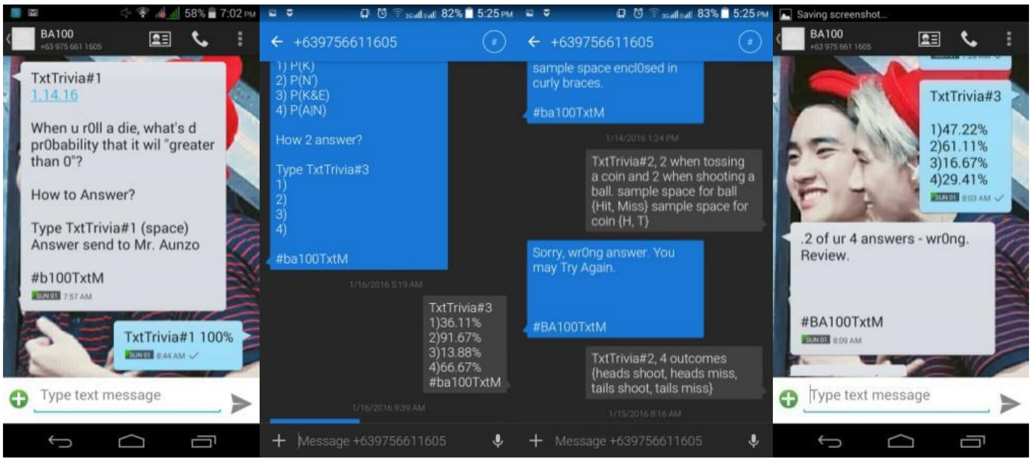

Figure 3. Samples Text Trivia Conversations

Actual Test – Examinations taken by the students inside the classroom. The objective of this examination is to measure *actual* students' learning on the Text Concept they received. The scores of this examination also affirm the scores earned by the students in the Text Trivia. Every set of questions on a particular Actual Test is parallel to a specific Text Trivia. The objective of the parallelism is to measure the difference between the students' scores in the Text Trivia and Actual Test. The students are allowed to read the Text Concepts on their cell phones while taking the exam. This exam is similar to the traditional seatwork given after the discussion, where teachers allow students to open their notes.

Figure 4. Sample of Students Taking the Actual Test

Text Bulletin – Reminders sent via text message by the teacher to the students. It includes schedules of the Text Trivias, Text Concepts, Actual Tests, Long Exam, and other typical reminders where teachers tend to forget to announce inside the classroom. It also includes congratulatory messages to students who are top scorers.

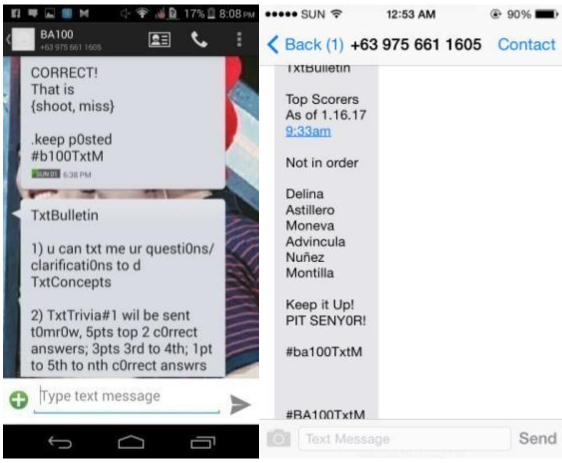

Figure 5: Sample Text-Bulletin

Text Wazzup – Prompt messages to some students such as a reminder of unanswered text trivia, follow-up on class standings and activities that were not yet submitted, and all forms of motivating students to perform well in the class. These are messages that encourage students to do better.

