THE IMPACT OF DIFFERENTIATED INSTRUCTION ON STUDENTS' ACHIEVEMENT IN MATHEMATICS AT MIDDLE SCHOOL LEVEL

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Abstract

The purpose of this study is to investigate the impact of differentiated instruction on students' achievement in mathematics at middle school level. Both quantitative and qualitative research methods were conducted to obtain the required data. The design adopted for quantitative study was one of the quasi-experimental designs, non-equivalent control group design. The subjects were (30) Grade Six students from BEHS (Tamarkone) in Wundwin Township, (67) Grade Six students from BEMS (1) in Wundwin Township, (140) Grade Six students from BEHS (1) in Thazi Township and (59) Grade Six students from BEHS (Khetmauk) in Thazi Township. The instruments used in the study were pretest, learning style inventory, posttest, observation checklist and interview questions. Experimental groups were taught with differentiated instruction, while the control groups were taught the same concept using formal method. Students' mathematics achievement was compared using one-way ANCOVA. The results showed that there were significant differences between middle school students who receive differentiated instruction and those who do not receive it on the scores of mathematics achievements for selected schools. The questionnaires findings showed that Grade Six students have positive attitudes towards mathematics learning through differentiated instruction. The interview findings pointed out that they propounded it is very suitable and valuable instructional design for teaching of mathematics.

Keywords: Differentiated Instruction, Mastery Learning Style, Understanding Learning Style, Interpersonal Learning Style, Self-expressive Learning Style, Mathematics Achievement.

Introduction

Gregory and Chapman (2002, cited in Dixon, Yssel, Connell & Hardin, 2014) expressed that it is an important role in education to change and renewal. Factors that contribute to the ever-changing classroom landscape include common core state standards, standards-based classrooms, high expectations and accountability for all students, multicultural diversity, recognition of different learning styles and multiple intelligences, and rapid societal and technological changes. Therefore, teachers should consider new instructional design for the students of different learning abilities.

Statement of the Problem

In Myanmar's schools, all students have the opportunities to learn the same content in exactly the same way. The students may try to learn the content in their own ways according to their learning styles. Therefore, a major issue in the classroom teaching is whether the specific learning differences of each student are being met. Differentiated instruction can help teachers to promote academic achievement in students.

Purposes of the Study

The main purpose of this study is to investigate the impact of differentiated instruction on students' achievement in mathematics at middle school level. The specific purposes are as follows.

1. To develop a differentiated instructional design for middle school students.
2. To explore the impact of differentiated instructional design on middle school students' achievement in mathematics.

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3. To investigate students' attitudes towards mathematics learning through differentiated instruction.
4. To find out the teachers' attitudes for implementing differentiated instruction in the mathematics classroom.
5. To give suggestions and recommendations for the improvement of mathematics teaching.

Research Questions

This study aims to answer the following research questions.

1. Is there a significant difference in the mathematics achievement between middle school students who received differentiated instruction and those who did not receive it?
2. How do the students who received differentiated instruction have attitudes towards mathematics learning through differentiated instruction?
3. How do the teachers who taught differentiated instruction have attitudes for implementing differentiated instruction in the mathematics classroom?

Scope of the Study

The present study is geographically restricted to two townships in Meiktila District: Wundwin and Thazi. Participants in this study are Grade Six students who are learning mathematics with reformed curriculum and junior teachers from the selected schools in the (2021-2022) Academic Year in which junior teachers' teaching and learning activities are linked with differentiated instruction. In this study, chapter one to four in Grade Six Mathematics Textbook Volume (I) and chapter one to two in Grade Six Mathematics Textbook Volume (II) were selected to use in the experiment.

Definition of Key Terms

The key terms used in this study are presented as follows.

Differentiated Instruction. Differentiated Instruction is described as student-centered and can be used to reach and engage students based on their diverse interests, strengths, weaknesses and how they learn best (Tomlinson, 2001, cited in Amadio, 2014).

Mastery Learning Style. The mastery learning style describes learning that focuses on remembering basic facts and details (Dodge, 2005, cited Thomas & Brunsting, 2010).

Understanding Learning Style. Understanding learning style describes learning that develops reasoning skills and an understanding of concepts, patterns, and proofs for ideas (Dodge, 2005, cited Thomas & Brunsting, 2010).

Interpersonal Learning Style. The interpersonal learning style describes learning from approaches that emphasize cooperative learning, real-life contexts, and connections to everyday life (Dodge, 2005, cited Thomas & Brunsting, 2010).

