THE EFFECT OF MASTERY LEARNING STRATEGY ON STUDENTS' MATHEMATICS ACHIEVEMENT AT THE MIDDLE SCHOOL LEVEL

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Abstract

The main purpose of the study was to study the effect of mastery learning strategy on students' mathematics achievement at the middle school level. Mixed-method, QUAN-Qual model was used to investigate the effect of mastery learning strategy. For quantitative research method, an experimental study was carried out to compare the students' achievement between experimental and control group. The design used in the study was one of the true experimental designs, viz, posttest only control group design. The instrument used in the study was a posttest. Two sample schools, No. (4) BEHS Kamayut and No. (2) BEMS Yankin were selected by a simple random sampling method. The subjects were (60) Grade Eight students from each school. There were two experimental groups and two control groups. The students from experimental groups were taught by using mastery learning strategy and the students from control groups were taught by using formal instruction. After the treatment, the posttest was administered to two groups. The independent samples *t*-test was used to compare the differences between two groups. The results showed that there were significant differences between two groups in No. (4) BEHS Kamayut ($t = 3.02$, $p < .01$) and No. (2) BEMS Yankin ($t = 4.72$, $p < .001$). For qualitative research method, the students in the experimental groups from two selected schools were given a questionnaire. The questionnaire consists of 18 items. 15 items of these are coded with five-point Likert-scale and 3 items are open-ended questions. The results showed that the students had positive attitude towards learning, retention of learned materials and involvement in instructional activities. Thus mastery learning strategy had positively contributed to the improvement of mathematics teaching and learning at the middle school level.

Keywords: Mastery learning, Mastery Learning Strategy

Introduction

Changes always happen in everything, everywhere and every situation. Society's thinking changes from decade to decade, generation to generation and century to century. Education depends on society. Since society changes, the vision for education must change. So the teaching and learning also change. The vision of the people on education should be accommodated with society (Underhill, 1981).

In relation to the development of society's thinking in the 21st century, mathematics occupies a crucial and unique role in the human's societies and represents a strategic key in the development of the whole mankind (Fatima, n.d.).

At every level, learning mathematics should be a natural outgrowth from the children themselves. Learning should be interesting for the children, should challenge their imagination and should beget creative solutions. Learning mathematics should be devoid of boredom, meaninglessness and coercion (Cruikshank & Shieffield, 1988).

Bloom contended that mastery learning is the theory that suggests that virtually all students can attain high degree of learning if given the needed time and appropriate learning conditions and that if teachers could provide these appropriate conditions, all students could reach a high level of achievement and their differences in their level of achievement would vanish (Guskey, 2007).

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Statement of the Problem

Mathematics has been considered as a difficult subject matter by the students in school practically all levels from primary to higher education. Students who have low aptitude typically thought that mathematics was very difficult subject and they have been discouraged by the teachers who are unable to deliver the subject matter due to the lack of Mathematics (United Nations Educational Scientific and Cultural Organizations [UNESCO], 2012).

Mastery learning is an innovative method providing the opportunity to all students who are taking mathematics with plenty of time to understand any topic in mathematics course based on their ability and capacity to learn mathematics at their own pace within the realm of their levels. Thus the researcher believes that attaining mastery in respective subjects for students is one of the important factors to promote mathematics education in Myanmar.

Purposes of the Study

The main purpose is to study the effect of mastery learning strategy on students' mathematics achievement at the middle school level.

The specific purposes are as follows:

- To study the theoretical foundation of mastery learning strategy in teaching mathematics
- To investigate the effect of mastery learning strategy on students' mathematics achievement
- To investigate the students' attitude towards mastery learning strategy
- To give suggestions for improving mathematics teaching and learning at the middle school level

Research Hypotheses

- There is a significant difference between mathematics achievement of the students who are taught with mastery learning strategy and those who are not.
- There is a significant difference between mathematics achievement of the students who are taught with mastery learning strategy and those who are not in performing knowledge level questions.
- There is a significant difference between mathematics achievement of the students who are taught with mastery learning strategy and those who are not in performing comprehension level questions.
- There is a significant difference between mathematics achievement of the students who are taught with mastery learning strategy and those who are not in performing application level questions.
- The students who learned with mastery learning strategy have positive attitude towards learning, retention of learned materials and involvement in instructional activities.

Definitions of the Key Terms

Mastery learning: mastery learning is a group-based, teacher-paced approach to mastery instruction wherein students learn, for the most part, cooperatively with their classmates. (Block & Burns, 1976)

Mastery learning strategy: A formative assessment strategy that involves the use of specific interventions, called correctives to address the specific comprehension needs of the learner (Bloom, 1968).

Scope of the Study

The following points indicate the scope of the study.

- This study is geographically restricted to Yangon Region.
- Subjects in this study are (60) Grade (8) students from the selected schools within the school-year (2018-2019).
- This study is limited to the content areas of Chapter (10) Equations with Literal Coefficients, Chapter (11) Formulae and Change of Subject and Chapter (12) Formulae Points in Rectangular Co-ordinates from Grade (8) mathematics textbook Volume I and Chapter (5) Areas and Volumes from Grade (8) mathematics textbook Volume II prescribed by the Department of Educational and Planning and Training, Myanmar, 2013.

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Significance of the Study

Learning is the active process. It is not achieved in any single way but through a variety of activities and is approached through a variety of avenues. All of these activities need to involve thinking. These activities need to be so planned that they will bring the learners along the path toward understanding and mastery of the subject at their levels of achievement (Highet, 1965).

