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Tools and Purposes of Computers in Mathematics Education in Different Learning Styles

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Philippine Normal University
National Center for Teacher Education

TOOLS AND PURPOSES OF COMPUTERS IN MATHEMATICS EDUCATION IN DIFFERENT LEARNING STYLES

A Special Project
Presented to the
School of Information and Knowledge Management
Institute of Knowledge Management
Philippine Normal University
Taft Avenue, Manila

In partial fulfilment of the requirement
for the degree Master of Education in
Educational Technology

by

MELIZA M. ROQUE

March, 2014

APPROVAL SHEET

In partial fulfilment for the requirements for the degree Master of Education in Educational Technology, this Special Project entitled "TOOLS AND PURPOSES OF COMPUTERS IN MATHEMATICS EDUCATION IN DIFFERENT LEARNING STYLES", prepared and submitted by MELIZA M. ROQUE is hereby recommended for presentation.

_____ Date

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Approved as partial fulfilment of the requirement for the degree Master of Education in Educational Technology.

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ABSTRACT

This study aims to identify the tools and purposes of computers use in Mathematics Education in Different Learning Styles. The study follows a survey model where 333 high school students were included in the study. Using Kolb's Learning Style Inventory showed that computers only ranked second as tools that facilitates the process in learning Mathematics which followed to calculators. Research-investigation, calculations and downloading homework were noted as the top three reasons for using the computer in Mathematics Education. The results of the study showed that there is no significant correlation in the responses of students with regards to frequency of computer use, the tools that facilitates the process in learning Mathematics and the purposes for using computer according to the learning styles of the students in Sitero Francisco Memorial National High School.

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m.m.r

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CHAPTER I

The Problem and Its Background

Introduction

Changes and advancement in technology are recognized to entirely affect the real world. Technology has an important position in the sphere of education, especially in Mathematics education. The application of technology in teaching and learning processes has been widespread. In Mathematics learning processes, where the rules of the constructivist learning approach were adopted (Applefield, Huber & Moallem, 2001), technology look to be an important component. It is accepted that both national and international entities have a positive viewpoint on technology and computer usage in Mathematics Education. One of the principles that NCTM [National Council of Teachers of Mathematics] (2008) determines for school Mathematics is technology. It reveals that technology is necessary in Mathematics Education because it enhances mathematics teaching and learning process. It was supported by the Department of Education (DepEd, 2013) in the K-12 curriculum (DepEd Order No. 31, s. 2012), that technology

should be integrated and utilized effectively in Mathematics teaching to develop problem solving skills, critical thinking, communicating, reasoning, making connections, decisions and representations in real life. And to use technology implies to use the computer as a tool that could facilitate mathematics teaching and learning process. The computer is not an option in Mathematics education, but instead possesses a complementary role in the organization.

Nowadays, it is a reality that student-centered method and principle should be considered in utilizing computer in mathematics education. With these, the principles of the constructivist learning approach are adapted and students' learning processes are supported while learning environments and materials are planned and developed (Solvie& Kloek, 2007). The learning environment and educational materials developed do not have the same effects on each student due to the differences in learners' knowledge perceiving and processing and reaction processes (Kolb, 1984).

Because of the differences in learners' knowledge, interpretation and reaction process, the learning environment and educational materials developed do not have the same effects. These individual differences were referred as the learning style of the students, which is one of the important issues in Mathematics teaching. Learning style has a deep impact on the education planners. It is seen that the learning styles can have the potential to develop and improve a quality educational design (McLoughlin, 1999).

It is still the alignment of the learning styles in the development of the educational materials that matter, despite the planned learning environment in which computers have been involved in teaching Mathematics. The basic idea here is to make sure that computer and other educational materials that the teacher use should sustain and facilitate student's learning. However, since students have their different needs and learning styles, there is a possibility that the material developed can aid one individual's learning process, while conversely, the learning process becomes harder for the other student. In line with this, the teacher should understand the

responsibility to read the individual learning styles while planning activities with the use of technology.This idea was supported by Sholes(www.ehow.com) in her webpage post stated that when a learner and the instructor have recognized the learning style that uses most often by the student, they can work together to organize activities that will lead to success for the learner.Özgen & Bindak (2012) (cited from Geisert & Dunn study in year 1990), mentioned that teachers should be more informed about the benefits of combining learning styles and computer usage in classroom instruction. Consideringthese two factorscould make the instructional tools more powerful.

It was seen that there is limited research related to learning style and computer use, particularly in secondary Mathematics education. Most of the studies conducted in mathematics education were focused on the attitudes and belief of teachers and students towards the computer, and the effectiveness of CAI in different settings and levels. In the literature, few studies can be found addressing the learning styles of the students, which linked to the tools facilitating Mathematics learning process and the purposes of computer use in Mathematics education. With all these

considerations, the researcher hopes to examine the tools and the purposes of the use of computers in Mathematics education in different learning styles. Thus, the study is intended to provide essential ideas and information in planning, designing and developing learning processes of the students in mathematics with respect to their learning styles.

