UBD-Inspired Strategy vs. Conventional Method in Teaching Real Numbers: An Attempt to Enhance Achievement and Enjoyment in Learning

SALLY Y. CUARESMA
Researcher

Master of Arts in Education
Major in Mathematics
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Grace C. Sadac, MAED
Adviser

Abstract

This study adopted a quasi-experimental method of research which seeks to compare the UbD-inspired strategy and the conventional method of teaching real numbers in terms of enhancing achievement and enjoyment in learning mathematics. The participants were 45 first year high school students in a private school who formed two matched groups with 22 students in the first group and 23 students in the second group.

A researcher-made fifty-item test was administered as pre-test at the onset of the experiment. After the experimental period which lasted for twenty school days, another set of fifty-item parallel test was administered as post-test. T-test was used to test the null hypothesis that there is no significant difference between UbD-inspired strategy and conventional method of teaching at 0.05 level of significance.

Pre and post-tests scores revealed no significant difference between the two groups subjected to two different strategies. This indicates that the use of the UbD-inspired strategy did not yield any additional increment in the performance of the students relative to those who were taught with the use of the conventional method.

It is recommended that in the implementation of any curriculum development framework, the Filipino learners' psyche must be considered with utmost importance. With such a premise, mathematics teachers should then be driven to discover more appropriate strategies which may not instantaneously result to significant transformations of educational competencies in terms of students' academic achievement but may positively improve students' attitude, appreciation and enjoyment in learning mathematics.

Key Words: achievement, conventional, learning, strategy

INTRODUCTION

Education plays a crucial role in the growth and development of individuals and consequently, the development of the country as a whole. Every learning institution's fundamental concern is the holistic development of a learner because it is through education that the intellectual faculties of a person are developed, thus, allowing the individual to advance in all aspects of living.

One core subject that significantly influences an individuals' aptitude is Mathematics. It is a quantitative subject that fosters the development of cognitive abilities such as thinking (Haylock & Cockburn, 2008). Reasoning skills are important for success in Mathematics and other subjects that students study in schools. Mathematics, particularly, is a base for all scientific and technological studies. Additionally, Mathematics has a high relevance and practical applications to many real-life situation and problems. It is therefore a key and compulsory subject in all school systems. Like Reading, Mathematics is a subject that is indeed necessary for functioning adequately in society.

Mathematics is a core subject that has not been easy for many students. Those who experience significant problems in learning and applying concepts in Mathematics manifest their Mathematics learning problems in a variety of ways. Research indicates a number of reasons the students experience difficulty in learning Mathematics (Mercer, Jordan, & Miller, 1996). Many students, despite a good understanding of mathematical concepts are inconsistent in computing. Some have difficulty in connecting the abstract or conceptual aspects of Mathematics in reality. Some have difficulty in making meaningful connections within and across mathematical experiences. For some students, difficulty in this subject is driven by problems with language. And lastly, a far less common problem – and probably the most severe – is the inability to effectively visualize mathematical concepts.

In this view, several strategies were adopted by most teachers to improve mathematics instruction. As cited in Cayabyab (1999), the most commonly used strategies were drill and review, integration, workbook exercises and infusion of desirable values. These strategies fall under the traditional method of teaching which were tested over the years. While the study of Lacuesta (1998) shows that mathematics teachers employ traditional teaching strategies very adequately, new strategies may still further enhance the interest of the learners. As such, the teachers have crucial functions to perform in the process of stimulating the interest of the learners that would produce desirable behavior and increased rate of achievement among the students. It cannot be denied that what students are to become depends, in no small measure, upon the influences arising from the school and specifically, the teachers in whose hands the students are molded.

Gregorio (as cited in Talplacido, 1999) pointed out that teaching and learning can be made effective and productive when the teacher knows the students' needs like their desire to be motivated, directed, guided and evaluated in all their learning activities.

A significant move of the Department of Education acknowledging the need to improve instruction and learning not only in mathematics but across all core subjects in the secondary level is the implementation of Secondary Education Development Program. Its primary aims are: to improve the quality of secondary education and the internal efficiency of the system; to expand access to quality secondary education; and, to promote equity in the allocation of resources especially at the local level. Its utmost concern is focused on the curriculum, instructional materials and physical facilities development with the end in view of improving teachers' teaching performance and students' learning (Marinas & Ditapat, n.d).

A move toward refining the curriculum paved the way for the release of DepEd Order No. 76 s.2010. This spells out the Policy Guidelines on the implementation of the 2010 Secondary Education Curriculum (SEC) using the Understanding by Design (UbD) model (Policy Guidelines of the 2010 SEC, n.d). UbD is a conceptual framework developed by Grant Wiggins and Jay McTighe, a design process, and a set of standards, used in the development of curriculum, unit, instruction and assessment.

Developments and refinements in the curriculum across learning areas, specifically, in mathematics significantly affect instruction. Gray and Wilcox (as cited in Hopkins, West, & Ainscow, 1996) contend that teaching and learning are the heart of any school's activities. The main responsibility of the teacher is to make the learner learn. The teaching strategies adopted by the teachers are very essential in meeting the varied learning needs of the students. It is assumed that each teaching style contributes to their teaching efficiency which is gauged through the continuous improvement in the achievement level of the students.