Self-expressive Learning Style. The self-expressive learning style describes learning that produces original work using creative application and synthesis of old skills and information (Dodge, 2005, cited Thomas & Brunsting, 2010).

Mathematics Achievement. The achievement test score which represents mathematics achievement of the student is defines as mathematics achievement (Dail, 2008).

Significance of the Study

Htoo Thant (2018) said that Myanmar government has continued changes and improvement from the by-heart learning with good marks and high grades to the system which is leading towards learning about twenty first century skills such as communication, collaboration, creativity and problem solving, critical thinking, and citizenship in education sector. In Myanmar, KG+12 system had been introduced.

Glasgow, McNary and Hicks (2006, cited in McLean, 2010) said that the curriculum changes, teachers cannot recognize the multitude of differences in individual students within a given classroom, but often they have failed to integrate these differences into their teaching strategies. This research is expected to give some benefits for teachers and students in teaching-learning process. By using differentiated instruction, every student is expected to be more involved in learning mathematics and feel happier in doing of practical works.

Review of Related Literature

Background Philosophies for Developing Differentiated Instruction

Educational philosophies related to this study are pragmatism, progressivism and constructivism.

Differentiated instruction is rooted in pragmatism. According to pragmatism, knowledge gained through doing, acting and living is useful and it emphasizes the functional knowledge and understanding. (Wilson, Kenneth & Bennett, 1994, cited in Magableh & Abdullah, 2020). Thus, it fosters the learners to be creative and constructive by nature and to be an active participant in educational process.

In progressivism, children's interests and feelings are the center of education, instead of past knowledge and value (IDCJ, 2004). Thus, students' practice in instructional procedures through emphasizing their interests and feelings is conducted in implementing differentiated instruction process.

Both Vygotsky's and Piaget's theories are also constructivist, emphasizing that children actively construct knowledge and understanding rather than being passive receptacles (Savery & Duffy, 2001). Therefore, social interaction plays a fundamental role in the proposed design of differentiated instruction.

Background Learning Theories for Developing Differentiated Instruction

Six learning theories are taken into consideration in the proposed differentiated instructional design.

Piaget's (1936, cited in McLeod, 2008) theory of cognitive development explains how a child constructs a mental model of the world. Piaget regarded as cognitive development as a process which occurs due to biological maturation and interaction with the environment. Thus, the proposed design for differentiated instruction is concerned with the developmental aspect of human learning and the way in which content is structured for learning.

The approach of differentiated instruction is held by the socio-cultural learning theory which is based on the work of Russian psychologist Lev Vygotsky (1962, 1978, cited in Burkett, 2013). The socio-cultural learning theory holds that the previous experiences and culture of the learner are critical because these influence the learning process for each individual. Therefore, social interaction is essential to the development of cognition.

Differentiated instruction is grounded Gardner's multiple intelligence theory. The theory is based on the belief that all of the human intelligences should be recognized and nurtured as

well as all combinations of the multiple intelligences (Armstrong, 1994, cited in Burkett, 2013). Therefore, teachers should be recognized and nurtured their students according to their multiple intelligences to adapt learning.

Brain-based learning has important implications for the differentiated classroom. The students must be in an environment conducive to learning. Students need to be challenged at appropriate levels in order for learning to occur. The brain needs to create its own understanding of ideas and skills by being presented with the concept to the facts so the learner can see the relationship between these and thus connect new information to prior knowledge (Burkett, 2013). Thus, the three concepts of brain-based learning can be considered in differentiated instruction depending on student levels of readiness, the needs of the teacher, and the nature of the content being taught.

According to Kolb (1984, cited in ETEY, 2016), experiential learning theory defines learning as the process whereby knowledge is created through the transformation of experience. Therefore, as different learners come into the classrooms with different backgrounds, the learning style of each student is one important fact that should be taken into account in implementing successful teaching and learning process.

Customized learning is really more focused on how students can be guided to initiate their own projects. It encourages them to willingly seek out knowledge according to their own drive and choice as opposed to how other methods give emphasis to specific cognitive and literary disciplines for the sake of the students' general progress (LLA, 2019).Therefore, the concept of customized learning theory is considered in proposed differentiated instructional design to encourages the students seek out knowledge through their own drive and choice, emotions, ambitions, and draw out their innate abilities to cope with actual life challenges.