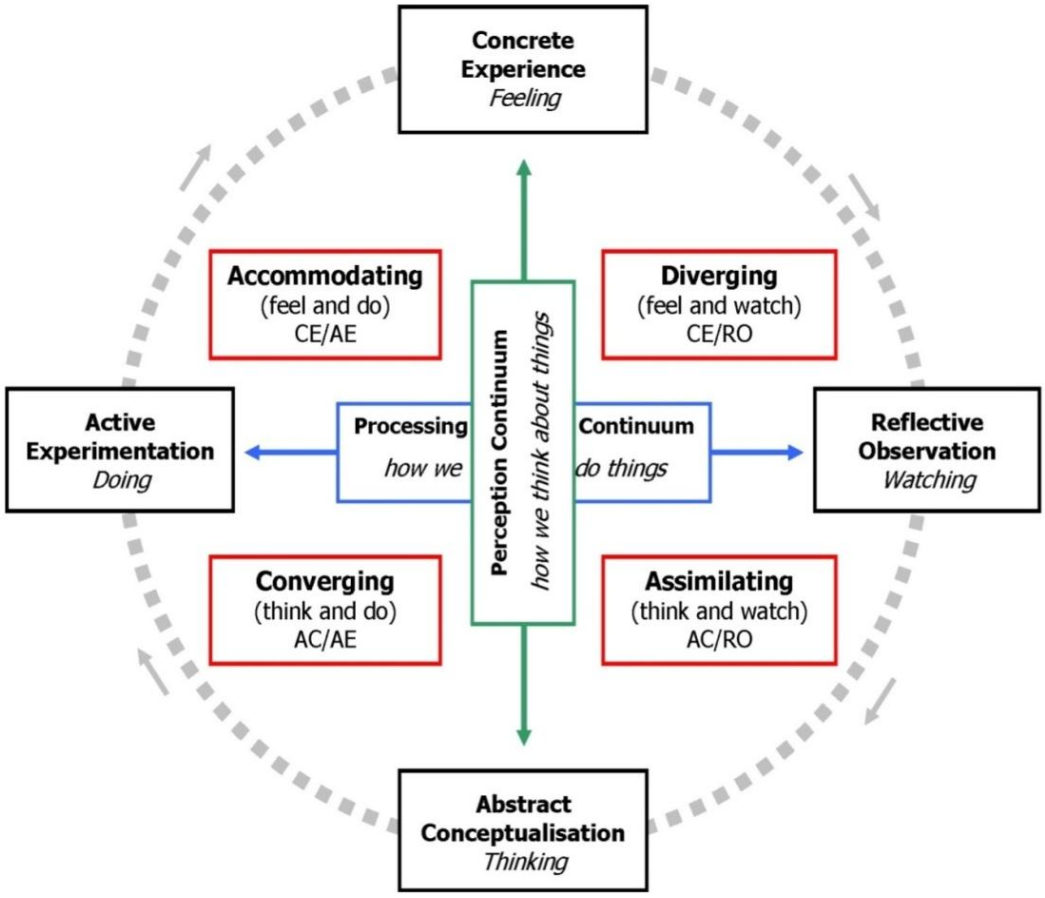
Conceptual Framework

Several different models and inventories have been prepared for assessing learning style. This study was conceptualized based on the learning style model developed by David Kolb in 1984.

This learning style model is one of the best-known models and commonly used learning style theories. Kolb believed that individual learning styles emerge due to genetics, life experiences, and the demands of the existing environment. In addition to four different learning styles, theory of experiential learning and a tool learning style inventory were also developed by Kolb.

Figure 1

Kolb's Learning Style



Based on Kolb's Learning Styles (1984)

The Learning Cycle and Learning Styles are illustrated in figure 1 and describe as follows.

- The 4 red rectangles correspond to the learning styles
- The four black rectangles correspond to the learning cycle.

- The green rectangle indicates the two different ways of knowing.
- The blue rectangle indicates the two different ways of understanding.

Learning is viewed as a four-phase cycle, in experiential theory. At first, the immediate and concrete experiences of the learners serve as a basis for observation. Next, the individual will reflects on these observations and start to build a general theory of what this information might mean. Then, generalizations and abstract concepts will now form which is based upon the hypothesis of the students. In the end, the individual tests and check the inference of these concepts in the new situations. After this phase, the experiential process will start again to the first phase.

The Kolb's Learning Styles are based on two learning techniques, namely **"Knowing"** and **"Transforming".**

Knowing techniques was divided into two phases; the **Concrete Experience (CE)** stage, where the individual learns through experience base method and make judgments based on

what they feel, and **Abstract Conceptualization (AC)** stage where the individual creating theories to give reasons for what they have observed.

Transforming knowledge techniques have also two divisions; the **Reflective Observations (RO)**, where learners trying to find the meaning or the association with the concrete experience through careful observations (watching and listening) and the **Active Experimentation (AE)**, where the individual learned with the use of an active and doing approach (experimentation).

These two techniques were combined and linked together, which best explained the characteristics of the four Kolb's learning styles model labeled as Diverger, Assimilator, Converger and Accommodator.

1. **The Diverger**

   Student with this learning styles were dominant abilities lie in the part of *Concrete Experience (CE) and Reflective Observation (RO)*. Divergers have the opposite strengths of the Converger.

The greatest strength of the divergers lies in their imaginative ability. They ponder concrete experiences and observe data; they watch and listen before offering an opinion; they delay decision makings not until they collected all information.

Divergers best learned from lecture method, brainstorming and hands-on exploration.

2. The Assimilator

Abstract Conceptualization(AC) and Reflective Observation(RO) are the most dominant skills of assimilator learners.

Students with this learning style like accurate and organized delivery of information and seek perfections. Assimilators tend to respect the knowledge and principles of the expert; they approach problems using step by step or vertical method; they were not at ease exploring a system and they mostly like to get the "right and correct" answer to the problems.

These learners are possibly less "instructor intensive" than those of three other learning styles. They followed carefully the prepared exercises, provided a resource person who is available and able to answer questions. Lecture method which followed by a demonstration is suited instructional method to Assimilators students.

3. The Converger

Learners with this learning style have the abilities to link the abstract conceptualization with active experimentation. They show practical problem solving and decision making skills; they act quickly with confidence to put the ideas into practice and they dislike open-ended question and reflection.

Convergers best learned with computer-assisted instruction, workbooks and problem sets for students to explore, field works and experimentations.