There are five factors which support successful learning according to Brown (1998) and these are wanting to learn, needing to learn, learning by doing, learning from feedback, and making sense from what has been learned (digesting).

When a learner has a strong desire to learn and internalize the value of learning, one will be capable of doing classroom activities that will improve the individual's knowledge and result in a powerful learner. This, in turn, is construed as the product of a skillful teacher (Hopkins, West & Ainscow, 1996).

Research findings reveal negative attitude of students toward Mathematics up to this time in spite of the continuous efforts in research to discover effective methods and strategies in teaching and learning it as a subject. The teacher who is the direct implementer of any school program performs a major role in achieving educational goals. The teacher must be well-equipped with knowledge and skills that teaching demands.

The continuous change and innovations and intensive evaluation of educational programs have brought about significant changes in the roles of the teacher in the classroom.

Visions of educational practice engage the energy and attention of educational reformers. These visions depart substantially from conventional practice and frame an active role for students as explorers, conjecturers, and constructors of their own learning. In this way of thinking, teachers function as guides, coaches, and facilitators of students' learning through posing questions, challenging students' thinking, and leading them in examining ideas and relationships (Cohen, Stoll, & Lewis, 1993). Advocates of this approach to practice assume that what students learn has to do fundamentally with how they learn it.

According to Ames and Archer (1988), education reformers envision classrooms where students and teachers acquire knowledge collaboratively, where orthodoxies of pedagogy and facts are continually challenged in classroom discourse, and where conceptual understanding of subject matter is the goal. This image of educational practice is often called teaching for understanding.

"Teaching for understanding aims to enhance the success of students at tasks variously described as problem solving, critical analysis, higher-order thinking, or flexible understanding of academic subject matter" (Prawat, 1989, p.109). It also requires new strategies of assessment and valuing students' work and progress. The new standard for teaching replaces conventional teach-and-test strategies with analytic reflection on classroom life and students' learning. Ongoing evaluation of classroom life and student thinking processes, rather than episodic paper and pencil tests, informs teachers teaching for understanding (American Association for the Advancement of Science, 1988).

"Mathematics is the major component of science and technology" (Salmorin & Florido, 2009, p.21), and this should inspire students to learn it. On the contrary, it is a common impression that mathematics is a difficult, tiresome, fatiguing subject because not all have been blessed to understand it. Many students try to understand it not because they see it as important but because they need to comply with curriculum requirements.

The understanding and learning of mathematics does not depend only on teacher's capabilities. Performance in mathematics is the result of the various factors including those within the student himself, the teachers, and the content to be learned.

The general intention of teaching is to affect learning on the learners. The central intention is to develop the innate tendencies of the learner and instill the proper values so that the acquired knowledge and skills will be utilized not only for self-growth but their effective integration in the society to perform a larger role.

The key person who gives vibrancy and direction to the entire teaching-learning process is the teacher. On his/her competence largely depends how the learning resources are utilized as means to concretize vague concepts. More than this, the innate tendencies and potentials of the students are drawn out so that they can be processed through the organized learning activities intended for the learners, consequently transforming them to functional knowledge and skills (Mosston & Ashworth, 1990).

The emerging body of educational research underscores the importance of the teacher in ensuring that learning take place in the classroom (Allan & Miller, 2000). The findings consistently indicate that the teacher is the single most important factor outside the home environment in affecting student development. Teachers who purposely plan and actively strive for learning using effective methods produce favorable results. The research has also reinforced the idea that classrooms are enormously complex arenas requiring vast teacher knowledge and understanding, as well as, skill and expertise (Nickson, 2000).

The teachers' role, which well applies to the mathematics teachers, means that all teachers will be doing certain tasks which learning machines cannot do. The teacher who only teaches facts may be replaced by a machine but not a teacher as motivator and facilitator of learning. He uses the classroom as a learning resource center, and at the same time extends the search for knowledge into the community, and helps the learner – the center of attraction in the whole educational system –discover for himself what is important for him to learn. Limpin (2001), noted that effective learners have the ability to draw information, ideas and wisdom from what the teacher has taught and use learning as their resources effectively. It is also cited that the major role of teaching is to create powerful learners who will manifest more progressive and dynamic ways to learn.

Students differ in their ability to learn. Some learn faster than others based on their capabilities and experiences. In some instances, strategies found effective with one type of students are ineffective with others (Brophy & Good, 1986). What the students bring to the classroom may be as important as any other factor in determining the effectiveness of a method. Teaching strategies adopted by teachers should be in accordance with the nature of the learner which includes his psychological and biological make-up (Limpin, 2001).

Some learners prefer routines and pattern; others love change and variety. Others absorb and retain new and difficult information by creating a picture in their minds or by listening to lectures. Some perform well in activities when paired with friends and still others prefer to be in solitude.

It is because of these diversified needs and preferences that teachers need to delve to understand learners' individual differences. An awareness of these diversities is the key for the teachers to be sensitive to their roles as educators and in identifying learners' learning strategies. This would eventually lead them to provide most appropriate instruction and the right attitudes and behavior in all circumstances during the learning process.