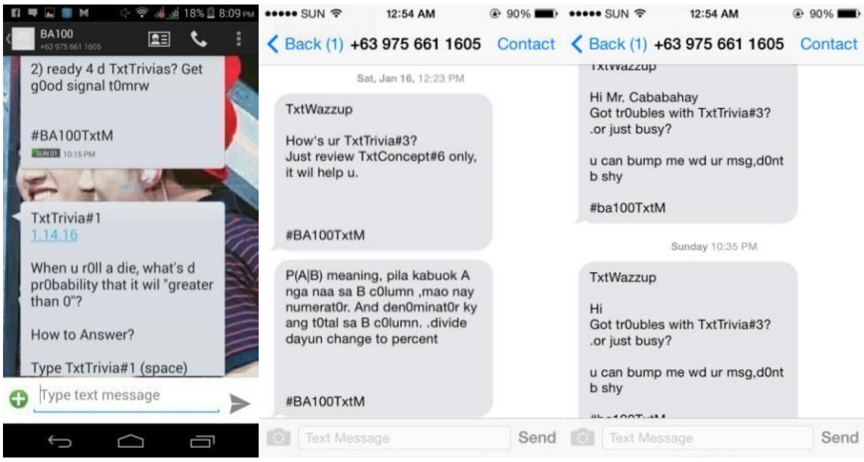

Figure 6: Sample Text-Wazzup

Methodology

This section presents the methodology employed in this research study. It also presents the logical processes adapted in the course of the study.

Research Design

This study employs the quasi-experimental design utilizing the pre-and post-test method of investigation. The pre-test was utilized to establish an equal footing of students on the lessons applied with a new teaching-learning design. Post-test showed the difference between the performance of the experimental and controlled group after the duration of the lesson. This study also utilized survey methodology to establish the following: a) students' attitude towards Mathematics; b) students' perception on text-messaging approach in teaching-learning Mathematics beyond four walls; and 3) students' attitude on text-messaging approach in teaching-learning Mathematics beyond four walls.

Samples and Setting

This study was conducted at the University of San Carlos, Cebu City, during the second semester of the school year 2015-2016. The respondents in this research study were accountancy students enrolled in a Business Statistics class. Two groups of Business Statistics classes were assigned to the teacher-researcher during the study duration, and the experimental group was chosen using the fishbowl method.

Measures

There were three sets of research instruments used in this study. The first set was a survey on students' attitudes towards Mathematics and students' perception of the text-messaging approach in teaching-learning Mathematics beyond four walls. This set was given to the respondents before the implementation of the text-messaging approach in the teaching-learning process. The second set was the survey on students' attitude on the text-messaging approach in teaching-learning Mathematics beyond four walls and students' assessment on the effectiveness of its implementation. This set was given after the duration of the implementation of the text-messaging approach in the teaching-learning process. The third set was the pre-and post-test which was the primary basis for establishing the impact of the implementation.

Data-Gathering Procedures

This section presents the data-gathering procedure undertaken by the researcher in the course of the research study.

Preliminaries

Preparation of text messages was conducted. The text concepts were composed in a keypad cellphone model to make sure all text messages are readable to any models. Sending trials were done on various phone models to check if the text messages are readable to the different models.

Implementation of teaching and learning beyond four walls

The table below presents the day-to-day activity in implementing the text-messaging as an off-classroom Mathematics teaching-learning process.

Day		Activities
Day 1	Wednesday class	a. Survey on Students' Attitude Towards Mathematics b. Orientation on the Mechanics of Text-Messaging c. Survey on Students' Perception on Text-Messaging d. Pre-Test e. After class, Teaching-Learning Thru Text-Concept #'s 1 – 3 f. Text Wazzup (to acknowledge receipt of text concepts)
Day 2	Thursday	a. Text Trivia #'s 1 – 2 b. Text Wazzup (unanswered trivia) c. Text Bulletin (top scorers of text trivia, announcement of following text concepts)