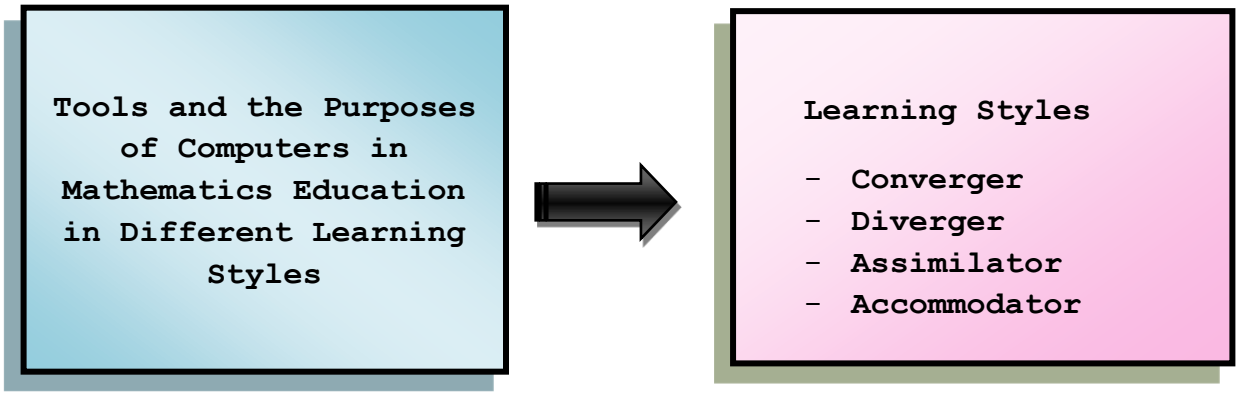
4. The Accommodator

Learners with this learning style are dominant in Concrete Experience (CE) and Active Experimentation. They are the kind of students that they must act first and reflect on the consequences later. Accommodator students are basically the opposite of Assimilator students. These learners are doers; they enjoy making experiments and carrying out plans in the real world. They are best described as risk-takers. They were also skillful in thinking on their feet and could change their plans spontaneously in responding to the new information. They typically use a trial-and-error method when solving problems.

Teachers with this type of student might expect the "devil's advocate" type and must take note that accommodators best learn in the independent discovery method.

Figure 2

Conceptual Paradigm



Dependent Variables **Independent Variables**

The data of the study will come from the responses of the students thru a survey sheet. Different responses toward the tools and functions of computers in Mathematics education are expected to rise due to students' own learning styles. The responses were grouped according to the learning modes of the students such as, Diverger, Assimilator, Converger and Accommodator. The researcher analyzed the data retrieved from each group and treated appropriate statistical test whether the given variables (learning styles and responses towards tools and purposes of Computers) have significant relationship and differences.

Statement of the Problem

This study attempts to assess the tools and the purposes of computers in Mathematics education in different learning styles.

Specifically, it sought to answer the following questions:

1. What is the profile of the respondents according to their learning styles?
2. Is there a significant correlation between the frequencies of computer use and different learning styles of high school students?
3. What are the tools that facilitated the Mathematics learning process of high school students with different learning styles?
4. Is there a significant difference between the tools that facilitate Mathematics learning processes of high school students with different learning styles?
5. Is there a significant difference between the purposes of high school students in using computer and their learning styles?

Scope and Delimitation

This study was conducted at Sitero Francisco Memorial National High School. The group of respondents was selected randomly from the total number of students enrolled SY 2013-2014, mixed male and female, 1st to 4th year from any sections. The study was conducted during the third quarter of the same school year. The sample size was determined using the Slovin's formula. This study is limited only in identifying the tools that facilitated the Mathematics learning processes and the purposes of computers in Mathematics education in different learning styles.

Survey sheets prepared by the researcher and Learning Style Inventory 3.1 developed by David A. Kolb was adopted in this study. Kolb LSI 3.1 is based on experiential learning theory and is designed to help individuals identify the way they learn from experience.

Significance of the Study

This study hopes to be beneficial to the following:

Learners – The appreciation and careful analysis of students learning style offers the learner with study techniques that could complement their own style of learning and will have a great chance to appreciate the value of learning mathematics. Learners will be more able to target the areas that they need for improvement. The more they know about their learning styles, the more they will be able to pinpoint the areas that are more difficult for them.

Mathematics Teachers – It also tries to suggest that the teachers should feel the necessity to interpret the individual learning styles of the students while planning activities by making use of technology in order to impart learning effectively. This study would also inspire Mathematics teachers that the powerful instructional tool will be dispatched when the strength of students' learning styles and computers are counted together.

School Administrators - this study may serve as a basis for determination of steps and plans to undertake in order to help the Mathematics Department to determine the usefulness of Computers in teaching Mathematics according to the students' learning styles now that this trend in teaching technologies is moving fast particularly in Science and Technology.Understanding learning styles can improve the planning and implementing of educational experiences, so they are more suitablysimilar in temperamentof the students' needs, in order to enhance their learning.

Parents – This study may also help the parents of the student to understand the learning needs and deficiencies of their children and thus made them more cooperative and participate with the teachers' effort of getting rid of these deficiencies.

Future researchers - the outcome of this study could serve as a due reference for researchers who wish to understand clearly and intensely practices with computers in the teaching of Mathematics secondary school, and its impact on students' learning styles.

Definition of Terms

For further understanding, the following terms are conceptually and operationally defined.

Computer. A device that computes, especially an electronic machine that performs logical operations, that collects, stores, associate, or otherwise processes information (**http://www.thefreedictionary.com/computer**). In this study, a computer refers to the technological machines which serve as an instructional tool and helps to facilitate learning and teaching mathematics more effectively.

Diverger, Assimilator, Converger and Accommodator. These terms refer to the identified learning styles of David Kolb in his experiential theory. These were used in this study as the term which will best describe the different learning styles of the students in Sitero Francisco Memorial National High School.

Learning Style. It is an individual's natural or habitual pattern of acquiring and processing information

in learning situations. A core concept is that people differ in how they learn (Wikipedia.com).In this study, learning style was identified and grouped according to the Kolb's experiential theory as Converger, Diverger, Assimilator, Accommodator. In order to distinguish the learning styles of students, the Learning Style Inventory – Version 3.1 developed by Kolb in the year 2005 was adapted.

Purposes. It is defined as the reason for which anything is done, created, or exists or it could be the intention to use, perform or accomplish something. In this study, purposes were used as the intention or best reason why high school students used computer in Mathematics Education.