Background Teaching Models for Developing Differentiated Instruction

Seven teaching models are taken into consideration in the proposed differentiated instructional design.

The four components of Glaser's model are instructional objectives (IO), entering behavior (EB), instructional procedures (IP) and performance assessment (PA) (Khin Zaw, 2001). So, Glaser's basic teaching model is adopted for the major components involved in the proposed instructional design for differentiated instruction.

Professor Dr. Talyzina's neo-cybernetic model is composed of instruction objectives, entering behavior, selection of knowledge, technological devices, step-by-step psychological theory, teaching algorithms, feedback phase, regulation (Khin Zaw, 2001). Therefore, in developing proposed instructional design for differentiated instruction, the ideas of Talyzina's model are mainly adopted for the first component (learning objectives), second component (pre-assessment, third component (instructional procedures) and feedback phase of proposed design.

According to Tomlinson's DI model, students' readiness, interests and learning profiles are important for teachers to recognize when providing instruction as they influence how students make sense of new information. Moreover, teachers must adapt the curricular elements, content, process and products according to students' readiness, interests and learning profiles (Erickson, 2010). Therefore, in developing proposed instructional design for differentiated instruction, the ideas of Tomlinson's model are mainly adopted for proposed design.

Dr. Khin Zaw's multimodal theoretical constructs consists of five main principles or components namely, channel capacity, brain resilience, redundancy, unitizing/symbolizing modes, and diffusing/re-synthesizing mode (Khin Zaw, 2001). The third component of

instructional procedures in proposed design includes positive or negative redundancy. Moreover, the third component in the proposed design bases utilizing/symbolizing modes and diffusing/ resynthesizing modes. Therefore, this model is adopted for the major components involved in the proposed instructional design for differentiated instruction.

According to To-With-By Model, stage one, or tier one, is "to" that is main lesson. In other words, "to" means the direction of instruction. Stage two, or tier two, is the "with" stage. "With" means the guided instruction. Stage three, or tier three, is the "by" stage. "By" means self-directed learning (Campbell, 2009). Therefore, in developing proposed instructional design for differentiated instruction; the ideas of To-With-By Model are mainly adopted for the third component (instructional procedures) of proposed design.

The ten-body brain-compatible elements of the highly effective teaching (HET) model are absence of threat/ nurturing reflective thinking, sensory-rich "being there" experiences, meaningful content, enriched environment, movement to enhance learning, choices, adequate time, collaboration, immediate feedback, and mastery (application) (Kovalik, 2017). Learning is a relationship between brain and body to enhance learning through their emotion, performance and movement. Therefore, in developing proposed instructional design for differentiated instruction, the ideas in ten elements in HET model are mainly adopted in the proposed instructional design.

The goal of Thomas and Brunsting (2010) was to make a deep connection between mathematics and learning styles. They identified four distinct styles of mathematics learners such as mastery math students, understanding math students, self-expressive math students and interpersonal math students. Therefore, in developing proposed instructional design for differentiated instruction, the ideas of grouping based on four mathematical learning styles are mainly adopted in the proposed instructional design.

Proposed Instructional Design for Differentiated Instruction

In proposed differentiated instructional design, there are five main components. Each of them is briefly explained as follows.

Learning objectives. In this component, learning objectives are identified based on Bloom's Taxonomy of educational objectives and skills in twenty first century.

Pre-assessment. In analyzing pre-assessment component, the instructor assesses the students' background knowledge.

Whole class instruction (grouping). The instructor assesses background knowledge such as a whole class. In whole class learning, the instructor provides students with opportunities to work collaboratively as a whole class. The students are grouped homogeneous groups based on four mathematical learning styles within one lesson.

Questioning (scaffolding strategy). The instructor uses questions as a scaffolding activity to provide support, assess progress and be adjusted according to student's needs in discussion or interaction.

Collaborative learning (learning activities). The instructor uses a collaborative learning strategy to involve student groups in a whole class activity. Each group brainstorms responses related to the questions. Then, the class discusses and reflects on the whole class effort.

Learning process. Learning process is acquiring new knowledge, understanding, behaviours, skills, values and attitudes.

Small group instruction (grouping). When considering for implementing mathematics activities, the instructor uses small group activities. In small group learning, students are assigned to four

groups based on commonalities with regard to their respective learning style (mastery, understanding, interpersonal and self-expressive).

Cooperative learning (scaffolding strategy). The instructor uses cooperative learning to incorporate scaffolding in homogeneous groupings that focus on providing peer and resource supports.