Learning process is lifelong. In this highly technological society, changes happen so rapidly that knowledge imparted today becomes easily obsolete tomorrow. Likewise, knowledge has become increasingly complex, that its mere transmission is no longer adequate. It has become to a point where it becomes imperative that the learners be equipped with the skills necessary to continue learning even when they have left the confines of the classroom as when they have left the formal education experience so that they may be able to adapt and respond to these changes (Ornstein, 1990).

It is vividly explained in Dunn and Frazier (1990) that teaching strategies play a great role in the teaching-learning process. These strategies may help the teacher in reaching the students so that their individual learning needs could be satisfied. Their essentiality in the entire teaching-learning process can never be neglected because, obviously, they affect the quantity and quality of learning required by the learners. Along this assertion, the teacher must be well-versed and competent in adopting varied teaching strategies.

The extent of how learners are benefited by these strategies may not have an absolute measurement. Ediger and Rao (2005) exemplified that teaching is a very personal activity and while certain teaching strategies might suit to the teacher, they might not be appropriate to another. Although there exists a core of good practices to which most teachers would subscribe, there are differences between teachers which relate to personality, style and philosophy.

However, amidst infusion of the best teaching strategies available, most of the learners today are having difficulties in solving mathematical problems for the reason that mathematics is taught through a context itself rather than knowing the value of mathematics in real life. Problem solving can be developed as a valuable skill in itself, a way of thinking rather than just as means to an end of finding the correct answer (NCTM, 1989).

"Mathematics has always been regarded with respect not only because of its unquestionable utility in everyday life, but more so because it is a study that challenges the finer capacities of the mind" (Solomon, 2001, p.85). Solomon noted that the study of mathematics has acquired the reputation of being the intellectual game of the mentally privileged only. This, of course, is an erroneous idea because Mathematics, properly understood, is simple, interesting and accessible to any normal mind. Yet, for some unhappy circumstances, the study of this science of numbers has been approached by hundreds of young boys and girls with a feeling of awe and fear.

According to Ball (1988), the study of Mathematics, when properly presented, can bring a wealth of enjoyment to the average student. Its comprehension lies within the reach of any individual and it does not require the delicate dispositions and sensitiveness to beauty which is enjoyed only by the artists and painters. It bars no one from the field, neither the shortsighted, nor the nervous, neither the anemic nor the cripple, as most sports do. Yet, it brings the thrill of a creation felt by the painter, it lulls one with the incomparable rhythm of its exactness, its harmony and its melody, it provides one with enjoyment accorded by the invigorating mental exercise as afforded to the physique by any sport.

Many researchers have done studies similar to this study focusing on different teaching strategies. One of them is the study of Reyes (1999), which aimed to investigate the effect of cooperative learning strategy on the academic achievement and attitude of students in mathematics. Although falling on similar nature of research, this study differs on the strategies being examined: the conventional method and the UbD-inspired strategy.

This study is anchored on Peterson's (1999) concepts of teaching strategies that are defined in terms of how teachers utilize space in the classroom, their choices of instructional activities and materials, and their methods of students' grouping. Teaching strategies are viewed as broad dimensions or personality types that encompass teaching stance, pattern of behavior, mode of performance and attitude toward self and others. More so, the studies on teaching strategies of Felder (1998), Grasha (1996) and Thompson (1995) are among the underpinnings of the study.

Felder (1998) opined that the teacher's teaching strategies are projections of his/her attributes and professional background. The compatibility of the teaching strategies of the teacher to the students' learning style in imparting the lesson will lead to a vivid retention. Thus, the knowledge acquired will be of help and useful in checking the mastery of the lesson.

Grasha (1996) emphasized that a teacher who clearly understands the possibilities and limits of his teaching strategies can make more consistent judgment about how best to use this medium. The nature of the subject taught and the learning competencies/skills to be developed among the learners, are essential factors to be considered by the teacher in adopting the suitable teaching strategies.

In addition to this, Thompson (1995) expounded that the students' capabilities to handle subject demands, their need for teachers to directly control classroom tasks, and their willingness to build/maintain relationships are important elements in determining what teaching strategies will be adopted in the classroom.

The foregoing concepts were considered as premises of this study which aimed to compare UbD with the conventional method in teaching real numbers in terms of enhancing achievement and enjoyment in learning mathematics.

The paradigm (Figure 1) further explains what the study would like to attain which teachers can utilize as they manage the entire teaching-learning process. As an effect, it is expected that the desired level of teaching efficiency and students' achievement and enjoyment be realized.