Slovins Formula. This was a statistical sampling technique formula introduced that helps the researchers to draw an unbiased samples out of the given research population.
It was calculated by the formula

$$n = \frac{N}{(1 + Ne^2)}$$

where: n = sample size, N = population size, e = margin of

error. In this study, the researcher considered this to identify the most appropriate, unbiased samples from the students of Sitero Francisco Memorial National High School in school year 2013-2014.

Tools. It is something (as an instrument or apparatus) used in performing an operation and in accomplishing a task. In this study, the word tool referred as the instructional tools that facilitated the learning of secondary students in Mathematics Education.

CHAPTER II

Review of Related Literature

This chapter begins with the historical perspectives of computers and the roles of computers in education and then continues with Mathematics Teaching with Computers. Following this, Learning Styles were discussed. Later, Computer and Learning Styles. Some researches in Philippine setting were reviewed to the consideration of computer usage and its implication in education which are presented in the last part of the chapter.

Brief History of Computers in Education

Computers and related technologies are now in most of the schools all around the world. Innovations in technology are certainly reflected in educational systems.

In most of the developed country's education has been penetrated by information technologies (IT); schools have computers, a large number of teachers use computers and new technologies while teaching, and more over textbooks have some parts devoted to new technologies.

New technologies are integrated into disciplines and more studies are being tempted by the new technologies in an integrated manner. Most of the educators and researchers seek to apply technologies in varied themes, and this integration changes the character, ideas and strategies of work in every subject. For instance, in mathematics education, the approach of teaching and learning, the roles and functions of most concepts have changed with the use of technology.

Despite the wide-spread interest in computers as an instructional tool did not occur until the 1980s, computers were first applied in education and training at a much earlier date.

In 1950, the researcher of IBM designed and developed the first Computer Assisted Instruction to be used in public schools. The user/students followed certain commands on the screen and received rewards for every correct answer they will give within the structure of behaviorist approaches. The large-scale project in education named as PLATO was implemented by Donal Bitier in 1959 at the

University of Illinois. In 1963, Patrick Suppes and Richard Atkinson established a program of research and development of computer-assisted instruction in Reading and Mathematics while they are at Stanford. They developed individualized instructional strategies to free the students from the lockstep process of group-paced instruction, and allow the learners to correct their responses through rapid feedback. The individual-paced programs allowed a student to take an active role in the learning process. Mastery was obtained through drill-and-practice.

In the early 1980s, many instructors were fascinated to microcomputers because aside from being inexpensive, and compressed, it could perform large functions that only large computers can do. The dominant use of computer-based instruction during the time was characterized by the influenced of *behavioral based branching* program software that focuses on drill-and-practice educational programming content and/or skills. The software that ran on the computers of the early 1980s were at first supported on Skinner's "methods of branching" that were divided into small sector; rewarding combined responses, and trainingdetached facts.

Eventually, computers started to have a big impact on teaching practices in school during 1990s. With the help of advances in learning and technology, researchers think about learning with technology as a means of problem-solving skills, constructing, and for attaining learner independence.

The cognitive method of technological instruction focused on analyzing how the person plans and perform the process of communicating, remembering, thinking, and understanding. Besides, students would also learn through simple simulations and games with the help of principles of cognitive learning.

The word processor has been discovered and appreciated by the instructors and students because of its the given advantages in writing and revising of paper works. The importance of the computer in making a very good learning environment were perceived by the other subject teachers.

From the year 1995, advances in computer, internet and other digital technology, have led to a rapidly increasing

interest in the use and appreciation of these media for teaching purposes. A volume of information accessible to students with a network of people all in all locations improved the communicating skills and the sharing of ideas. Moreover, distance education courses are offered, in this way students in geographically isolated schools have extended learning opportunities in a diversity of fields.Theoretical explanations could now be established and manipulated with the aid of technology innovations.A complete, modern learning environment became possible.Since the arrival of the personal computers within the middle Eighties, computers have speedily become one amongst key educational technologies used in both formal and informal education.

Computers become one of the technological teaching tools in both formal and informal instruction when the personal computers were presented. The function of the computer was changed because of the two factors: first, it can give students better learning experiences and secondly, it gives students the power to manipulate the manner and depth of learning. Furthermore, teachers can utilize the computer as an aid in the classroom activity management and

it plays a big role in the curriculum especially to the teaching and learning process.

Roles of Computers in Education

At this point, the researcher thought that it would be helpful to offer some descriptions of learning activities involving computers. In the field of instruction there are three broad groups of computer applications:

- Asasubject of instruction,
- As a tool or device,
- As an instructor teaching device,

The computer may be the subject of instruction, for instance, computer programming course, where students can gain knowledge about how to construct programming languages.

The computer assists both teachers and students in every different way. It could be used as a tool or device; such as calculator, typewriter and presentation aid. The computer acted as; calculators, that students could use in solving complex math problems; typewriter, (word processing

programs) that complete term papers, project and assignment; and a data presentation assistance (PowerPoint presentation programs) to express the substance of the subject-matters. The role of the computer as an instructional device were represented by the different Computer Assisted Instruction (CAI). For example, Geogebra and Geometric Sketchpad, which used in geometry lessons.

After providing a brief reminding of the applications of computers, there is a need to mention the computers in teaching Mathematics.

Mathematics Teaching with Computers

Technology has become a part of most of the activities in a person's everyday life. Eventually, it entered into the educational arena as well as other fields. The role of technology in schools is growing in both technological tools such as computers and related software. Moreover, the new technological tools and related environments are growing in the general reform in Mathematics education to provide more enjoyable and efficient learning opportunities to students.

Various potentials of using rules to teach mathematical ideas signify promises of advantages for educators who are skilled in using computers. As can be seen in our environment, most of the applications in information technology are directly connected with Mathematics such as the use of computers in malls and supermarkets or even the use of simple calculators. It is evident that the use of computers and calculators are very useful since it is a part of everyday life and for this reason, mathematics educators strive hard to integrate this on their teaching.