Task rotation (learning activities). The instructor use task rotation based on their four learning styles. The tasks are based on four different strategies such as mastery strategies, understanding strategies, interpersonal strategies and self-expressive strategies.

Students' Reflection. Student's reflection is to be aware of their own thinking processes and to be able to make transparent to others. It is an assessment why they learned and how they learned and what needs to be done as a result.

Partners/ Individuals (grouping). When considering for implementing students' reflection, the instructor gives two choices for students such as partners or individuals.

Graphic organizers/Think-alouds (scaffolding strategy). In working with partners, the instructor uses graphic organizers to provide multiple formats to help students organize thinking and research. For individual learning experiences, the instructor uses think-alouds to provide opportunities for students to engage in metacognitive activities while being provided with support and guidance.

Discussion breaks/ Learning logs (learning activities). In working with partners, the instructor uses discussion breaks to provide an opportunity for students to discuss ideas, questions and information. In individual learning experiences, the instructor uses learning logs to track and reflect their learning.

Formative Assessment. The instructor can assess students' learning throughout the learning process of the model by formative assessment strategies such as asking questions, observing students' facial expressions and body language, and by listening students' discussion.

Summative Assessment. The students work more independently. After the evaluation process, the instructor examines whether the students achieved the desired learning outcomes or not. If they achieve these outcomes, they are moved to the next content. Unless they achieve these outcomes, feedback is made to provide next lesson preparation (See Figure 1).