(1973) and Bloom (1974) proposed that learners with high ability learn quickly and learners with low ability learn slowly. This conceptualization of learning give rise to the concept of mastery learning instead of formal instruction. In formal instructional environments, time to learn was held constant and the levels of performance varied. In mastery learning, the situation is reversed. Performance is held constant and time to learn is allowed to vary. In mastery learning, the learners are compared on the basis of amount learned during a certain period of time. In other words, the goals are changing from achieving some specified objectives in a given time period, to achieving all the objectives in a varying time period (Underhill, 1981).

Theoretical Framework

Importance of Mathematics

Mathematics comprises different topical strands, such as algebra and geometry, but these strands are highly interconnected. The interconnections should be displayed prominently in the curriculum and in instructional materials and lessons. A coherent curriculum effectively organized and integrates importance mathematical ideas so that students can see how the ideas

build on, or connect with other ideas thus enabling them to develop new understandings and skills (National Council of Teachers of Mathematics [NCTM], 2000). To implement the curriculum effectively, the teachers use variation of teaching methods and variations of instructional activities to close the children's achievement gaps (Guskey, 2007).

Teaching mathematics well involves creating, enriching, maintaining and adapting instruction to move towards mathematical goals, capture and sustain interests and engage students in building mathematical understanding. Teachers establish and nurture an environment conducive to learning mathematics through the decisions they make, the conversation they orchestrate, make the physical setting they create. In effective teaching, worthwhile mathematical tasks are used to introduce important mathematical ideas and to engage and challenge the students intellectually. Effective teaching involves observing students, listing carefully to their ideas and explanations, having mathematical goals and using the information to make instructional decisions. To improve their mathematics instruction, teachers must be able to analyze what they and their students are doing and consider how those actions are affecting students' learning (NCTM, 2000). Thus Bloom (Guskey, 2010) suggested that although students vary widely in their learning rates if teachers provide the necessary time and appropriate learning conditions, nearly all students could reach a high level of achievement.

Mastery learning

The theory of mastery learning is based on the belief that all students can learn when provided with conditions that are appropriate for their learning.

Steps in Mastery Learning

Bloom has suggested that the steps for effective mastery learning.

1. Defining the Mastery

The teacher should first define what materials students will be expected to learn or what is meant by mastery of the subject. They are also explained the concepts involved, the processes to be followed and adopted, the skills to be employed and the amount of time to be taken for the mastery of a particular content area. The teacher also prepares a summative test by covering all objectives and decides the standard. Suppose a teacher decides that scoring at least 80% to 90% in the examination would indicate mastery of the standard would be regarded as 'masters' and those who do not would be regarded as 'non-masters' (Block, 1971; Block & Burns, 1976).

2. Planning for mastery

Planning must be consistent with the way in which mastery has been defined. Especially the plan must include activities, materials related to the unit objectives and also include additional supplementary activities and materials for those students who fail to attain the performance standard on the unit formative test (Block, 1971; Block & Burns, 1976).

Planning for mastery involve following tasks;

i. The teacher divides the course to be taught for mastery into a series of smaller sequence learning units, each of which cover in two weeks time.

ii. For each unit, teacher constructs a formative test or a brief diagnostic progress test. These tests are designed to provide specific information of feedback to both the

teacher and the student about how the student is changing as a result of group-based instruction.

iii. Then the teacher specifies a score or performance standard on each formative test, which will be indicative of unit mastery. Generally a score of 80-90% indicated mastery.

If the instruction material is not followed, the teacher develops a set of alternative instructional material or correctives for each unit to master the content, and to overcome the learning problems before proceeding to the next step or subsequent learning (Block, 1971; Block & Burns, 1976).

3. Orienting for Mastery

After planning for mastery, the teacher is now ready to teach. But the students are not accustomed to mastery learning. So before the teacher starts teaching for mastery. It is essential that the teacher should explain to the students what they are going to learn, how they are going to learn, what should be the outcome for learning and what standard of attainment is expected of them. This will provide the necessary orientation and motivation to the students for learning (Block, 1971).

4. Teaching for Mastery

After proper orientation and motivation the teacher teaches the 1st learning unit using the group based teaching methods. After teaching one unit of the lesson, the teacher administers the unit's formative test to the entire class. On the basis of the test scores, the teacher identifies those who have achieved the unit mastery standard and those who have not. For non-master the teacher follows the alternative instructional material and corrective formative test till the achievement of mastery. The masters are engaged either in enrichment activities or serve as tutor for non-masters. This procedure continues till the completion of all the units (Block, 1971; Block & Burns, 1976).

5. Grading for Mastery

The final step and major task is grading for mastery. After teaching all the units, the teacher administers the summative evaluation test and awards grades. The teacher awards 'A' grade whose scores are at or above the predetermined mastery performance standard and scores below this level are awarded grades appropriate to the level they have achieved (Block, 1971).

Evaluation of Mastery Learning

An effective mastery learning requires two types of evaluation.

(1) Formative evaluation

Formative evaluation is used to provide information useful for directing students study and teacher practice. Formative tests have two purposes.

(a) To find out how much the pupils have learned in a restricted area of content at the end of a unit of instruction.

(b) To diagnose pupils difficulties.

(2) Summative evaluation

Achievement test at the end of periods of instructions are summative test and its attempt to sum-up total achievement in a course. In mastery learning, the primary purpose of summative evaluation is to grade students according to their achievement of the aims of the course or the criteria (Block, 1971).

Mastery Learning Instructional Process

Through this process of formative classroom assessment combined with the systematic correction of individual learning difficulties, Bloom (Guskey, 1987, 2005) believed that all students could be provided with a more appropriate quality of instruction than the traditional instruction. As a result, nearly all learn well and truly master the unit concepts or learning goals. This also drastically reduce the variation in achievement levels and eliminate the achievement gaps.