Computer into Mathematics Curriculum

The term "curriculum" is defined as an outlined plan for education that describes what students need to know, how students are to gain the determined program goals, the method of teachers must do to help students develop knowledge and framework of teaching and learning process.

Mathematics is widely regarded as one of the most important parts of the school curriculum. Indeed, it is

probable that more lessons of mathematics are taught in schools and college throughout the world than any other subject.

Students use computers primarily as individualized tutorial activities which are exactly the same with traditional paper and pencil exercises. In the case of traditional methods in mathematics teaching, it is obvious that mathematical concepts are usually being transferred in an abstract way.

The needed and the desired utilization of the computers in Mathematics classrooms is based on using of the computer as a tool to promote student learning within the regular curriculum. Computers have to be incorporated into the basic life of the mathematics lessons in meaningful ways to understand and appreciate the significant differences in the usefulness of mathematics instruction. The only way to obtain the effective results of the usage of the computers in mathematics lessons is the tying computer use of major curriculum goals.

The utilization of computers provides a great deal of advantages. It sharpens one's mind by means of problem solving and conceptual understanding. In addition to this, students learn how to solve real world based problem situations. With the benefits that this sort of technology brings, a necessity to take advantage of this in mathematics curriculum was felt. Moreover, a link between hands-on experiences and abstract learning is thought to be possible with the use of computers. Thus, it can assist learners to gain more understanding on a topic through exploration and experimentation.

However, to make those things possible, the teachers must bear in mind that the computer use will be more effective if they plan and align the instructional tools to the students' differences and learning styles.

Learning Styles

Learning is described as the process whereby knowledge is created through the transformation of experiences. People use learning to deal and manage everyday situations, giving rise to different modes of learning. The concept of

learning styles has received substantial attention in the observed literature and many theories have been proposed in order to better appreciation of the dynamic process of learning. A diversity of learning style theories and frameworks have been developed along with accompanying instruments that operationalize their learning style constructs.

An advantage of assessing student's learning style is the knowledge acquisition that one can get upon obtaining the learners dominant skills. Using this knowledge, one can create, improve, lay out and present resources and educational programs that will engage students in learning and applying the information and professional knowledge in an endeavor to individualized or personalized instruction.

The most common learning theory in research is information processing, which considers personality theories and suggests four sequential stages during the learning process. The data processing theories are based on Lewin's Cycle of Adult Learning (Kolb, 1984). Lewin’s cycle describes four phases that follow on from each other during the learning process. The first phase is concrete

experience, followed by personal reflection on the experience. This is then blended with previous knowledge (abstract conceptualization), and finally new ways of adjusting to experiences are explored (active experimentation) (Kolb, 1984). Experiential Learning Cycle identified by David Kolb is one system based on Lewin's work. Kolb supports the concept of influences on learning style from personality traits.

In Kolb's Experiential Learning Cycle, an individual would experience through all four stages (Kolb, 1984). Some points may pass through, or one stage may become the focus. As delineated by Kolb, preferences within a concrete experience stage of learning results in educating from specific experiences or from relating to people. Once the reflective observation phase is favored, watchful observation and searching for meaning is likely to be evident (Kolb, 1984). A preference for the abstract conceptualization stage will produce logical analysis and systematic preparation. The last stage of the cycle contains taking risks and pursuing activities or tasks, behaviors that are mentioned in an individual with a preference for active experimentation. Kolb acquires the

Lewin's original rotation a step further, suggesting a specific learning style choice based on an individuals' utilization of the four learning phases (Kolb, 1984). The resulting learning styles are "diverger", "assimilator", "converger" and "accommodator",. The characteristics of the four learning styles and the best delivery method are shown in Table 1 adapted from Sarabdeen (2013).

Table 1

Kolb's Theory

Characteristics of Various Learners

and Best Delivery Methods

Kolb's Learning Style	Characteristics	Training Delivery Mode
Diverger	They are good at concrete experience and reflective observation. Consequently, they tend to be imaginative and provide innovative ideas	Traditional classroom based delivery that is comprised of brainstorming sessions, reflective activities, speeches and rhetorical questions
Assimilator	This group uses abstract conceptualization and reflective observation. They are adept at using inductive reasoning. They are private learners.	Prefer to print-based delivery
Converger	They are good in abstract conceptualization and active experimentation. Thus, they will be able	Small-group discussion and classroom participation. Dislike lectures. They are not natural risk

	to gain practical application of ideas by deductive reasoning. They are logical and excellent problem solvers.	takers. Therefore, they prefer data-based programs and prefer computer based learning.
Accommodator	This group of learner tends to use concrete experience and active experimentation. They are proficient at actually doing the things.	Like experiment. So could use hands-on computer based simulation games, online group work, role play games and observations. They prefer a computer based delivery mode.

COMPUTER AND LEARNING STYLES

The concepts of computer and learning style have been the subjects of research in several different age groups and areas of study. It is seen that studies have been made on subjects such as learning style and attitude towards computers and computer assisted learning (Brudenell, 1990), e-learning (Brown, et.al., 2009), blended learning (Akkoyunlu&Soylu, 2008), computer anxiety& stress (Cummings &Ballance, 2009), computer performance (Miller, 2005),attitude towards computer assisted learning and computer achievements (Sarıçam etal 2013), achievement in different learning environments (Soylu & Akkoyunlu, 2009),and multimedia course design (Zin, 2009).

Sarıçam (2013) examined pre-service teachers' attitudes towards computer assisted teaching and their computer achievements based on their learning styles. Sarıçamconcluded that computer assisted education attitudes of visual learners are high level and there are significant relationship between attitude scores and computer achievements.

Zin (2009) concluded in his experimental study, in which he analyzed the effectiveness of a multimedia course design he developed for math education based on learning style, that students are effective in producing learning materials in the experimental group created, based on learning styles.

Cummings & Ballance (2009) found that computer related anxieties of primary school teachers have significant differences based on learning styles.