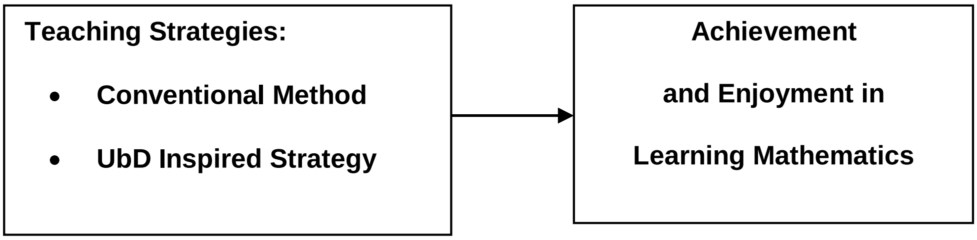

Figure 1. ***Research Paradigm on Teaching Strategies as attempt to enhance students' achievement and enjoyment in learning Mathematics***

The above-framework is further clarified and operationalized by its objectives. This study provides comparison on UbD-inspired strategy and conventional method in solving mathematical problems and equation for a sample of first year high school students. Specifically, it seeks to determine if there is a significant difference between the two groups' increments in scores and the two groups' enjoyment in learning Mathematics based on the teacher-researcher's observation and students' perception.

A teacher's goal is not only to make students learn; they must be taught to understand. "Understanding does not happen by chance, it happens by design" as stated by Diwa Publishing House, one of the known publishers in the country.

Teaching principle requires that teachers know and understand mathematics at a deep level that they understand their students and that they employ a wide range of strategies using appropriate pedagogy. Teachers make effect not only with the mathematics content that students learn, but also the students' dispositions toward learning Mathematics.

Students reveal their understanding when they are provided with complex, authentic opportunities to explain, interpret, apply and self-assess. Teachers become most effective when they seek feedback from students and their peers, and use that feedback to adjust approaches to design and teaching.

This study is designed to obtain inputs that may be useful in improving students' achievement in mathematics, emphasizing the teachers' critical role as designer of students' learning. It may help teachers clarify learning goals, devise revealing assessments of students understanding and craft effective learning activities. Administrators may also benefit from this study with respect to the improvement of curriculum design which may redound to students' academic improvement and to the greater efficiency of the school.

This study may also serve as a guide to Mathematics-I teachers in order to become more self-reliant, and to facilitate effective classroom instructions by conducting a performance task that may provide students varied learning experiences to develop their skills in understanding mathematics concepts.

The following terms are defined in accordance with their conceptual and operational meanings to have a working knowledge and better understanding of this study.

Achievement. This refers to a task-oriented behavior that allows the individual's performance to be evaluated according to some internally imposed criterion (Rao, 1995). In this study, it is measured by the post-test scores which set out to explain how the students' mathematical skills in solving problems and equations involving real numbers change overtime after using UbD-inspired strategy.

Conventional method. This refers to a teaching method where classes are conducted in a traditional teaching style with an emphasis on lectures and note-taking (Teaching Methods, n.d). In this study, it refers to a strategy where the teacher introduces concepts on the chalkboard, explains concepts, asks the students to copy lecture, and uses pen and paper in assessing students' achievement.

Enjoyment. This refers to the degree to which students enjoy working mathematics and mathematic classes (Thorndike-Christ, 1991). In this study, it refers to the enthusiasm that students demonstrate as they actively participate and show positive responses.

Increment in scores. This refers to the change in quantity that depends on another quantity (Stewart, 1999). In this study, it refers to the difference of the pre and posttests scores; that is, Posttest – Pretest= increment.

Real numbers. This refers to all the numbers that can be represented by the points on a number line (Herrera, O' Dell, Tesorio, & Villaluna, 2010). In this study, it refers to the set of numbers which will be used in solving mathematical problems and equations.

UbD- Understanding by Design. This refers to a framework for designing curriculum units, performance assessments and instruction that lead to deep understanding of the content (McTighe & Wiggins, 2005). In this study, it refers to a strategy where the students are engaged in varied activities and where the teacher-researcher includes performance task as a form of evaluating students' achievement and enjoyment.

Comparing the *Conventional Method* and *Understanding by Design* as Teaching Strategies

In view of the importance of adopting varied teaching strategies to classroom instruction, the researcher deemed it necessary to undertake this study to determine which strategy between the Conventional Method and that which employs Understanding by Design is better vis-a-vis students' achievement and enjoyment in learning mathematics. The following is a thorough discussion of the two methods to provide more enlightenment.

Conventional method. Teaching has been practiced since the earliest times. For thousands of years, fathers have taught their sons what they will need to know as adults, and mothers have taught their daughters on how to perform household chores. Because of the importance to mankind of the teaching process, human beings have also been seeking new ways to improve their methods of teaching.

When historians of education recall all who have contributed toward educational progress, they usually devote several pages to those revolutionists who invented steel pens and blackboards. They proclaim that these men were the indispensable instruments in the substitution of group recitations for individual instructions.

Conventional methods of teaching refers to the teaching methods adopted by teachers which are concentrated on whole class teaching and learning as to instructional planning, students grouping and evaluation techniques (Javier, 2002).

The most common methods of traditional teaching are discovery approach and expository method. Indeed, using discovery approach in teaching would entail more time but could contribute much to the individual becoming thoughtful and imaginative. However, in spite of these contentions, it has been observed that many mathematics teachers prefer the expository method. Often, they are faced with problems on how to present the lesson in the most attractive way to motivate students. They wonder whether it is better to begin with a formula or definition of the concept of principles, illustrate them by a series of examples and questions which lead to a generalization or rule in the concept (Gapuz, 2001).