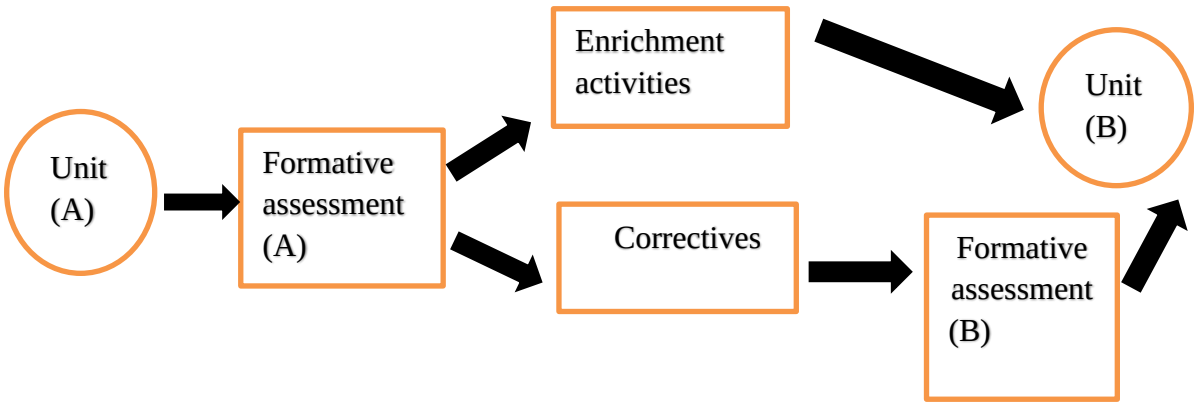

Figure 2.2 Mastery Learning Instructional Process (Guskey, 1987).

Unit A: Mastery learning starts teaching by asking the previous knowledge of the students. Mastery learning stresses the importance of administering a quick and targeted pre-assessment to all students before beginning instruction to determine whether they have the perquisite knowledge and skills for success in the upcoming learning sequences. Some teachers pre-assess students orally by asking them about previous learning experiences or understanding. Pre-assessing makes the teacher to ensure the conditions for success before the instruction begins (Guskey, 2010).

Formative assessment (A): The use of regular formative assessments systematically monitor student progress and give students prescriptive feedback. These brief classroom assessments measure the most important learning goals from the instructional unit and typically are administered after a week or two of the instruction. They reinforce precisely what the students were expected to learn, identify what they learned well and describe what they need to learn better.

Formative assessments vary in form depending on the subject area, the grade level and the learning outcomes involved. They may be short quizzes, written assignments oral presentations, skill demonstration or performances. The important feature of formative assessments are that the teachers use them to gather evidence of students learning. Formative assessments provide the basis for all programs that emphasize assessment "for" learning as opposed to assessment "of" learning (Guskey, 2010).

Corrective instruction: After the formative assessment (A), corrective instruction was followed to remedy whatever learning problems the assessment identified. Corrective instruction is not the same as reteaching. Mastery learning teachers use corrective instruction that accommodate differences in students' learning styles, learning modalities or types of intelligence. Corrective instruction can also be used as peer tutoring or cooperative learning groups. Corrective instruction might last one or two days. Corrective instruction guarantees that students have the learning perquisites for subsequent units, initial instruction in later units can proceed more rapidly (Guskey, 2010).

Formative assessment (B): In mastery learning, assessment is an ongoing effort to help the students learn. So after corrective instruction, mastery learning teachers give students a second, parallel formative assessment that helps to determine the effectiveness of the corrective instruction and offers students a second chance to demonstrate mastery and experience success. Mastery learning teachers make a point of recognizing those who do well on the second formative assessment have learned just as much and deserve the same grades as those who scored well on the first try (Guskey, 2010).

Enrichment activities: Mastery learning teachers offer effective enrichment activities that provide valuable, challenging and rewarding learning experiences for learners who have mastered the material and do not need corrective instruction. These activities should enable successful learners to explore in greater depth a range of related topics that keenly interest them but lie beyond the established curriculum. Many teachers draw from activities developed for gifted or talented students when planning enrichment activities including academic games and peer tutoring.

Students engaged in enrichment activities gain valuable learning experiences without necessarily moving ahead in the instructional sequence. This makes it easier for other students who have been doing corrective work to resume their place in the regular instructional sequence when they are done (Guskey, 2010).

Unit B: Unit B means the next lesson or the next topic. If the students achieve 80% and above for Unit A in summative evaluation test, the teacher continues to Unit B.

Research Methodology

Research Design

The design used in this study was one of the true experimental design, viz, posttest only control group design.

Procedure for the Study

This study was to investigate the effect of mastery learning strategy on Grade Eight students' achievement in mathematics in Yangon Region. Students were divided into two groups in each school; the experimental and control groups by using simple random sampling method.

There were (30) students in each group. In each school, the control group was provided a treatment by using formal instruction and the experimental group was provided by using mastery learning strategy. The posttest was administered at the end of the treatment period. All the participants have to take a posttest.

Instruments

The instrument used for this study was the posttest and attitude questionnaire. To examine the students' attitude towards learning, retention of learned materials and involvement in instructional activities, a questionnaire was constructed. It consists of (18) items. (15) items of these are coded with five-point Likert-scale and (3) items are open-ended questions. The statements of the (15) items were described by five responses: strongly disagreed, disagreed, undecided, agreed and strongly agreed. Arbitrary scoring weight (1,2,3,4,5) was assigned for the responses. Moreover, the participants were allowed to express their attitude freely towards mastery learning strategy through three open-ended questions.

Population and Sample Size

This study was geographically restricted to Yangon Region. The required sample schools were selected by using simple random sampling method. The sample schools were BEHS (4) Kamayut and BEMS (2) Yankin. BEHS (4) Kamayut was selected from West District in Yangon Region and BEMS (2) Yankin was selected from East District in Yangon Region. The population in this study was (105) students in Grade Eight at BEHS (4) Kamayut and (69) students in Grade Eight at BEMS (2) Yankin. Only (60) students from each school were selected by using a simple random sampling method.