Day		Activities
Day 3	Friday	a. Teaching-Learning Thru Text-Concept #'s 4 – 6 b. Text Wazzup (to acknowledge receipt of text concepts)
Day 4	Saturday	a. Text Trivia #'s 3 – 4 b. Text Wazzup (unanswered trivia) c. Text Bulletins (top scorers text trivia, announcement of following text concepts, and actual test schedules)
Day 5	Sunday	a. Teaching-LearningThru Text-Concepts #'s 7 – 9 b. Text Wazzup (to acknowledge receipt of text concepts)
Day 6	Monday class	a. Actual Test #1. Covering Text-Concepts #'s 1 – 3 and Text Trivia #'s 1 – 2 b. Checking and Discussion
Day 7	Tuesday	a. TextBulletins (top scorers of the actual test, schedules of next actual test, etc.) b. TextWazzups (class standing, missed trivia, etc.)
Day 8	Wednesday class	a. Actual Test #2. Covering Text-Concepts #'s 4 – 6 and Text Trivia #'s 3 – 4 b. Checking and Discussion
Day 9	Thursday	a. Text Bulletins (top scorers of the actual test, schedules of next actual test, etc.) b. Text Wazzups (class standing, missed trivia, etc.)
Day 10	Monday class	a. Actual Test #3. Problem Solving b. Checking and Discussion c. Long Exam
Day 11	Tuesday	a. Text Bulletins (top scorers of the actual test, schedules of next actual test, etc.) b. Text Wazzups (class standing, missed trivia, etc.)
Day 12	Wednesday class	a. Post-Test b. Survey on Students' Attitude on Txt-Messaging and Perception on the Effectiveness of Text-Messaging

Results and Discussions

This section presents the results and findings of the research study after a thorough statistical treatment and analysis of the gathered data from the controlled and experimental groups.

Table 1. Student's Attitude towards Mathematics

Statements	5	4	3	2	1	Total	Wx	Description
1	6	9	20	3	2	40	3.35	Undecided
2	7	12	16	4	1	40	3.50	Agree
3	1	9	13	13	4	40	2.75	Undecided
4	17	8	12	3	0	40	3.98	Agree
5	6	10	15	9	0	40	3.33	Undecided
6	4	8	11	10	7	40	2.80	Undecided
7	10	12	14	3	1	40	3.68	Agree
8	11	11	10	4	4	40	3.53	Agree
9	6	7	11	9	7	40	2.90	Undecided
10	6	5	11	12	6	40	2.83	Undecided
11	7	14	12	3	4	40	3.43	Agree

Statements	5	4	3	2	1	Total	Wx	Description
12	6	10	18	6	0	40	3.40	Undecided
13	3	9	22	4	2	40	3.18	Undecided
14	18	17	2	2	1	40	4.23	Strongly Agree
15	3	12	14	7	4	40	3.08	Undecided
Total	111	153	201	92	43	600	3.33	Undecided

Table 1 shows the students' attitudes towards mathematics. Attitude towards mathematics can be referred to as a positive or negative emotional disposition towards mathematics (Zan& Martino, 2003).

The table shows an overall weighted mean of 3.33. It implies that the students neither have a positive attitude nor a negative attitude towards mathematics. The results further showed that the students were uncertain about their attitude towards mathematics.

With a weighted mean of 4.23, the student strongly agreed with the statement, *"Mathematics is as important as any subject in school."*

Table 2. Difference in the Students' Attitude towards Mathematics Between the Controlled and Experimental Group

Variable	Wx	Description	p-value	Computed Value	Tabular value	Remarks
Controlled	3.32	Undecided	0.4334	3.80	9.488	No significant difference
Experiment	3.33	Undecided				

Table 2 shows the difference in the students' attitudes towards mathematics between the experimental and controlled groups. As reflected in the table, the computed value, which is 3.80, is less than the tabular value, 9.488. It leads to acknowledging our null hypothesis, which means there is no significant difference in the students' attitudes towards mathematics between the experimental and controlled groups. It coincides with the p-value greater than 5% alpha level, leading to acknowledging the null hypothesis. It implies further that the controlled and experimental groups both showed uncertainty in their attitude towards mathematics.

In this connection, to ensure successful completion of e-Learning projects, the developers must possess technical skills and soft skills of interpersonal communication and understanding of human motivation problems (Jewels and Ford, 2006). Since (SMS) is vastly utilized, various schools have included them in their lesson plans. Indeed, some teachers used the quick writing style to spark the students' learning. The children were allowed to use SMS language in their first draft to get thoughts and ideas into the paper more quickly (Mahmoud, 2013).