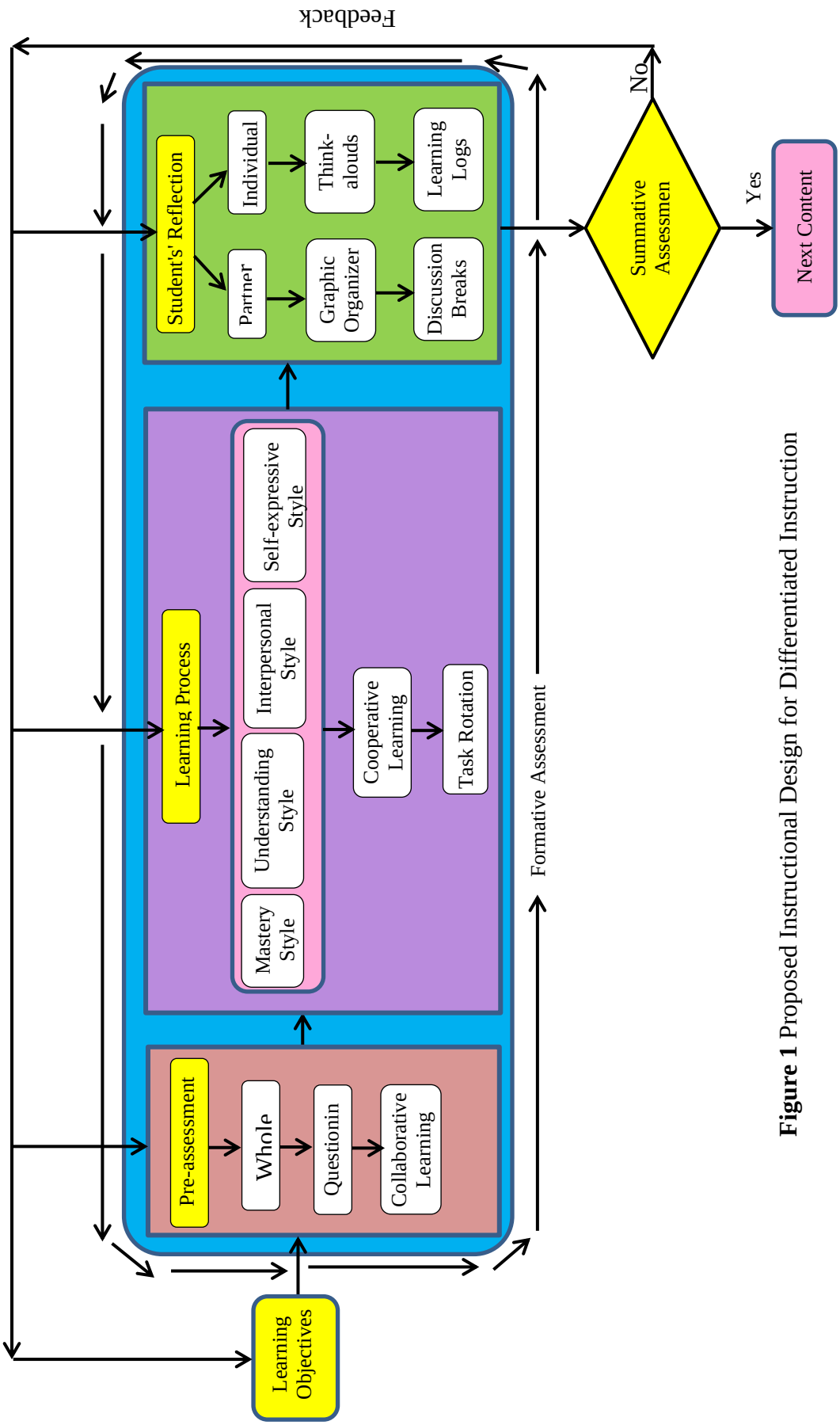

Figure 1 Proposed Instructional Design for Differentiated Instruction

Research Method

Both quantitative and qualitative research methods were used in this study.

Research Design

The aim of this study is to investigate the impact of differentiated instruction on students' achievement in mathematics at middle school level. This study was adopted by using the explanatory sequential mixed method (QUAN→qual) design.

Quantitative Research Method

Quantitative research method was used to analyze students' mathematics achievement and higher order thinking skills and lower order thinking skills. The non-equivalent control group design, one of the quasi-experimental designs, was adopted in this study.

Population and Sample. Grade Six students were selected from the selected schools as the subjects. Table 1 shows population and sample of the quantitative study.

Table 1 Population and Sample

Selected Township	Selected School	No. of population	No. of Subject
Wun Dwin	B.E.H.S (Tamarkone)	30	30
	B.E.M.S (1) Wundwin	67	67
Thazi	B.E.H.S(1) Thazi	140	140
	B.E.M.S (Khetmauk)	59	59

Instruments. Pretest, learning style inventory and posttest were used as quantitative research instruments.

Pretest. The pretest question consists of (14) multiple choice items and (5) short questions. Test items were constructed based on Grade Four mathematics textbook. The total score for pretest is (30) marks. Time duration is (45) minutes, (1) period.

Learning style inventory. In this study, the inventory for four learning styles was used by Thomas and Brusting (2010). Each component consisted of (10) items on five-point Likert-type scale from (1) to (5), totally (40) items were included in this inventory.

Posttest. The posttest question consists of (13) multiple choice items and (7) short questions. Test items were constructed based on Grade Six mathematics textbook. The total score for posttest is (30) marks. Time duration is (45) minutes, (1) period.

Learning materials. To construct learning activities for differentiated instruction, four chapters were selected from Grade Six mathematics textbook Volume (I) and two chapters were selected from Grade Six mathematics textbook Volume (II).

Data Analysis. The Statistical Package for Social Science (SPSS) Version 20 was used to analyze the quantitative data. The data were analyzed by using one-way analysis of covariance (One-Way ANCOVA).

Qualitative Research Method

Qualitative research method was used to investigate attitudes of students and teachers.

Population and Sample. Students who participated in the experimental groups and teachers who taught the experimental groups were selected as the subjects.

Instruments. Observation checklist, questionnaire and interview were used.

Classroom Observation Checklists. In this study, controlled observation which is non-participant and overt will be used. The 'yes' or 'no' checklist was used for assessing differentiated instruction, where the behavior never occurred is marked '0', the behavior occurred is '1'.

Questionnaire. Five-point Likert-type scale from (1) to (5) was used to indicate the attitudes towards mathematics learning through differentiated instruction.

Interview. The first part of interview question is about the demographic information and the second one is about the attitudes of teachers towards the proposed differentiated instructional design.

Data Analysis. In this study, coding analysis was used to analyze the qualitative data. Thematic analysis in content analysis was used to establish the existence and frequency of concepts, most often represented by words of phrases in a text.

Pilot Study

Pilot study was conducted with Grade Six students and middle school teachers in B.E.H.S (Branch-Shaw Pin), Meiktila District. The internal consistency (Cronbach's Alpha) of the pretest, posttest and students' attitudes questionnaire were 0.797, 0.820 and 0.891 respectively. Therefore, these questionnaires and items were suitable to use for experimental study.