Data Analysis

The data were analyzed by using the Statistical Package for the Social Science (SPSS) with descriptive statistics, mean and standard deviation.

Research Findings

Quantitative Research Findings

For quantitative research findings, the data were recorded systematically. These data were analyzed by using the independent samples t-test to compare the differences between the experimental and the control groups (Gay & Airasian, 2003).

Table 1 *t*-Values for Posttest Mathematics Achievement Scores

School	Group	N	Mean	SD	MD	*t*	*df*	Sig. (2-tailed)
BEHS(4) Kamayut	Experimental	30	34.87	9.10	6.2	3.02	58	.004**
	Control	30	28.67	6.64				
BEMS (2)Yankin	Experimental	30	35.50	9.67	9.53	4.72	58	.000***
	Control	30	25.97	6.58				

Note: $^{**}p < .01$ $^{***}p < .001$

The means of the experimental group were significantly higher than that of the control group in each school. It showed that there was a significant difference between students who were taught by using mastery learning strategy and those who were taught as formal on the overall scores of mathematics achievement in both selected schools.

Table 2 t-Values for Scores on Knowledge Level Questions

School	Group	N	Mean	SD	MD	*t*	*df*	Sig. (2-tailed)
BEHS(4) Kamayut	Experimental	30	1.70	.70	0.13	.75	58	.458 (ns)
	Control	30	1.57	.68				
BEMS (2)Yankin	Experimental	30	1.83	.86	0.26	1.42	58	.716 (ns)
	Control	30	1.57	.77				

Note: ns = not significant

Results of knowledge level questions showed that the means of the experimental groups were not significantly higher than that of the control groups in both selected schools. It showed that there was no significant difference between the experimental and the control groups for the scores on knowledge level questions in both selected schools.

Table 3 *t*-Values for Scores on Comprehension Level Questions

School	Group	N	Mean	SD	MD	*t*	*df*	Sig. (2-tailed)
BEHS(4) Kamayut	Experimental	30	14.77	4.15	4.44	3.20	58	.000***
	Control	30	10.33	2.83				
BEMS (2)Yankin	Experimental	30	15.43	4.10	4.70	4.36	58	.000***
	Control	30	10.73	4.24				

Note: ***p < .001

According to the scores on comprehension level questions, the means of the experimental groups were significantly higher than that of the control groups in both selected schools. It showed that there was a significant difference between the experimental and the control groups for the scores on the comprehension level questions in both selected schools.

Table 4 *t*-Values for Scores on Application Level Questions

School	Group	N	Mean	SD	MD	*t*	*df*	Sig. (2-tailed)
BEHS(4) Kamayut	Experimental	30	18.67	6.53	4.90	3.27	58	.002**
	Control	30	13.77	4.97				
BEMS (2)Yankin	Experimental	30	18.60	7.06	5.93	3.96	58	.000***
	Control	30	12.67	4.19				

Note: ***p* < .01 ****p* < .001

As regards with the scores on the application level questions, the means of the experimental groups were significantly higher than that of the control groups in both selected schools. It showed that there was a significant difference between the experimental and the control groups for the scores on application level questions in both selected schools.

Qualitative Research Findings

The attitude, feelings, experiences and opinions of students that were found in the study were presented in this part. A qualitative study was carried out with a questionnaire. It consists of (15) items in (3) dimensions; attitude towards learning, retention of learned materials and involvement in instructional activities and (3) open-ended questions. (15) items are coded with

five-point Likert-scale. For (15) items, the percentages of students' positive and do not have positive attitude towards each dimension are as follows.

Table 5 Percentages of Students' Attitude towards Each Dimension

No.	Dimension	Positive Attitude (%)	Do not have Positive Attitude (%)
1.	Attitude towards Learning	93%	7%
2.	Retention of Learned Materials	94%	6%
3.	Involvement in Instructional Activities	94%	6%

According to the above results, most of the students have positive attitude towards each dimension. But some of the students do not have positive attitude. This is because they have no experience in solving problems in this new way. They have no confidence to solve the problems themselves and so they don't fully understand the concepts in mathematics. And they've never seen this type of teaching. They always solve the problems by following the teacher's instruction. In new strategy, they solve the problems themselves so they can't learn well the problems. Moreover, they have no experience in learning by doing activities to solve the problems and to derive the formulae. They thought that learning by doing is time-consuming. They are solely interested to solve the problems with teacher's help.

Discussion, Suggestions, Conclusion

Discussion

In quantitative study, the posttest was administered after the treatment period. When the posttest means are compared, the results showed that the means of the experimental group were significantly higher than that of control group in each school. Thus teaching with mastery learning strategy has significant effect on students' mathematics achievement when compared with formal instruction.

According to the comparison of means on knowledge level questions in two selected schools, the results pointed out that there is no significance between the control groups and the experimental groups. It can be said that the students can learn well knowledge level questions when the teacher uses either mastery learning strategy or formal instruction. It can be concluded that formal instruction is effective to some extent in mathematics teaching and helps the students to achieve lower cognitive skills.

When the means of comprehension level questions are compared, the results showed that there were significant difference between the two groups. This results claimed that the achievement of students who are taught with mastery learning strategy was higher than the achievement of students who are taught with formal instruction.

Moreover, when the means of application level questions are compared, the results showed that there were significant difference between the two groups. The results contended that the students in experimental group show their ability in solving problems by using previous learned materials in new situations.

In qualitative study, the questionnaire was administered for the students in experimental groups. The questionnaire included three dimensions. The students explore their opinions for each dimension openly.