Traditional procedures, as embodied in what is generally termed the recitation method, are found to be out of harmony with the objectives of modern education. These procedures seem to have developed under the dominance of a psychology of learning and are the expressions of social ideals which no longer accord with the fundamental aspirations of democratic citizenship (Payne, 1999).

Understanding by Design as a strategy. According to McTighe and Wiggins (1999), Understanding by Design is a framework for improving student achievement. Emphasizing the teacher's critical role as a designer of student learning, UbD works within the standards-driven curriculum to help teachers clarify learning goals, revise revealing assessments of student understanding, and craft effective and engaging learning activities.

Understanding by Design (UbD) represents a focus on the best practices in curricular design, a shift away from the mere coverage of topics as dictated by the sequence of a textbook to a view of designing, teaching, and assessing that will lead to true understanding of big ideas, the mastery of core subject-area tasks, and an ongoing system of reflection and assessment that leads to the refinement and improvement of the educational process (McTighe & Wiggins, 2005).

Reed (n.d), also emphasized that Understanding by Design is based on the following key ideas: a) a primary goal of education should be the development and deepening of student understanding; B) effective curriculum development reflects a three-stage design process called "backward design" that delays the planning of classroom activities until goals have been clarified and assessments have been designed. This process helps to avoid the twin problems of textbook coverage and activity oriented teaching, in which no clear priorities and purposes are apparent; C) students and school performance gains are achieved through regular review of results followed by the targeted adjustments to curriculum and instruction; D) teachers, schools, and districts benefit by working smarter through the collaborative design, sharing, and peer review of units of study.

According to Tomlinson and McTighe (2006), Understanding by Design is centered on three stages:

Stage 1- Identifying desired results of instruction.

This the critical part of the UbD process. In this stage the desired results of instruction are specified. The backward design process comes into play as the focus of the designers is directed to the end results expected from instruction. Stage 1 involves the designers' three specific tasks: identifying enduring understanding, identifying essential questions, and identifying other important knowledge and skills.

Stage 2- Determining acceptable evidences.

The concept of backward design again comes into play in stage two as the design team's attention is turned to determining acceptable evidence to judge whether the intended results of instruction were achieved and how well they were achieved. In this stage, the tasks of the design team involve formulating performance tasks and projects as well as traditional assessments such as quizzes and tests.

Stage 3- Planning learning experiences and instruction

Stage three involves the designing or learning activities and instructions, where the teachers teach and follow logically starting from stage 1. Many educators traditionally think of this stage first when designing units of instruction. The backward design reserves this stage as the final part of the design process. This stage requires that the students be given numerous opportunities to draw inferences and make generalizations themselves.

The acronym WHERE is a stage 3 design tool for the planning of learning experiences and activities offered by McTighe and Wiggins (1999). WHERE is based on research and classroom tested practice. The acronym was culled from the following guidelines: Where is the unit headed and what is the purpose of day-to-day work? Hook the students through engaging work that makes them more eager to explore key ideas. Explore the subject in depth, equip students with required knowledge and skill to perform successfully on final tasks, and help students experience key ideas. Rethink with students the big ideas; students rehearse and revise their work. Evaluate results and develop action plans through self-assessment of results.

McTighe and Wiggins (2005) offer a helpful design tool in the form of an acronym, GRASPS, to assist educators in formulating authentic and engaging tasks and projects. The perspective letters of the acronym represent the following: **G**oal- the goal of the performance task, Role- the role of the students as they carry out the performance task, Audience- the target audience to which the finished product/performance will be presented, Situation- the context, Product or Performance- the result of the performance task or activity, Standards for Success- the criteria by which the product/performance will be judged.

METHOD

Quasi-experimental method of research was employed to compare the results of the use of UbD-inspired strategy and the conventional method in teaching real numbers.

Below is the quasi-experimental design which was used:

M	$\mathbf{O_1}$	**X**	$\mathbf{O_2}$	**(E)**
M	$\mathbf{O_3}$		$\mathbf{O_4}$	**(C)**

Figure 2. ***Matched Pre-Test Posttest Control Group Design used in the study***

Symbols used:

X = intervention/treatment/manipulation (UbD-inspired strategy)
O = Observation
M = Matched
C = Control group (group subjected to conventional method of teaching)
E = Experimental group (group subjected to UbD-inspired strategy)

The participants in the study were first year high school students from a private school. A total number of 45 students were enrolled for the school year 2011-2012 with 22 students in section A, and 23 students in section B. The head of the school and the registrar grouped the number of enrolled first year students into two, where the first section has 10 students who graduated in the said institution and 12 new students coming from different private and public schools. The other nine old students and 14 new students were grouped to compose the other section. Said students were under the researcher's supervision. To randomly assign which section receives Ubd-inspired strategy, the researcher tossed a coin. The process resulted in the following:

Section A- Ubd-inspired strategy, Section B- Conventional method

This study used a researcher-made 50-item test which was administered as a pre-test on real numbers at the onset of the experiment and another set of 50-item test parallel to the pre-test, which were used for the post-test.