Table 3. Students' Perception on Teaching-Learning Mathematics beyond Four Walls, Text-Messaging Approach

Statement	5	4	3	2	1	Total	Wx	Description
1	15	19	6	0	0	40	4.23	Strongly Agree
2	7	16	16	1	0	40	3.73	Agree
3	5	17	17	1	0	40	3.65	Agree
4	3	10	17	10	0	40	3.15	Undecided
5	6	13	19	1	1	40	3.55	Agree
6	3	11	24	2	0	40	3.38	Undecided
7	6	11	19	3	1	40	3.45	Agree

Statement	5	4	3	2	1	Total	Wx	Description
8	10	14	15	1	0	40	3.83	Agree
9	14	19	6	1	0	40	4.15	Agree
10	7	11	21	0	1	40	3.58	Agree
11	10	14	15	1	0	40	3.83	Agree
Total	86	155	175	21	3	440	3.68	Agree

Table 3 shows the students' perception of the Mathematics teaching-learning process beyond four walls, text-messaging approach. It disclosed the students' viewpoint *before* they experienced the implementation of the text-messaging as an off-classroom Mathematics teaching-learning process.

The table shows the overall weighted mean of 3.68, which means that the students have a *positive conception* before its implementation. Indeed, they *strongly agreed* on the first statement, *"I willingly adopted the text-messaging as an off-classroom Mathematics teaching-learning process*." In addition, the table shows that there is no statement which the students disagreed. It further shows preliminary acceptance of the respondents in joining the teaching-learning mathematics beyond the four walls with the aid of Text messaging. These results coincide with Barreh, K. A.(2015), who mentioned that students find Text messaging in the teaching-learning process a good idea and a helpful tool in understanding their lessons. Incorporating this with their studies makes the student have a very positive perception and outlook in meeting their expectations with the lesson, making encouragements to enhance and learning even outside the school premises.

Table 4. Students' Attitude on Teaching-Learning Mathematics beyond Four-Walls, Text-Messaging Approach

Statements	5	4	3	2	1	Total	Wx	Description
1	7	21	8	4	0	40	3.78	Agree
2	10	21	7	2	0	40	3.98	Agree
3	4	13	17	6	0	40	3.38	Undecided
4	3	10	15	9	3	40	3.03	Undecided
5	11	9	15	3	2	40	3.60	Agree
6	5	17	14	3	1	40	3.55	Agree
7	6	13	15	6	0	40	3.48	Agree
8	9	15	13	3	0	40	3.75	Agree
9	13	18	9	0	0	40	4.10	Agree
10	5	12	12	10	1	40	3.25	Undecided
11	11	14	13	2	0	40	3.85	Agree
Total	84	163	138	48	7	440	3.61	Agree

Table 4 shows the students' attitude on Mathematics teaching-learning process beyond the four-walls, text-messaging approach. It disclosed the students' viewpoint *after* they experienced the implementation of the text-messaging as an off-classroom Mathematics teaching-learning process.

As shown in the table, the results show that most of the students agree and are amiable with the implementation of Text messaging in the mathematics teaching-learning process. The total weighted mean of 3.61 revealed that students still a *positive attitude* on Text messaging after its implementation as an off-classroom teaching-learning technique. The students did not negatively respond to any of the statements, but some were uncertain. These findings coincide with the study conducted by

Aunzo et al. (2016) entitled Classroom-Based Integration of Text-Messaging in Mathematics Teaching-Learning Process. The study also revealed that the student-respondents were also agreeable in terms of attitude with text-messaging in the mathematics teaching-learning process. These findings support the idea that the latest generation of undergraduates has grown up in a world of pervasive digital technology where widespread ownership of mobile devices has provided an infrastructure that these students rely on for building extensive social communication networks (Reid and Reid 2005).

Table 5. Difference between Perception and Attitude

Variable	Wx	Description	p-value	Computed Value	Tabular value	Remark
Perception	3.68	Agree	0.0021	16.76	9.488	Significant Difference
Attitude	3.61	Agree				

Table 5 shows the difference between the student's perception and the students' attitude on the implementation of Text messaging as an off-classroom Mathematics teaching-learning process. As shown in the table, the p-value of 0.0021 is less than the 5% alpha level. It leads to the rejection of our null hypothesis. It means that there is a significant difference between the student's perception and attitude towards the implementation of Text messaging in the teaching-learning process. It coincides with the computed value (16.76) greater than the tabular value (9.488).