Procedure

Before the experimental study, the training for differentiated instruction lasts for three days. And then, the sample schools were selected randomly from Wundwin and Thazi Townships. A pretest was administered to both groups to measure the initial levels and then learning style inventory was administered to determine which learning style students have based on four types of mathematics learning styles. Learning styles results in all selected schools can be seen in Table 2.

Table 2 Learning Styles Results in S1, S2, S3 and S4

Learning Style	No. of Participant				Total
	S1	S2	S3	S4	
Mastery Learning Style	3	2	12	10	27
Understanding Learning Style	4	13	17	11	45
Interpersonal Learning Style	6	11	27	7	51
Self-expressive Learning Style	2	8	14	2	26
Total	**15**	**34**	**70**	**30**	**149**

Note. S1=B.E.H.S (Tamarkone); S2= B.E.M.S (1), Wundwin;
S3= B.E.H.S (1), Thazi; S4= B.E.M.S (Khetmauk)

The results showed that the number of interpersonal learning style learners was at the first position, understanding learning style at the second position, mastery learning style at the third position and self-expressive learning style at the fourth position. Therefore, it can be interpreted that most of the students preferred to participate in interpersonal style learning (See Table 2).

Research Findings

Quantitative Research Findings of Pretest

Table 3,4,5,6 show one-way ANCOVA results for pretest scores of Grade Six students in S1, S2, S3 and S4.

Table 3 One-way ANCOVA Results for Pretest Scores of Grade Six Students in S1

Source	Type III Sum of Squares	*df*	Mean of Squares	*F*	Sig
Corrected Model	.033[a]	1	.033	.002	.960
Intercept	7905.633	1	7905.633	592.922	.000
ID	.033	1	.033	.002	.960 (ns)
Error	373.333	28	13.333		
Total	8279.000	30			
Corrected Total	373.367	29			

Note. a. R Squared =.000 (Adjusted R Squared= .36), ns= not significant

The results showed that there were no significant differences between entry behaviours of the experimental groups and the control groups in S1.

Table 4 One-way ANCOVA Results for Pretest Scores of Grade Six Students in S2

Source	Type III Sum of Squares	*df*	Mean of Squares	*F*	Sig
Corrected Model	79.718[a]	1	79.718	8.482	.005
Intercept	19152.195	1	19152.195	2037.771	.000
ID	79.718	1	79.718	8.482	.005**
Error	610.909	65	9.399		
Total	19884.000	67			
Corrected Total	690.627	66			

Note. a. R Squared =.115 (Adjusted R Squared= .102), $^{**}p < .01$

The results showed that there were significant differences between entry behaviours of the experimental groups and the control groups in S2.

Table 5 One-way ANCOVA Results for Pretest Scores of Grade Six Students in S3

Source	Type III Sum of Squares	*df*	Mean of Squares	*F*	Sig
Corrected Model	1.607[a]	1	1.607	.129	.720
Intercept	35107.779	1	35107.779	2817.419	.000
ID	1.607	1	1.607	.129	.720 (ns)
Error	1719.614	138	12.461		
Total	36829.000	140			
Corrected Total	1721.221	139			

Note. a. R Squared =.001 (Adjusted R Squared= .006), ns= not significant

The results showed that there were no significant differences between entry behaviours of the experimental groups and the control groups in S3.

Table 6 One-way ANCOVA Results for Pretest Scores of Grade Six Students in S4

Source	Type III Sum of Squares	*df*	Mean of Squares	*F*	Sig
Corrected Model	195.771[a]	1	195.771	33.523	.000
Intercept	16080.516	1	16080.516	2753.566	.000
ID	195.771	1	195.771	33.523	.000***
Error		57	5.840		
Total	16674.000	59			
Corrected Total	528.644	58			

Note. a. R Squared =.370 (Adjusted R Squared= .359), $^{***}p < .001$

The results showed that there were significant differences between entry behaviours of the experimental groups and the control groups in S4.

Quantitative Research Findings of Posttest

Table 7 shows one-way ANCOVA results for mathematics achievement on posttest scores of Grade Six students in S1, S2, S3 and S4.