The 50-item pre-test was divided into six parts. Test I was about the basic concepts of real numbers and the number line. Test II focused on the relationships between various types of numbers that were illustrated using a diagram. Test III contained questions on the order of integers, which differentiated the positive and negative points in the number line by putting a symbol such as >, =, or <. This test also included the concept of the absolute value of the coordinates. Test IV was on the basic properties of operations which helped the students identify whole numbers, integers, rational and irrational, and real numbers. Test V was about listing the elements of the set being described which emphasized that every point on the line corresponds to a unique number. And Test VI was an evaluation of the series of operations of integers associated with grouping symbols.

The pre and post-tests underwent face and content validation by three Mathematics teachers. One was a college professor, an expert in test construction, and the other two were experienced Mathematics-I teachers. The content of said tests were deliberately arranged according to the level of difficulty, and examined based on appropriateness to participants' level. Suggestions from the experts were considered in constructing the final draft of the tests.

The experiment was divided into three phases. A detailed experimental procedure is provided in the proceeding section.

Pre-experimental Period

Before the school year (2010-2011) ended, the researcher had included in her letter of intent the request to handle mathematics-I for the school year 2011-2012 since the approved topic of the researcher for this study is a part of the curriculum of the freshmen.

The researcher managed to monitor the number of enrollees as the classes started on June 13, 2011. There were a total of 45 enrolled students. Nineteen students were considered old students because they graduated in said institution and sixteen new students coming from different public and private schools. The registrar, together with the principal, decided to group the number of enrolled students into two, where the first section had 10 old students and 12 new students, while the other section is composed of nine old and 14 new students.

Informed with the number of enrolled students for the first year high school, the researcher secured permission from the principal to conduct the experiment. Having secured the approval of the request, the principal and the researcher along with the other two mathematics teachers randomly assigned which of the two groups were to receive the treatment by tossing a coin. UbD-inspired strategy was employed to section A and the conventional method of teaching to section B. A UbD-based lesson plan for the experimental group and a traditional lesson plan for the control group were prepared by the researcher and duly checked by the principal.

Two sets of 50-item test were prepared, validated, and used as pre-test and post-test. Suggestions for corrections were considered for the final form of said tests.

The pre-test was administered by the researcher on June 17, 2011 both for the experimental and control groups. The participants were told that the test would be diagnostic in nature and the purpose was to establish baseline data as to the level of their mathematical comprehension.

Experimental Period

Formal discussions started on June 21 of the school year 2011-2012. Two intact groups were involved in the experiment and were also handled by the researcher.

Table 1 shows the class schedule of the two groups.

Table 1
Mathematics Class Schedule of the Experimental Group and Control Group

Groups	Mathematics Teacher	Days	Time
Experimental Group	The Researcher	Monday-Friday	7:30-8:30
Control Group	The Researcher	Monday-Friday	2:20-3:20

The experimental group was subjected to UbD-inspired strategy of teaching where the participants were not advised to jot down lecture notes. Several activities were administered based on the UbD lesson plan. Role playing was also done by the experimental group which was considered as the students' performance task. The participants took on matured roles during the play such as a bank manager, teller, depositor and bank employee.

The participants in the control group on the other hand, were advised to write and jot down lecture on their notes. Activities were also administered based on the traditional lesson plan and based on the flow of discussions.

Post-Experimental Period

A 50-item post-test was prepared by the researcher parallel to the pre-test and the same was validated by the principal, two other mathematics teachers, and a college professor who is adept in test construction. Said test was administered to both the experimental and control groups.

The post-test given was considered as the participants' monthly test which was equivalent to 15% of their first grading grade in mathematics-I for the present school year.

To determine if there is a significant difference between the two groups, their pre and posttests scores were compared using t-test at 0.05 level of significance. Teacher-researcher's observations and students' perception based on the post experimental interviews were conducted in order to extract other benefits that may be derived from the use of UbD.

RESULTS

Findings of this study are organized according to the sequence of the objectives: the Difference in the Performance of the Experiment Group and Control Group in the Pre-Test; the Difference on the Performance of the Experimental Group and Control Group in the Post-Test; jump t-test of the Experimental and Control Group; the Two Groups' Enjoyment in Learning Mathematics Based on the Researcher-Teacher's Observations; and the Two Groups' Enjoyment in Learning Mathematics Based on Students' Perceptions.

Difference in the Performance of the Experiment Group and Control Group in the Pre-Test

The table shows the results of the pre-test of the two groups.

Table 2
Performance of the Two Groups of Participants in the Pre-Test

Group	No. of Students	Mean Scores	Standard Deviation
Experimental Group	22	22.82	7.61
Control Group	23	16.09	4.10

As can be gleaned in the table, the experimental group acquired a mean score of 22.82 with a standard deviation of 7.61. On the other hand, the control group obtained a mean score of 16.09 with a standard deviation of 4.10. The experimental group obtained a higher standard deviation than the control group which reveals that the participants' scores in this group are more dispersed.