It further implies that the students' rating on the utilization of Text messaging as an off-classroom Mathematics teaching-learning process has dropped from 3.68 to 3.61. This finding relates to a few student-respondents who narrated that they will feel nervous when my phone rings during the implementation. However, many students found the implementation fun because they experienced a unique teaching-learning process. These relate to the research conducted by Reid and Reid (2004), which stated that the students who primarily used Text and instant messaging for social purposes have the willingness to adapt for educational purposes.

Table 6. Effectiveness of Text-Messaging in Mathematics Teaching-Learning Process as Perceived by the Students

Statements	5	4	3	2	1	Total	Wx	Description
1	9	18	7	6	0	40	3.75	Agree
2	3	14	18	2	3	40	3.30	Undecided
3	14	20	5	1	0	40	4.18	Agree
4	12	17	10	1	0	40	4.00	Agree
Total	38	69	40	10	3	160	3.81	Agree

Table 6 shows the students' assessment on the effectiveness of the implementation of Text messaging as an off-classroom Mathematics teaching-learning process. As reflected in this table, the overall weighted average is 3.81. It shows that the students' have a positive stand on implementing text-messaging as an off-classroom Mathematics teaching-learning process. It implies that students rated the implementation as effective. It relates to McConatha and Praul (2008), who cited that students using mobile learning have demonstrated a better level of knowledge of the subject matter covered in the course when compared to students choosing not to use the tools. In this study, the students did not have any negative rating on the effectiveness of Text messaging. Instead, they had uncertainty on their response to the second statement, *"Text-messaging as an off-classroom Mathematics teaching-learning process was the best, easiest, and fastest learning technique of getting a response in learning."*

Table 7. Scores of Experimental Group

	Exercise #1		Exercise #2	
	Text Trivia	Actual Test	Text Trivia	Actual Test
Average	7.14	7.84	9.54	9.92
Std. Dev.	2.51	1.44	2.52	2.49

Table 7 shows the scores of the experimental group on the Text Trivias and the Actual Tests. Based on the table, it shows that the scores of the experimental group have increased from Text Trivia to Actual Test. It implies an improvement in the scores of the experimental group from the exercises given via Text messaging to the actual exam inside the classroom. Indeed, the standard deviation has decreased from Text Trivia scores to Actual Test. It shows that the student's scores in the Actual Test are less scattered than in Text Trivia and are much closer to the average score.

These findings further imply that lessons discussed via text message effectively impart knowledge to the students because the students were able to comprehend what the teacher sent. According to Lominé(2009), discussing the lesson via text message is also effective because students can text their teacher and seek advice.

Table 8. Variations of Text Trivia Scores and Actual Test (n = 37)

	Exercise 1		Exercise 2	
	f	%	f	%
The same	10	27.03	5	13.51
Increase	16	43.24	17	45.95
Decrease	11	29.73	15	40.54

Table 8 shows the variation of the Text Trivia and Actual Test scores of the experimental group. This table shows whether the scores of the experimental group increased, decreased, or remained the same from Text Trivia to the Actual Test. As reflected on the table, it showed that the majority of the scores increased on both exercises.

It means that their scores in the Actual Test are higher than their scores in the Text Trivia. In the first set of exercises, 43.24% of students have had an increased score from Text Trivia to Actual Test. Also, in the second set of exercises, 45.95% of the students had an increased score from Text Trivia to the Actual Test.

On the other hand, 29.73% (Exercise 1) and 40.54% (Exercise 2) of the students decreased from the Text Trivia to the Actual Test. These scores have an average decrease of 2.6 (Exercise 1) and 2.0 (Exercise 2) points. Additionally, 27.03% (Exercise 1) and 13.31% (Exercise 2) got identical Text Trivia and Actual Test scores. It means that the scores they get in the Text Trivia are the same score in the Actual Test. It means that their scores in the Actual Test are lower than the Text Trivia. These results support Lauderdale and Partin (2013), who cited the findings of their previous research that students have enjoyed incorporating mobile devices into classroom activities, and learning outcomes are increased as a result.