For dimension 1 - attitude towards learning, most of the students showed that they have positive attitude towards mastery learning strategy. They can solve the problems more easily and using various methods according to their background knowledge.

For dimension 2 – retention of learned materials, most of the students positively responded the questions. They can use their own ideas and their classmates' ideas to solve problems. They have sufficient time to learn and they receive immediate feedback for their learning.

For dimension 3 – involvement in instructional activities, it can be found that most of the students revealed that they have positive attitude towards involvement in instructional activities. This is because they can solve the problems cooperatively with their classmates rather than solving the problems by following the instruction of the teacher.

For (3) open-ended questions, the students responded that they feel happy in learning mathematics more and more with this new strategy. They revealed that the relationship between the teachers and the students are better than previous teaching and so they learn mathematics more easily. This is because they can ask the teacher when they have difficulty in solving problems. They are more interesting new learning strategy because their role changed from passive learners to active learners. They participate in learning activities and can solve the problems themselves. Thus they contended that learning mathematics with mastery learning strategy is really effective.

Suggestions

In this study, the researcher studied the effect of mastery learning strategy by using quantitative and qualitative methods. According to quantitative results, the students' achievements are not varied at the knowledge level questions but are varied at the comprehension and application level questions. This is because new learning strategy is more effective than formal instruction. These results suggested that mathematics teaching should not solely emphasize on getting solution but it should focus on the general mental operations or problem solving process that can be used and applied to any problems. Thus the teachers should try to promote their teaching strategies. They should teach the mathematics concepts by doing activities. They should train the students to be able to solve the problems themselves. The role of the teachers should be as a facilitator and be always dynamic.

According to the qualitative results, most of the students showed that they have positive attitude towards new learning strategy. They are more likely to solve the problems as a group activity. Thus the teachers should provide opportunities for the students to work together in a group. It is clear that working together in a small group is essential to improve the achievement of the students. The teachers should adopt the various methods of teaching to promote the students' attitude towards mathematics and should create positive learning environment for their students' learning. Classroom climate is related to some extent in the achievement of the students. The learning environment should be designed to promote students' thinking skills. The teachers should create the learning environment where the students can apply their own knowledge to solve the problems. So that the students can become independent learners.

Conclusion

The main purpose of the study is to study the effect of mastery learning strategy on students' mathematics achievement at the middle school level. Both quantitative and qualitative studies were conducted to obtain the required data. For the quantitative study, one of the true experimental design, viz., posttest only control group design was adopted to compare the students' mathematics achievement between two groups: control group and experimental group. For qualitative study, a questionnaire was used to interpret the students' attitude towards learning, retention of learned materials and involvement in instructional activities.

In each school, students were randomly divided into two groups. The experimental group was given the treatment by using mastery learning strategy and the control group was treated by formal instruction.

In experimental group, the students were taught with small groups. The instructional process begins to learn a unit by adopting appropriate teaching methods. After teaching each unit, students' performance is assessed by giving an assessment in order to provide information or feedback on their learning. Students must exhibit and achieve mastery one unit before moving on next unit. Students who fail to achieve mastery are subjected to receive remediation through additional activities like peer tutoring, learner-centered activities or additional assignments. The students who are mastered the first assignment are provided with enrichment activities. And then all the students are administered a summative evaluation test. Sufficient time for learning is provided for these students. Students continued the cycle of studying and testing until mastery is achieved and then move to the next unit.

In control group, the students were taught learning materials under the whole class instruction. The students solve the problems under the control of the teacher. And the students follow the teachers' instruction. They rely on the information provided by the teacher to solve the problems.

Conclusion can be drawn on the basis of the results of research findings. In terms of the statistical results, students' performance between control and experimental groups had significant difference on overall mathematics achievement, comprehension level questions and application level questions. All the students showed that they have positive attitude towards mastery learning strategy.

Today, modern society demands high quality teaching and learning from teachers. Teachers have to possess a great deal of knowledge and skills with regard to both teaching and assignment practice in order to meet those demands and standards of quality education. Teaching with high quality teaching tend to do and find out more about their own craft, pushing out the boundaries of their learning and teaching, looking for the new topics and ways teach.

Mastery learning provides the teachers a strong sense of personal responsibility for students' learning. Students do not compete against each other but rather work together to attain a shared goal. Thus, the teachers help the students to reach high standard of learning. The students in mastery learning classes are able to learn abstract ideas related to particular subjects, they can apply these ideas to new problems and they retain these ideas longer. Thus the drop-out rate among students has been cut off in learning with mastery learning strategy (Guskey, 1985).

It can be concluded that teaching by mastery learning strategy has positively contributed to the improvement of mathematics teaching and learning at the middle school level. Thus using mastery learning strategy in the classroom will promote the students' achievement, participation in learning activities and develop problem solving skills. Thus the research on mastery learning strategies supports both quantitative and qualitative effects on mathematics teaching and learning. And attaining mastery in respective subjects for students is one of the important factors to promote mathematics education in Myanmar.

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References

Block, J.H. (1971). *Mastery learning*, Holt, Rinehart and Winston, New York.

Block, J.H. & Burns, R.B. (1976). *Mastery learning*. Retrieved Aug 28, 2018 from, https://journals.sagepub.com/ doi/abs/ 10.3102/0091732X004001003?journalCode- rrea

Crucikshank, D.E. & Sheffield, L.J. (1988). *Teaching mathematics to elementary school children: A foundation for the future.* London: MEEEILL PUBLISHING COMPANY

Fatima, R. (n.d.). *Role of mathematics in the development of society*. Retrieved September 30, 2018 from, http://www.ncert.nic.in/pdf_files/finalarticlerole%20of%20mathematics%20in%0the%20%developme nt%20ofsociety-ncer-pdf

Gay, L.R., & Airasian, P. (2003). *Educational research: Competencies for analysis and application* (7th ed.). New Jersey: Pearson Education.