Difference on the Performance of the Experimental Group and Control Group in the Post-Test

The post-tests of the two groups were given after the formal discussion of the entire unit based on the textbook used. Table 3 presents the experimental and control groups' post test scores. Mean scores representing the performance of the two groups are 28.41 and 20.91 respectively. Standard deviation of the experimental group is 9.33 which is higher than that of the control group, which further explains the larger variation of scores of the participants; i.e., there were high scoring and low scoring examinees in the experimental group.

Table 3
Performance of the Two Groups of Participants in the Post-Test

Group	No. of Students	Mean Scores	Standard Deviation
Experimental Group	22	28.41	9.33
Control Group	23	20.91	5.88

Experimental and Control Groups' Incremental Scores

Table 4 presents the increase in scores of the two groups. Experimental group obtained a mean score of 5.59 with a standard deviation of 5.39, while the control group acquired a mean score of 4.83 and a standard deviation of 5.92. Obtaining a higher standard deviation manifests that the incremental scores of the participants in the control group are more varied.

Moreover, when the two groups were compared using the independent samples test, the p-value obtained was .65. This indicates that there is no significant difference between the strategies employed at 0.05 level of significance.

Table 4
Results of the Two groups' Incremental Scores

Group	No. of Students	Mean Incremental Scores	Standard Deviation	t-test P-value
Experimental Group	22	5.59	5.39	.65
Control Group	23	4.83	5.92	

Two Groups' Enjoyment in Learning Mathematics Based on the Researcher-Teacher's Observations

A UbD-based lesson plan was strictly followed in the discussion of the lessons for the experimental group, while the entire discussion of the lessons in the control group was guided by a researcher-made traditional learning plan/guide. Written lectures were not mandatory for the experimental group as suggested by the mathematics coordinator and as a part of the UbD-based lesson plan. On the other hand, the control group was given enough time to copy whatever the researcher-teacher had written on the board. The following are the observations of the researcher:

Having been engaged in varied activities, students in the two groups expressed that they were stimulated to think well as the tricks used by the teacher required them to. Both the experimental and the control groups participated well in their respective learning activities. Enjoyment is seen on their facial reactions after the secret trick had been revealed.

Teachers in other subjects had observed the excitement and interest of the participants in the experimental group whenever they were about to attend the mathematics class. They had seen that much time and effort was put by the students on the activities employed by the researcher-teacher using the UbD-based lesson plan.

Role playing was also a part of the UbD-based lesson plan in which the students acted as mature people. Participants in the experimental group showed eagerness and excitement in wearing their costumes which indicate the students' enjoyment.

Two Groups' Enjoyment in Learning Mathematics Based on the Students' Perception

The researcher-teacher conducted post experiment interviews both to the experimental and control groups to determine if participants enjoyed learning through the strategies employed in their corresponding groups. It may be inferred from the feedback of the participants in the experimental group that majority of them had enjoyed the mathematics classes.

"Dalawa sa grupo namin ang may dalang digi-cam para makuhanan lahat ng moments sa role playing." [Two of us in the group brought a digital camera to be able to capture each moment of the role playing.]

P1

As directly uttered by one student coming from the experimental group. On the other hand, the participants in the control group have also expressed their excitement every time an activity is done. One of them said:

"Nag enjoy ako sa klase natin sa math kahit lagi ako zero." [I enjoyed our mathematics class even if I always get zero during exams.]

P2

Another affirmation of enjoyment is when one of the participants compared mathematics classes during their elementary years and the present. According to the participant from the experimental group, a performance task was never done in their mathematics class in his elementary years. In his excitement, he even narrated how he prepared his costume as a bank manager.

"Hiniram ko yung uniform ng uncle ko na nagtatrabaho sa bangko. Bagay nga sa akin." [I borrowed the uniform of my uncle, who is working in the bank. I look good wearing it.]

P3

Participants in both groups claimed that they had a hard time solving mathematical equations on integers, but still had enjoyed arriving at the correct answer after a long solution had caused them feeling of fulfillment. One of them said:

" Ang sarap ng feeling pag nakuha mo yung tamang sagot, ang haba kaya ng solution." [It is very much fulfilling, arriving at the correct answer after a long solution.]

P4

Still based on the post experiment interviews, some of the participants in the control group had commented that they did not enjoy the mathematics classes for the reason that they feel sleepy during their mathematics period. Other reasons for not enjoying the subject were revealed:

"Ayaw ko sa mga numbers" [I simply do not like numbers.]

P5

"Mas kumplikado ang mga equations ngayon kesa sa math last year."[Equations now are more complicated compared to the math last year.]

P6

Another participant from the experimental group expresses that there's nothing new with the strategy employed. A participant claimed,

"Nakakainip minsan, kasi walang bago ,addition, subtraction, multiplication at division pa rin." [Sometimes it is boring because there is nothing new, it is all about addition, subtraction, multiplication and division.]
P6

DISCUSSION

Mathematics has always been regarded with respect not only because of its unquestionable utility in everyday life, but more so because it is a study that challenges the finer capacities of the mind (Solomon, 2001). According to Ball (1988), the study of mathematics, properly presented, can bring a wealth of enjoyment to the average student. Its comprehension lies within the reach of any normal intellect and it does not require the delicate dispositions and sensitiveness to beauty which is enjoyed only by the artists and painters.