Table 9. Scores of Experimental Group in Exercise 1 and Exercise 2

		Average	Std. Dev.	p-value	Computed Value	Tabular Value	Remarks
Exercise 1	Text Trivia	7.14	2.51	0.1751	1.38	1.96	No significant difference
	Actual Test	7.84	1.44				
Exercise 2	Text Trivia	9.54	2.52	0.4893	0.7	1.96	No significant difference
	Actual Test	9.92	2.49				

Table 9 shows the experimental group's scores in Exercises 1 and 2. The table shows that the p-values 0.1751 (Exercise 1) and 0.4893 (Exercise 2) are greater than the 5% significance level. It leads to the acceptance of our null hypothesis. It means that there is no significant difference between their scores in Text Trivia and the Actual Test. It coincides with the computed values 1.38 (Exercise 1) and 0.70 (Exercise 2), which are less than the tabular value 1.96. It also leads to the acceptance of the null hypothesis. It supports the findings that the students are engaged in actual learning via text-messaging as an off-classroom Mathematics teaching-learning process. Indeed, several studies targeted disengaged youth and found that these devices helped build teacher-student relationships, which facilitated improved learner engagement (Ferry, 2009).

Table 10. Difference between the Scores of the Experimental (n = 37) and Controlled Groups (n = 34)

Activities	Groups	Average	Std. Dev.	p-value	Computed Value	Tabular Value	Remarks
Pre-Test	Controlled	10.38	2.86	0.78028967	0.28	1.96	No significant difference
	Experi-mental	10.19	2.94				
Exercise 1	Controlled	5.53	2.36	0.00000401	5.01	1.96	There is a significant difference.
	Experi-mental	7.84	1.44				
Exercise 2	Controlled	9.71	2.53	0.72170982	0.36	1.96	No significant difference
	Experi-mental	9.92	2.49				
Exercise 3	Controlled	10.82	2.97	0.66678423	0.43	1.96	No significant difference
	Experi-mental	11.08	1.99				
Long Quiz	Controlled	12.74	2.37	0.57425155	0.56	1.96	No significant difference
	Experi-mental	12.41	2.54				
Post-Test	Controlled	16.88	1.97	0.58444057	0.55	1.96	No significant difference
	Experi-mental	17.19	2.65				

Table 10 shows the differences between the experimental and controlled groups in all the activities undertaken in the lesson. The table shows that only in Exercise 1 where the scores of the groups differ significantly.

In the pre-test, the p-value 0.78028967 is greater than the 0.05 level of significance. It leads to the acceptance of our null hypothesis.

It also coincides with the computed value of 0.28 that less than the tabular value of 1.96. These show no significant difference between the scores of the controlled group and the experimental group. These imply that the students are set on equal footing before the start of the new lesson.

In exercise 1, the p-value of 0.00000401 is lesser than the 0.05 level of significance. It leads to the rejection of our null hypothesis. It implies a significant difference between the scores of the controlled group and the experimental group. It coincides with the computed value of 5.01 that is greater than the tabular value of 1.96. These findings imply that the experimental group performed better than the controlled groups in Exercise 1.

Moreover, the p-values in Exercises 2 (0.72170982), Exercise 3 (0.66678423), Long Quiz (0.57425155), and Post-Test (0.58444057) are greater than the 0.05 level of significance. They coincide with their computed values which are lesser than 1.96 tabular values. These lead to the rejection of the null hypothesis. It means that there is no significant difference between the scores of the controlled and experimental groups in the said activities. This further implies that these groups performed *just equally* in these examinations.

These findings relatively imply that text-messaging as an off-classroom Mathematics teaching-learning process is *effective*. It is revealed by the equality of the scores of the experimental group with the controlled group. Even though the experimental group did not undergo a formal discussion inside the classroom, they performed equally with the controlled group which the discussion was held formally inside the classroom. These relate to the study conducted by Thornton and Houser (2005), who found out that the Japanese students have significantly learned multiple vocabularies if they received vocabulary lessons through text messages via their mobile phones compared to students who received the same information in a paper format.