Table 7 One-way ANCOVA Results for Mathematics Achievement on Posttest of Grade Six Students in S1, S2, S3 and S4

School	Source	*df*	*F*	*MD*	Sig. (2 tailed)	Partial Eta Squared	Unadjusted Mean		Adjusted Mean	
							EG	CG	EG	CG
S1	Pretest	1	.064		.802	.002				
	Group	1	23.504	4.66	.000***	.465	20.73	16.07	20.73	16.07
	Error	27								
S2	Pretest	1	.136		.713	.002				
	Group	1	24.198	3.40	.000***	.274	21.03	17.55	20.98	17.58
	Error	64								
S3	Pretest	1	.147		.702	.001				
	Group	1	76.596	3.09	.000***	.359	21.49	18.39	21.48	18.39
	Error	137								
S4	Pretest	1	.190		.664	.003				
	Group	1	40.531	4.57	.000***	.420	22.00	17.62	22.09	17.52
	Error	56								

Note. EG= Experimental Group, CG=Control Group,
S1=B.E.H.S (Tamarkone), S2= B.E.M.S (1), Wundwin,
S3= B.E.H.S (1), Thazi, S4= B.E.M.S (Khetmauk);
$^{***}p < .001$.

The results show that the use of proposed instructional design has a significant effect on posttest in students' mathematics achievement.

Findings of Observation Checklist in S1, S2, S3 and S4

Observation checklist results for each dimension in S1, S2, S3 and S4 can be seen in Table 8.

Table 8 Observation Checklist Results of Five Dimensions in S1, S2, S3 and S4

School	Average Percentage									
	Physical Environment		Teacher Behaviors		Student Engagement		Materials/ Resources		Assessment Strategies	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
S1	94	6	98	2	91	9	96	4	99	1
S2	91	9	97	3	92	8	97	3	99	1
S3	93	7	98	2	95	5	96	4	99	1
S4	95	5	97	3	93	7	95	5	99	1
Average Percentage	**93**	**7**	**97**	**3**	**93**	**7**	**96**	**4**	**99**	**1**

Note. S1=B.E.H.S (Tamarkone), S2= B.E.M.S (1), Wundwin,
S3= B.E.H.S (1) Thazi, S4= B.E.M.S (Khetmauk)

The classroom observation checklist results support the results of the research study. Most of the observational time in each dimension as physical environment, teacher's behavior, student engagement, resources and, assessment strategies followed differentiated instructional rules according to these results.

Findings of Students' Attitudes towards Mathematics Learning through Differentiated Instruction

To obtain the students' attitudes towards mathematics learning through learning activities based on the proposed differentiated instructional design, survey questionnaires were used. Students' responses on these items are expressed in Table 9.

Table 9 Responded Rates of Students' Attitudes towards Mathematics Learning based on the Proposed Differentiated Instructional Design

No.	Statement	N	Percentage (%)				
			Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	I explain my ideas and thoughts by verbal sharing in solving the problems.	149	6	3	2	6	83
2	I explain my ideas and thoughts by writing in solving the problems.	149	6	1	3	7	83
3	I listen to my friends' ideas and thoughts in solving the problems.	149	4	3	3	7	83
4	I hesitate to explain my ideas and thoughts with friends in solving the problems.	149	80	9	3	5	3
5	I actively participate in class discussion for solving the problems.	149	6	3	3	5	83

No.	Statement	N	Percentage (%)				
6	I discuss the problems with the whole class.	149	5	3	4	4	84
7	I discuss the problems with the pair.	149	4	3	4	5	84
8	Through the proposed differentiated instructional design, I take my responsibilities when I discuss the problems with the group.	149	4	2	3	6	85
9	I value individual work for solving the problems.	149	2	1	2	7	88
10	I cooperate the selected learning activities with the friends.	149	4	3	3	7	83
11	I am difficult to change my ideas and thoughts without discussion.	149	91	4	2	2	1
12	I try to develop my ideas and thoughts in solving the problems.	149	3	2	2	6	87
13	I try to get broad knowledge in solving the problem or creating the new ideas.	149	3	1	2	6	88
14	I try to solve the problem regarded as a chance without being afraid of getting wrong answers.	149	4	1	2	6	87
15	I try to solve the problems with creating new ideas.	149	3	2	2	7	86
16	I try to ask for the problems when I face the difficulties.	149	6	1	2	6	85
17	I describe and explore the problems to be solved.	149	5	0	3	10	82
18	I decide and perform the ways and the problems to be solved.	149	4	1	2	8	85
19	I am difficult to select and formulate the ways and the problems to be solved.	149	85	9	2	1	3
20	I reflect and repair the ways and the problems to be solved.	149	3	1	1	6	89
21	I communicate with the friends in learning activities based on the mutual respect.	149	3	2	2	7	86
22	I perform the learning activities with ease.	149	87	4	4	2	3
23	I help each other in leaning activities if needed.	149	4	4	2	5	85
24	I discuss and communicate with others rudely.	149	87	7	1	1	4
25	I try to achieve a proper balance in the learning activities according to my respective duties.	149	4	1	1	4	90

Note. N = number of students who participated in the experimental group

According to the responses of survey questionnaires, it can be interpreted that students have positive attitudes towards mathematics learning with communication skills, collaboration skills, creativity and problem solving, and critical thinking, and citizenship through the proposed differentiated instructional design.