Miller (2005) presented in his study the effects of learning styles in performance based on computer assisted teaching, evaluated according to the Gregorc and Kolb

learning style model, he found out that the Gregorc learning style model had a significant effect, while on the contrary, the Kolb learning style model did not.

Buch and Bartely (2002) used Kolb model in his research where they conducted a survey in a big financial services institution in the Southeast USA. Three hundred thirty five employees' were identified and questionnaire was distributed, but165 employees only participated. They use research questionnaire which includes five delivery modes: the audio based, the print based, the TV based, the computer based, and the classroom based. The result revealed that25% were accommodators 29% were assimilators, 22% were convergers and 24%were divergers. This confirmed that in an adult population, various styles of learning are manifested. The divergers preferred conventional mode of delivery and accommodators preferred computer based learning. The result of this study, is one of the many research findings that support Kolb's theory of Learning Style Inventory.

Regardless of learning style models or learning aspects of the model (visual, auditory, active, reflective,

tactile, concrete, abstract), the basic objective should be to develop computer assisted learning activities compliant to the dominant learning styles of learners. While students find the opportunity to discover more easily through the learning activities which are appropriate to their own learning styles, they will get the chance to deal with difficulties and see the alternatives by means of other learning styles. In line with this, within the scope of the constructivist approach, it is taken to be as helpful to apply an approach of multiple learning styles (Solvie& Kloek, 2007).

Research of Computer Used in the Philippines

As stated above computers' use is increasing all over the world. In the last three decades, computer technologies have evolved rapidly and intensively. By this swift growth, integration of information technologies into the teaching and learning activities has turned into possible and financially manageable. These advancements of computer technologies have changed the instructional strategies that the teachers followed in their lectures and the ways students learn. Several schools, including those in the

Philippines, are now moving towards using computers to improve the quality of teaching and learning.

There are many studies in the Philippine education system that confirms the effectiveness of computers at different grade levels and subject areas mainly Science and Mathematics teaching.For example, in science education, a study led by Alvarez (2010), investigated the effect of computer-aided instruction on the academic performance of third year students in Science and Technology III at Cawayan Integrated School, Division of Northern Samar.Quasi-experimental design was employed in the study considering that the grades have been already consolidated.There is control group which was was exposed to traditional lecture-discussion method while the experimental group was was treated a computer-aided instruction. The results of the study indicated that, the experimental group of students outperformed the control group of students in the academic performance of the third year students in Science and Technology III.

Ragasa (2008) compared the effects of CAI with the Traditional Based Instruction (TBI) of Teaching Basic

Statistics. She concluded that the gain scores of the mathematics achievement test on equations unit were significantly higher in the group of students who were exposed to CAI than the group of students who was exposed to TBI.

However, the effectiveness of technology will be more effective if the people behind the students' learning will consider the learning styles in making and developing an instruction that will cater the special needs of the pupils. Ingosan et.al (2012), conducted a study in the University of the Cordilleras in Baguio City, Philippines. The study explored the potential of a learning style-driven e-learning system to assist learners.This task was carried out by shaping the learning style model to identify the learning style of learners; determining the learning style model tool to classify the learners based on their learning style; identifying the characteristics of the proposed learning style-driven e-learning so it can adapt to the learning style of learners; and, determining the benefits of applying the learning style-driven e-learning.At the conclusion, the researchers proved that a learning style-

driven e-learning system is a tool in the learning process similarly with the traditional classroom learning.

Dacanay (2010), have undergone a study that focused primarily on the conception and development of the e-learning courseware that served as a supplementary tool in learning Computer Programming 2 in Don Mariano Marcos Memorial State University in Agoo La Union.The design and development operations were supported by instructional design using the ADDIE model which has five (5) phases, namely analysis, design, development, implementation, and evaluation.He carefully analyzed and incorporated the instructional goals, learning objectives, assessment modules and course content using a variety of learning style presentations to keep the learners engaged, to enrich the learning experience and to maximize the course's impact. The study determined that the preferred presentation elements in each topic in Computer Programming 2 are using visual learning presentation elements. The LAN-based learning management system was considered in designing the proposed system.

Tonog (2012), conducted a study at the University of Eastern Philippines (UEP) in Catarman, Northern Samar that focused on the teaching styles of the teachers, the students' learning styles and the effect of their styles on the student academic achievement in General Chemistry 1. There is a significant relationship between teaching and learning styles, especially on the following factors: teaching methods with auditory learning mode; instructional planning with a variety of teaching strategies, learning either individually or with peers and friends; student grouping and room design with late morning; and educational philosophy with motivation. This study concluded that teaching and learning styles affect students- academic achievement.

Tao (2011) predicted English achievement of Chinese students using the Productivity Environmental Preference Survey (PEPS), broadly focused learning style instrument. The study ought to know which among the learning styles could best predict English achievement of the students. The participants consisted of 300 non-English major, students aged from 18 to 23 in the second year at a Chinese

university here in the Philippines. A Chinese translation of the PEPS was adapted to assess the students' learning preferences pertaining to the following 19 modalities: noise, brightness, temperature, design, motivation, perseverance, accountability, peer orientation, structure, authority orientation, auditory, visual, tactile, kinesthetic, mobility, intake, morning/ evening, and late afternoon,

The multiple regressions were used to examine whether these PEPS subscales could significantly predict English proficiency. Results indicated that only Seating design (0.04), Responsibility (0.00), Authority orientation (0.00), Kinesthetic (0.01), and Mobility (0.00) were significant predictors of English achievement (p<. 05), which account for 19% of variance in English Achievement (R2=0.19, Adjusted R2=0.15).

Since the advancements in technology are inevitably reflected in educational systems, some competitive schools in the Philippines have completed their hardware and software needs to employ the information technologies in education, but teachers along with the educational officials must look at the differences and the needs of the

students with regard to their learning styles in the preparing, planning and implementing the policies and curriculum for the next generation.