Teachers who are important authorities in the educative process should take time to develop positive mathematical affect alongside the development of mathematical cognition. Adoption and utilization of effective strategies by teachers making mathematics more meaningful and relevant allow students to develop a positive outlook and increased interest in learning the subject. A new approach to learning must be developed for it has been observed that many students flunk mathematics because of their weak foundation and poor study habits. The need for innovative approach must be given enough attention for this might be the way which will lead to the realization of teachers' and students' common goal allowing students to alter negative attitudes and, consequently, thrive in the study of mathematics.

Challenged by the abovementioned situation, this study was conceived to determine if UbD-inspired strategy is more effective than the conventional method of teaching, an attempt to enhance students' achievement and enjoyment in learning mathematics.

Experimental group obtained a mean score higher than the control group in the pre-test. This outcome may be attributed to the fact that 95% of the participants in the experimental group have attended the enrichment program which the school offered during summer. As compared to the participants in the control group, only 80% of them have attended the said enrichment program. Some of the topics were discussed by a different mathematics teacher during the enrichment. This program has been offered by the school for the incoming freshmen to make them ready, to give them idea how it is to be a high school student, and to let them be familiarized with each other.

The performance of the two groups in the post-test revealed the same results with that of the pre-test. The experimental group obtained a higher standard deviation than the control group, which implies the higher variation of scores of the participants. According to Navidi (2010), large negative deviations are as indicative of spread of deviations as positive deviations are. This explains that when the spread is large, the sample values will tend to be far from their mean, but when the spread is small, the values will tend to be close to their mean. Both groups showed improvement in their mean scores. This result implies that the two strategies employed have positive impact.

With regard to the t-test of incremental scores of both groups, the mean score of the experimental group is still higher than that of the control group. This signifies that the participants in the experimental group are more mathematically inclined. On the other hand, the control group obtained a higher standard deviation than the experimental group which manifests that the scores of the participants in the control group are more varied. This denotes that there are participants whose scores are either extremely high or extremely low.

Moreover, when the two groups were compared using the independent sample test, the p-value obtained was .65. Thus, results conveyed that integrating UbD-inspired strategy was insignificant relative to students' achievement when compared with the results obtained from using the conventional method of teaching.

On account of the two groups' enjoyment in learning mathematics based on the researcher-teacher's observations, the UbD-inspired strategy was significantly relevant. The experiment revealed that the participants in the experimental group were more motivated and excited every time an activity was conducted. Participants in the control group have also shown a certain level of excitement and motivation but not as intensive as that of the first group. This may be attributed to the fact that the students involved were teenagers whose ages range from 12 to 13. At their age, they are easily attracted to games. The rules and processes involved in solving operations on real numbers were easily captured and understood by the students in the experimental group which were proven further by their scores in the seatworks and quizzes.

It may be said that the society's perception of education is divided between those who believe that new methods are better than the conventional methods of teaching. According to Wilder, Wilder, Pimm and Westwell (1999), every strategy in teaching is important for they deliver the same message to the students.

According to McTighe and Wiggins (2008), the potential of UbD for curricular improvement has struck a chord in American Education. An indication of this is evidently pictured in statistics. Over 250,000 educators own the UbD book, over 30,000 handbooks are in use, and more than 150 university education classes use the UbD book as a text.

In the Philippine setting, however, a different scenario exists. Most educators here do not necessarily own a UbD book, let alone, utilize a UbD handbook or even use UbD book as a textbook. Many could not have full access to current studies in educational planning and curriculum conducted elsewhere. Thus, adaptations may be altogether out of context and may not yield the same results as those originally implemented. Maximum adoption of educational directions was observed, and conversely, minimal adaptations were noted.

"Experimental groups are experimental. They usually lie outside the regular curriculum" (Krantz, 1991, p.38). It will be years before teachers will know whether students taught with the new techniques understand and retain the material satisfactorily and complete their training successfully.

Moreover, the Secretary of Department of Education, Bro. Armin Luisito claimed that, "teaching and learning for understanding requires a big shift and that changing the paradigm of teaching cannot happen overnight" (DepEd To Enhance Math Teachers Competencies, n.d).

A new strategy (UbD in particular) in teaching mathematics does not necessarily differ from conventional strategies in terms of the amount of learning caused among students. Thus, adopting new teaching strategies may not outrightly provide significant increments on students' performance. However, new teaching strategies may pave the way for a stronger foundation coupled with substantial exposure on real life situations to ultimately yield better performance in Mathematics. These new strategies also engage students in a performance task which is seen to be a possible way of alleviating mathematics anxiety.

In the implementation of any curriculum development framework, the Filipino learners' psyche must be considered with utmost importance. The intellectual capacities of Filipino learners are but a piece of the wholeness of their being and essence. Adopting new learning strategies entails taking the learner at the fore and considering him/her as the baseline of all the other considerations taken into account. With such a premise, mathematics teachers should then be driven to discover more appropriate strategies which may not instantaneously result to significant transformations of educational competencies in terms of students' academic achievement but may positively improve students' attitude, appreciation and enjoyment in learning mathematics.

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