Guskey, T.R. (1985). Bloom's mastery learning: A legacy for effectiveness. *Educational Horizons, 63*(2), 90-92. Retrieved July 26, 2018 from, https://www.jstor.org/stable/42926963

Guskey, T.R. (1987). The essential elements of mastery learning. *The Journal of ClassroomInteraction, 22*(2), 19-22. Retrieved July 26, 2018 from, https://www.jstor.org/stable/23869735

Guskey, T.R. (2005). *Formative classroom assessment and Benjamin S.Bloom: Theory, research and implications*. Retrieved July 14, 2018 from, https://eric.ed.gov/?id=ED490412

Guskey, T.R. (2007).*Closing achievement gaps: Revisiting Benjamin S. Bloom's learning for mastery*. Retrieved Aug 28, 2018 from, https://tguskey.com/wp.content/uploads

Guskey, T.R. (2010). *Lessons of mastery learning*. Retrieved June 11, 2018 from,www.ascd.org/publications/ educational-leadership/oct-10/vol68/num02/lessons-of-Mastery-learning-aspx

Highet, G. (1965). *The act of teaching* (4th ed.). London: METHUEN & CO LTD.

National Council of Teachers of Mathematics (NCTM), (2000). *Principles and standards for school mathematics*. Retrieved December 21, 2017 from https://www.fayar.net/east/teacher.web/Math/ Standards/ document/chapter2/htm

Underhill, B. (1981). *Teaching elementary school mathematics* (3rd ed.). London: Merrill.

United Nations Educational Scientific and Cultural Organization (UNESCO). (2012). *Challenges in basic mathematics education.* Retrieved July 7, 2018 from, http://unesdoc.unesco.org/images/0019/ 001917/191776e.pdf

Appendix (A)
Achievement Test
၂၀၁၈–၂၀၁၉ ပညာသင်နှစ်

သတမတန်း **သချိာ** **ခွင့်ပြုချိန် (၁း၃၀) နာရီ**

အပိုင်း (က)

၁. အောက်ပါတို့အနက်မှ အဖြေမှန်ကိုရွေးပါ။ **(၁၀) မှတ်**

(၁) အောက်ပါညီမျှခြင်းများမှ အကွာရာမြောက်ဖော်ကိန်းပါ ညီမျှခြင်းမှာ

A. $ax + bx = abc$ B. $3x + 4 = 5$ C. $\frac{2x}{3} + \frac{3y}{4} = 9$ D. $\frac{y}{4} = 3$ ဖြစ်သည်။

(2) $v = \frac{4}{3}\pi r^3$ ပုံသေနည်းမှ π ကိုရှာရန် ပုံသေနည်းမှာ

A. $\frac{3r}{\pi}$ B. $\frac{4v}{3r^3}$ C. $\frac{4r^3}{3v}$ D. $\frac{3v}{4r^3}$ ဖြစ်သည်။

(၃) လျှပ်စစ်ဓာတ်အား သုံးစွဲသည့်အခါ ပေးဆောင်ရမည့်ငွေသည်မီတာထိန်းသိမ်းစောင့်ရှောက်ခ အတွက် ၁၀၀၀ ကျပ်နှင့် ဓာတ်အားခအတွက် တစ်ယနစ် ၅၀ ကျပ်နှုန်းဖြစ်သည်။ လျှပ်စစ် ဓာတ်းအားခ ထ ယူနစ်သုံးစွဲသည့်အတွက် ပေးဆောင်ရမည့် ငွေ၊ ကျပ်ကိုရှာရန်ပုံသေနည်းမှာ

A. $k = 1000x + 50$ B. $k = 50x + 1000$ C. $k = 1000 - 50x$ D. $k = 50x - 1000$ ဖြစ်သည်။

(၄) ဌ ဝင်ရိုးနှင့် ့ ဝင်ရး ထောင့်မှန်ကျသော အမှတ်သည်

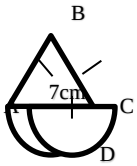
A. ပေးရင်းအမှတ် B. မူလအမှတ် C. စမှတ် D. ဆုံးမှတ် ဖြစ်သည်။

(၅) အောက်ပါတို့အနက်မှ စက်ဝန်းရှာသောပုံသေနည်းမှာ ခ =

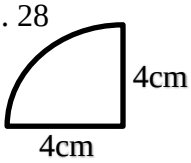
A. $2\pi r$ B. $2\pi r^2$ C. $\frac{4}{3}\pi r^2$ D. $2\pi r^2 h$ ဖြစ်သည်။

(၆) ပုံတွင် ΔABC သည် သုံးနားညီတြိဂံဖြစ်၍ ADC သည်စက်ဝိုင်းခြမ်းတစ်ခုဖြစ်သည်။ ပေးထားသောပုံ၏ ပတ်လည် အနားမှာ

A. 14 B. 25 C. 28 D. 36 cm ဖြစ်သည်။



(၇) ပုံပါစက်ဝိုင်းစိတ်၏ ဧရိယာမှာ



A. 15.24 cm^2 B. 14.7 cm^2 C. 12.56 cm^2 D. 11.22 cm^2 ဖြစ်သည်။

(၈) ထုလုံးရှည်မှန်တစ်ခု၏ မျက်နှာပြင်ခုံး ဧရိယာမှာ A =

A. $\pi r^2 h$ B. $\frac{1}{2}\pi r^2 h$ C. πdh D. $\pi r^2 h^2$ ဖြစ်သည်။

(၉) ထုလုံးရှည်တစ်ခု၏ အချင်းဝက်မှာ ၄ခာ ရှိ၍ အမြင့် ၁၄ခာ ရှိသော် ၄င်း၏ ထုထည်မှာ

A. 704 B. 352 C. 1408 D. 88 cm^3 ဖြစ်သည်။

(၁၀) ဥသုံညီဗဟုဂံ၏ ဧရိယာကို ရှာသော ပုံသေနည်းမှာ A =

A. $\frac{1}{2}bp$ B. $\frac{1}{2}hp$ C. $\frac{1}{2}bh$ D. $\frac{1}{4}bh$ ဖြစ်သည်။

အပိုင်း (ခ)