Table 11. Pretest and Post-test Scores of the Experimental and Controlled Group

Group	Test	Ave.	Std. Dev.	Paired-Sample Statistics						
				Ave.	Std. Dev.	df	p-value	Computed Value	Tabular Value	Remark
Cont.	Pre	10.38	2.81	13.63	2.6	33	5.92E-16	14.6	1.69	There is a Difference
	Post	16.88	1.94							
Exp.	Pre	10.19	2.9	13.69	3.24	36	2.65E-15	13.14	1.69	There is a Difference
	Post	17.19	2.62							

Table 11 shows the difference between the experimental and the controlled group's Pre-Test and Post Test scores. The table shows that the p-value 5.92E-16 (controlled) and 2.65E-15 (experimental) are lesser than the 0.05 level of significance. These lead to the rejection of the null hypothesis. It means that the post-test scores of the controlled and experimental groups are greater than the pre-test scores. It implies an improvement in the result from the pre-test to the post-test.

Table 12. Difference in the Proportion of Students who Passed in the Exam

Groups	n	Number of Students Passed	p-value	Computed Value	Tabular Value	Remarks
Experimental	37	32	0.5324	0.62	1.96	No significant difference
Controlled	34	31				

Table 12 shows the difference between the proportion of students who passed the exam (long quiz plus post-test) of the controlled and experimental groups. As shown in the table, the p-value of 0.5324 is greater than the 0.05 level of significance. It implies that the proportion of students who passed in the experimental group is the same as that of the controlled group. It leads to the acceptance of our null hypothesis.

Table 13. Difference between Midterm Grades

Group	Average	Std. Dev.	p-value	Computed Value	Tabular Value	Remarks
Controlled	2.43	0.46	0.813505	0.23625216	1.96	No significant difference
Experimental	2.46	0.51				

Table 13 shows the difference between the midterm grades of the controlled group and the experimental group. As shown in the table, the p-value of 0.813505 is greater than the 0.05 level of significance. It leads to the acceptance of our null hypothesis. It implies that the midterm grades between the two groups have are the same. These findings revealed equal footing of students at the end of the semester. It supports the reason why these groups are used as a sample in this study.

Conclusions

Based on the statistical analysis of the gathered data, it is concluded that the text-messaging approach in the teaching-learning of Mathematics beyond four walls is *effective* in the sense that even though there is no formal class encounter for lecture, the following was derived:

1. There is no significant difference between the post-test result of the controlled and experimental groups.
2. There is no significant difference between the proportion of students who passed the exam from the controlled and experimental groups.
3. There is a significant increase in the scores of the experimental group from the pre-test to the post-test.

In addition, the following significant findings were derived based on data analysis and interpretation:

1. The students rated the utilization of the text-messaging approach in the teaching-learning of Mathematics beyond four walls as *effective*.
2. The students have a *positive perception* and *positive attitude* towards utilizing the text-messaging approach in the teaching-learning of Mathematics beyond four walls. However, there is a significant difference in their rating before the implementation (3.68) and after the implementation (3.61). It means that there is a decreased level of agreement of the students after experiencing text-messaging in the teaching-learning process but still has remained a positive attitude.

Recommendations

Based on the findings and conclusions, the researcher provides the following recommendations.

1. A strategic plan has to be created before implementing the text-messaging approach in the teaching-learning of Mathematics beyond four walls.
2. A comprehensive timetable on sending the text concepts has to be developed with the students.
3. The scoring mechanics in the text trivia has to be discussed with the students.
4. The following has to be sent to the students in order for them to enhance their knowledge and understandability.
   a. Updates on exam schedules and results;
   b. Update class standing;
   c. Concepts that need to be explained thoroughly for students' comprehension;
   d. Enrichment items, especially those who performed low in the quiz and those who are shy during seatwork;
   e. Congratulatory remarks for those who scored high in exams and those who did excellent participation in the discussion;
   f. Follow-ups on projects that are not yet submitted;
   g. Updates on new topics;

Author Declaration

Author Contribution

The article was written by a single author, who read and approved the final published version of the article.

Data Availability Statement

Data sharing is not applicable as no new data were created and analyzed in the present study.

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