Findings of Teachers' Interviews

Four teachers who taught the experimental groups in the selected schools were interviewed. Coding analysis and thematic analysis were used to analyze the qualitative data. There are five themes to analyze the data.

Theme 1 (Teaching Experience): All teachers who taught in the experimental groups had many teaching experiences and their total teaching services are above 10 years. They all had both primary teacher training and junior teacher training. Three teachers were BA degree holders and the rest of three teachers is BSc degree holder but only one teacher was in line with her mathematics major specialization and teaching.

Theme 2 (Knowledge about Differentiated Instruction): According to their responses, they understand differentiated instruction. They said there were differences between the new curriculum prescribed by the ministry of education and the proposed instructional design. Teaching aids and learning materials are easy to collect in daily life situations for teachers and effective for students. Classroom setting was prepared for all students to be ease and then the students actively participate in all class learning activities.

Theme 3 (Challenges): The challenge was that knowledge about differentiated instruction, time allocation, class size, differences between urban and rural students, knowledge about collaborative summarizing.

Theme 4 (Overcoming the Challenges): They solved those problems by knowledge from training orientation to differentiated instruction, adaptation with time allocation, preparation with classroom setting and peer discussion.

Theme 5 (Advantages): They propounded that it is very suitable and valuable design for teaching of mathematics. In general, the proposed differentiated instructional design improved students' mathematics learning.

Summary of Research Findings

Research findings from the selected schools are summarized as follows.

1. There were significant differences between experimental groups and control groups on the posttest scores of mathematics achievement in all four selected schools.
2. The students in the experimental group developed positive attitudes towards their mathematics learning.
3. Teachers propounded that it is very suitable and valuable design for teaching of mathematics.

Discussion

In terms of the statistical results, students' performance had significant difference on overall mathematics achievement. Findings from students' questionnaires and teachers' interviews prove that proposed instructional design for differentiated instruction has positive impact on students' mathematics achievement and thinking skills. Therefore, it can be interpreted that most of the students preferred to participate in interpersonal style learning among four schools. It is hoped that using instructional design for differentiated instruction in middle school mathematics teaching can develop students' mathematics achievement.

Suggestions

It can be suggested that the teachers should try to read books concerned with teaching-learning process and discuss teaching-learning process with peer teachers to improve students' achievement in different ways. The teachers should try to create positive classroom atmosphere, give clear instruction, motivate student to engage in class activities, carefully manage resources and, carefully use instructional assessment strategies. Moreover, teachers should be aware of time limitation to make group work more meaningful. Therefore, it is suggested that teacher-student ratio should be 1:30 according to Myanmar situation. Therefore, it can be suggested that teachers should try to study e-learning to meet students' different needs in 21st century demands

and explore different levels in e-learning for target groups to be effective teaching-learning classrooms.

Conclusion

The results of quantitative study and the qualitative study support the objectives of the research of the study. According to the findings on the research, it is hoped that this proposed instructional design can be useful to some extent for mathematics learning. Finally, it can be concluded that this study will also serve as a future reference for researchers in other subject areas. Not only in mathematics but also in other subjects, concepts are the basic building blocks of understanding. Based on these findings, further researches can be conducted on the effectiveness of mathematics through differentiated instruction.

Acknowledgements

Firstly, we would like to offer respectful to Dr. Khin Zaw (Retired Rector, YUOE), Dr. Kay Thwe Hlaing, (Rector), Dr. May Myat Thu, Dr. Khin Khin Oo, and Dr. Nyo Nyo Lwin (Pro-Rectors, YUOE), Daw Aye Aye Kywe (Retired Associate Professor, YUOE) who allowed us to carry out this study successfully. Then, we would like to express our thanks to Professor Dr. Khin Mar Khine (Professor and Head of Department, Department of Curriculum and Methodology, YUOE), who lovingly and patiently guided for achieving this study.

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