၂။ မေးခွန်းအားလုံးဖြေဆိုပါ။ **(၁၅) မှတ်**

(၁) မော်တော်တစ်စင်းသည် ခရီးတစ်ခုကိုသွားရာ ရေဆန်ဖြစ်၍ တစ်နာရီလျှင် d မိုင်နှုန်းသာ သွားနိုင်၏။ အပြန် ရေစုန်ခရီးတွင်မူ တစ်နာရီ f မိုင်နှုန်းသွားနိုင်သဖြင့် အသွားအပြန် အချိန်နှစ်ရပ်ပေါင်း h နာရီဖြစ်သော် ခရီးမိုင်ပေါင်းကိုရှာပါ။

(2) $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ ပုံသေနည်းကို လ ပဓာနကိန်းရှိသောပုံသေနည်းသို့ ပြောင်းပါ။

(၃) အောက်ပါအမှတ်များသည် မည်သည့်လေးပိုင်းစိတ်အတွင်းတွင်ရှိသနည်း။

A(1,3), B(-6,-1), C(2,-2)

(၄) စက်ဝိုင်းတစ်ခုတွင် စက်ဝန်းပိုင်းတစ်ခုက ဗဟိုဌာနဝဲထောင့် 90° ဖြစ်၍ စက်ဝိုင်း အချင်းဝက်သည် 3 ½ cm ဖြစ်လျှင် ထိုစက်ဝန်းပိုင်း၏ အလျားကိုရှာပါ။

(၅) ဓာတ်ဆီထည့်သော ကန်တစ်ကန်သည် ဆလင်ဒါပုံဖြစ်၍ အချင်း 14cm နှင့် အမြင့် 5cm ဖြစ်လျှင် မျက်နှာပြင်ဧရိယာနှင့် ထိပ်ဝဧရိယာတို့ကိုရှာပါ။

အပိုင်း (ဂ)

မေးခွန်းအားလုံးဖြေဆိုပါ။ (၂၅) မှတ်

၃။ လူတစ်ယောက်သည် သူ၏သားထက် n နှစ်ပို၍ကြီး၏။ လွန်ခဲ့သော m နှစ်က အဖ၏ အသက်သည် သားအသက်၏ p ဆဖြစ်လျှင် သားအဖနှစ်ယောက်၏ ယခုအသက် အသီးသီး ကိုရှာပါ။

၄။ အနားအရေအတွက် n ရှိသော ဗဟုဂံ၏ အတွင်းထောင့်ပေါင်းလဒ် R သည် (2n-4) ထောင့်မှန်နှင့်ညီမျှ၏။

(a) n ကိုရှာရန်ပုံသေနည်းသို့ပြောင်းပါ။

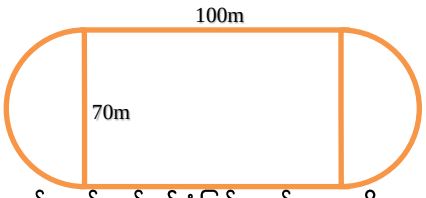
(b) R = 10 ဖြစ်လျှင် n မည်မျှနည်း။

(c) n = 20 ဖြစ်လျှင် R မည်မျှနည်း။

၅။ အောက်ပါအမှတ်များကို နေရာချပေးပါ။

(0, 3), (-6,-1), (2,-2),(0,0), (-2,2)

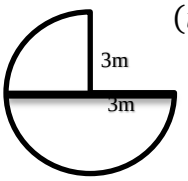
6.



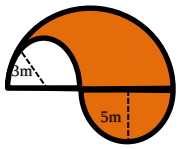
ပုံသည် ဘောလုံးကွင်းတစ်ကွင်း၏ပုံဖြစ်သည်။ ဂိုးနောက်ပိုင်းသည် စက်ဝိုင်းခြမ်းပုံဖြစ်သည်။ အကယ်၍ ထောင့်မှန်စတုဂံပုံ ဘောလုံးကွင်းသည် အလျား 100m ၊ အနံ 70m ဖြစ်လျှင် စက်ဝိုင်းခြမ်းများအပါအဝင် ကွင်း၏ ပတ်လည်အနားသည် မည်မျှဖြစ်သနည်း။

7. အောက်ပါပုံများ၏ ဧရိယာကိုရှာပါ။

(*i*)



(*ii*)



Appendix (B)