SYNTHESIS

The preceding discussion is part of broad literature that is supposed to be necessary to sustain a general theoretical and conceptual background on the students learning style, computer that contribute to different learning style and its effectiveness in the field of education, particularly in Mathematics teaching and learning activities. As mentioned, technology has a great impact on every dimension of peoples' everyday life. Education is just one of these parts where computers were introduced as a teaching tool for the enrichment and support of subject matters. With the help of computers and with the consideration of the learning styles that dominates to the students, it was expected that they will to improve their learning, resourcefulness techniques, problem solving skills, and retention. Thus, they will have an opportunity to be more active learners.

Chapter 3

Methodology

This chapter presents the research design, participant and sampling techniques, research instruments, data gathering procedure, and statistical treatment of data.

RESEARCH DESIGN

A research plan is described as a blueprint, or outline, for conducting the study in such a way that maximum control will be exercised over factors that could interfere with the robustness of the research outcomes. This is the researcher's overall plan for obtaining answers to the research questions guiding the work.

A method that is frequently used to obtain information on social and behavioral variables and the relationships between these variables is survey method, in which the researcher selects a sample or subgroup of people and asks them questions about issues related to the research.The answers to these questions are then regarded as a description identifying the thoughts and attitudes of the whole population from which the sample was taken.Surveys

are conducted for the general purpose of obtaining information about practices, feelings, attitudes and other characteristics of people.

For these reasons, the researcher used descriptive research methodology and designed a survey instrument to examine the tools and purposes of using computers in Mathematics education based on different learning styles. In this study,a survey was conducted which includes data about personal information of high school students, their learning styles, and status on possessing a computer and preferences about using computers in Mathematics education, as well as their purpose of use.

Figure 1

Research Procedure Diagram

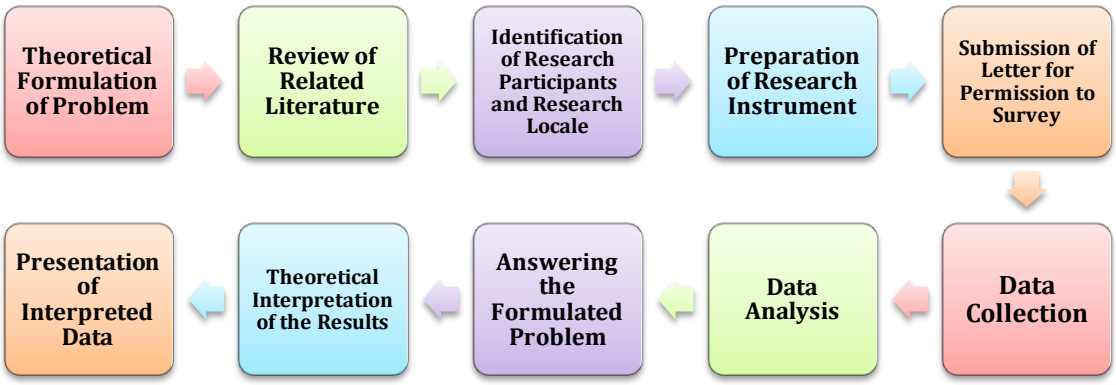


Figure 1 shows the research procedure undergone by the research to determine the tools and purposes of Computers in Mathematics Education in Different Learning Style

Participants of the Study

A population is the entire group of subjects that meet a designated set of criteria. The population of this study was comprised of High School Students of Sitero Francisco Memorial National High School, S.Y 2013-2014.

Sampling is the process of taking a portion of the population to represent the entire population.In this survey, stratified random sampling was used to hold the target sample.The goal of the stratified random sample is to lessen the probability of human bias in the selection of cases that will bepart of the sample.As a result, the stratified random sample is provided with a sample that is highly representative of the population being studied, taking for granted that there is limited missing data. Since the units selected for inclusion within the sample are selected using probabilistic methods, stratified random

sampling allow researchers to make statistical conclusions from the data collected that will be considered to be valid. The stratified random sample also develops the representation of particular strata (group) contained in the population, as well as giving guarantees that these strata are not over-represented. Together, this assists the researcher to evaluate strata, as well as construct more valid inferences from the sample to the population.Consequently, the sample in this study was divided by year level to address the fact that there is wide variance in the number of high school student.

There are 1999 regular students enrolled in Sitero Francisco Memorial National High School,2013-2014. To achieve the total number of sample, Slovin's formula(see Appendix A) was adapted in this study. Using 5% margin of error, there were 333 high school students who were the samples of this study. Table 2 shows the number of students per year level that participated in this study.

Table 2

Number of Students Per Year Level Participated

Year /Grade Level	Total Population per Year/Grade	Number of Participant
Grade 7	609	102
Grade 8	554	92
Third Year	432	72
Fourth Year	404	67
Total	**1999**	**333**

Research Locale

This study was conducted in Sitero Francisco Memorial National High School (SFMNHS). This is the only legislated High School in Valenzuela City with its humble beginnings through the passage of Republic Act 8842 on August 22, 2002. It is located at Sta. Monica Subdivision, Ugong, Valenzuela City.

In February 2009, SFMNHS was recorded as the First Public School in the country that conducted an electronic voting to elect the student government officers under the

supervision of the school principal, Cesar C. Villareal. (Philippine Daily Inquirer, March 15,2009).

In June 2, 2010, Mr. Villareal made SFMNHS recognized again for being the First Solar-Powered School in the country after the installation of six 1-kW solar panels to light its 9 classrooms.

In the school year 2010-2011, the local government provided 50 computers and a technician in the computer laboratory of Sitero Francisco Memorial National High School. This computer laboratory is used by the students and teachers as part of the teaching-learning environment.

It is seen that Sitero Francisco Memorial National High School were ahead in terms of technology compared to the other schools in Valenzuela.

At present, there are 61 teaching staff and 10 non-teaching staff in SFMNHS.

Research Instruments

The following research instruments were used in this study.