Attitude Questionnaires

Mastery Learning Strategy သင်နည်းနှင့် ပတ်သက်သော သဘောထားစစ်ဆေးလွှာ

အောက်ပါတို့ကို ဖတ်ရှု၍ သင်နှင့်ကိုက်ညီမည့် သင့်လျော်ရာနံပါတ်ကို ဝိုင်းပါ။

၁ = အလွန်သဘောမတူပါ။ ၂ = သဘောမတူပါ။ ၃ = မသေချာပါ။

၄ = သဘောတူပါသည်။ ၅ = အလွန်သဘောတူပါသည်။

စဉ်	အကြောင်းအရာ **သင်ယူခြင်းနှင့်ပတ်သက်သော သဘောထား**					
(၁)	ယခုသင်ယူခဲ့ရသော နည်းသစ်ဖြင့် သန်ါဘာသာရပ်ကို သင်ယူရခြင်းကို နှစ်သက်ပါသည်။	၁	၂	၃	၄	၅
(၂)	ဤနည်းဖြင့် သန်ါဘာသာရပ်ကို သင်ယူရာတွင် သန်ါ ပုစ္ဆာများ ဖြေရှင်းရာ၌ မိမိကိုယ်ကိုယ် ယုံကြည်မှု ပိုရှိလာပါသည်။	၁	၂	၃	၄	၅
(၃)	ဤနည်းဖြင့် သန်ါသင်ယူရာတွင် မိမိ၏ကိုယ်ပိုင်အယူအဆ များကို ဖော်ထုတ်ခွင့်ရှိသည် ဟုထင်မြင်မိပါသည်။	၁	၂	၃	၄	၅
(၄)	ဤနည်းဖြင့် သန်ါဘာသာ သင်ယရာတွင် သင်ခန်းစာပါ အကြောင်းအရာများကို အပြည့်အဝနားလည်သောကြောင့် သန်ါဘာသာရပ်ကို ပိုမိုကြိုက်နှစ်သက်ပါသည်။	၁	၂	၃	၄	၅
(၅)	ဤနည်းဖြင့် သင်ယူရာတွင် ရရှိလာသော ဗဟုသုတများကို လက်တွေ့ ဘဝတွင်လည်း ပြန်လည်အသုံးချနိုင်သောကြောင့် သန်ါဘာသာရပ်ကို ဆက်လက်လေ့လာလိုသော ဆန္ဒများ ပေါ်ပေါက်လာပါသည်။	၁	၂	၃	၄	၅
	သင်ယူခဲ့ပြီးသော အကြောင်းအရာများကို ကြာရှည်စွာ မှတ်မိခြင်း					
(၆)	ဤနည်းဖြင့် သန်ါဘာသာရပ်ကိုသင်ယူရာတွင်သင်ခန်းစာပါ အကြောင်းအရာများကို ကြာရှည်စွာ မှတ်မိပါသည်။	၁	၂	၃	၄	၅
(၇)	ဤနည်းဖြင့်သန်ါဘာသာရပ်ကိုသင်ယူရာတွင်သိထားပြီးသော အသိများကို အခြေခံသောကြောင့် အကြောင်းအရာအသစ်များကို ပိုမိုစွဲမြဲစွာ မှတ်မိပါသည်။	၁	၂	၃	၄	၅
(၈)	သင်ခန်းစာပါအကြောင်းအရာများကို ကိုယ်တိုင်လက်တွေ့ လုပ်ဆောင် ကာ သင်ယူရသောကြောင့် ထိုအကြောင်းအရာ များကို ပိုမို မှတ်မိလာ ပါသည်။	၁	၂	၃	၄	၅
(၉)	သန်ါပုစ္ဆာများဖြေရှင်းရာတွင် နည်းအမျိုးမျိုးကိုအသုံးပြု၍ ဖြေရှင်းရသောကြောင့် သန်ါပုစ္ဆာများကို လွယ်ကူစွာ မမေ့တော့ပါ။	၁	၂	၃	၄	၅
(၁၀)	ဤနည်းဖြင့် သင်ယူရသောကြောင့် စာမေးပွဲများတွင် သန်ါဘာသာရပ် ကို ကောင်းစွာဖြေဆိုနိုင်ပါသည်။	၁	၂	၃	၄	၅
	သင်ယူမှုလုပ်ငန်းများတွင် ပါဝင်ဆောင်ရွက်ခြင်း					
(၁၁)	ဤနည်းဖြင့် သန်ါဘာသာရပ်ကို သင်ယူရာတွင်သင်ယူမှု လုပ်ငန်း များတွင် ကျောင်းသားများတက်ကြွစွာပါဝင်ရပါသည်။	၁	၂	၃	၄	၅
(၁၂)	ဤနည်းဖြင့် သန်ါသင်ယူရာတွင်ကိုယ်တိုင်ပါဝင်လုပ်ဆောင် ရသော ကြောင့် အချို့ပုစ္ဆာများကို ဆရာ၏ အကူအညီ မယူဘဲ ဖြေရှင်းနိုင် ပါသည်။	၁	၂	၃	၄	၅
(၁၃)	ဤနည်းဖြင့် သန်ါသင်ယူရာတွင် အတန်းဖော်များ၏ အယူအဆ များကိုလည်း သိနိုင်ပါသည်။	၁	၂	၃	၄	၅
(၁၄)	ဤနည်းဖြင့် သန်ါသင်ယူရာတွင် လက်တွေ့လုပ်ငန်းများမှ တစ်ဆင့် သင်ယူရသောကြောင့် သင်ယူသူများသည် စူးစမ်းလေ့လာတတ်သော အလေ့အကျင့်များရရှိလာပါသည်။	၁	၂	၃	၄	၅
(၁၅)	ဤနည်းဖြင့် သန်ါဘာသာရပ်ကို သင်ယူရာတွင် သင်ယူသူ များသည် အတန်းဖော်များနှင့် ပူးပေါင်းဆောင်ရွက်ခွင့် ရပါသည်။	၁	၂	၃	၄	၅

(၁၆) ဤနည်းဖြင့်သန်ဂါသင်ယူရာတွင် သင်၏ခံစားချက်များကို ဖော်ပြပါ။

_____ (၁၇)

ဤနည်းဖြင့်သန်ဂါသင်ယူရာတွင်ယခင်သင်နည်းနှင့်ကွဲပြားသောသင်၏ပါဝင်ဆောင်ရွက်ခွင့် များကို ဖော်ပြပါ။

_____(၁၈) ဤသင်နည်းနှင့်ပတ်သက်၍ သင်၏ထင်မြင်ယူဆချက်မ့ားကို ရေးပါ။

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