- Survey sheets
- Learning Style Inventory

In the study, a survey sheet was used in order to determine students' personal information, their status of possessing a personal computer, their regularity of using a computer, and the purposes of their preferences for using computers in mathematics education. In this survey sheet, students' purposes for using the tools were examined with open-ended questions. To identify the quality of the survey sheet, the researcher recruit a small group of students (10 students) to answer the given questions and to provide input on their understanding of the questions and ability to complete it. All conflicts with regards to the survey question constructed such as unfamiliar words, the clarity of the questions, the flow of the survey sheet questions and the actual time required to complete answering the questions were addressed and noted.

In order to determine the learning styles of the respondents, the study employed the *"Learning Style Inventory –Version3.1"*which was developed by Kolb (2005). The inventory contains nine fill-in items, each of which consists of four choices. For each given situation, an individual is asked to rate the most suitable statement with "4", the second most suitable with "3", the third most suitable with "2", and the least suitable with "1" point. Each choice contains a phrase that described the four learning preferences (concrete experience, abstract conceptualization, active experimentation, and reflective observation). The Turkish version of Kolb's Learning Style Inventory was tested by Gencel (2007) to examine the validity and reliability of the inventory. The researcher sets the validity and reliability coefficients of the inventory dimensions as0. 61 for concrete experience (CE), 0.66 for abstract conceptualization (AC), 0.76 for reflective observation (RO), 0.69 for active experimentation (AE), and 0.66 for abstract conceptualization (AC). As it has been used in several studies, the inventory is considered as valid and reliable.

Data Gathering Procedure

This is a descriptive study in survey model conducted to identify the tools and the purposes of computers in Mathematics education in different learning styles.

The researcher briefs the students about the study and its significance to them. Then, the Kolb's Learning Style Inventory was discussed on how it will be done. After determining the learning styles of each respondent, they were asked to answer the survey questionnaire which includes data about personal information, their learning styles, the tools facilitate their learning, the status on possessing a computer and preferences about using computers in mathematics education, as well as their purpose of using it.

Data Analysis Procedure

The researcher analyzed and applied corresponding statistical treatment to all data gathered in the study. Tables and descriptive statistics were constructed to display results with respect to each of the three research questions. Findings, conclusion and recommendation will also be given after the treatment.

FREQUENCY & PERCENTAGE. This statistical tools were used to describe the personal information of students, tools facilitate Mathematics learning and the purposes of using computers.

CHI-SQUARE GOODNESS OF FIT. This statistical treatment was used to determine if there is a significant difference between observed frequencies and theoretical frequencies. In this study, responses about the tools that facilitate mathematics learning processes, the purposes of high school students in using computers and the learning styles of the student were tested by this tool.

CHI-SQUARE TEST OF CORRELATION. This statistical tool was used to test if there is a significant relationship between two nominal variables. In this study, the relation of students' learning styles and the frequency of computer use were treated by this tool.

LEARNING STYLE TYPE GRID. By rating the nine items in the learning style inventory, the participants obtained a minimum score of 8 and a maximum score of 24 for each

learning preference; concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The two combination scores are obtained from two subtractions: AC-CE (described as the perceiving knowledge) and AE-RO (processing knowledge). After the rating, composite scores were computed and will consider in identifying an individual's learning style.The obtained composite scores were placed in the coordinate system given in the Learning Style Type Grid (see Appendix C), created by Kolb in the year 1999. It provides a clear visual understanding for the learning styles.The score obtained with AC – CE was placed on the "y" axis, while the score obtained with AE – RO was placed on the "x" axis, and the resulting area of intersection for these two scores was identified to indicate an individual's learning style (*Diverger, Converger, Assimilator, Accommodator*).

Chapter IV

Presentation, Analysis and Interpretation of Data

In this chapter the results of the data analysis are presented. The data were collected and then processed in response to the problems given in chapter 1 of this study. The purpose of this study is to examine the tools and the purposes of computers in Mathematics education in different learning styles.

The results obtained from data analysis according to the order of presentation of the sub-problems are given as follows:

Table 3
Respondents Profile According
to Year Level and Learning Styles

Year Level	Learning Styles				total
	Diverger	Assimilator	Converger	Accommodator	
Grade 7	40	16	16	30	102
Grade 8	38	10	18	26	92
Third Year	19	9	16	28	72
Fourth Year	32	5	5	25	67
total	**129**	**40**	**55**	**109**	**333**
percentage	**38.74%**	**12.01%**	**16.52%**	**32.73%**	**100%**

Table 3 shows the distribution of respondents according to their year level and learning styles. One hundred twenty nine(38.74%) of the respondents were diverger students, 109(32.73%) were accommodator students, 55 or 16.52% were converger students and the remaining 40 respondents were categorized as assimilator students. Most of the respondents were diverger and accommodator students, this means that most of the respondents' dominant learning abilities lies on their concrete experience and they also learn the things through reflective observation (diverger) and active experimentation (accommodator).

In order to find an answer to the second sub-problem of the study, which was mentioned as "Is there a significant difference between the computer use frequency of high school students with different learning styles?", the information related to the students' frequency of computer use and chi-square analysis were given in Table 4 and 5.

It was found that students in all learning styles use computers at least "13 - 18 hours a week". Moreover, it is seen that the accommodator and diverger students use

computers more often than the students with other learning styles.

Table 4

Results Regarding Students' Frequency of Computer Use According To Learning Styles

		Learning Styles									
		Diverger		Assimilator		Converger		Accommodator		total	
		f	%	f	%	f	%	f	%	f	%
Frequency Of Computer Use	never	1	0.8	2	1.6	2	1.6	0	0.0	5	3.9
	1- 6 hour/s a week	10	7.8	4	3.1	11	8.5	4	3.1	29	22.5
	7 - 12 hours a week	55	42.6	12	9.3	18	14.0	36	27.9	121	93.8
	13 - 18 hours a week	18	14.0	9	7.0	4	3.1	26	20.2	57	44.2
	19 - 24 hours a week	25	19.4	10	7.8	11	8.5	22	17.1	68	52.7
	more than 24 hours a week	20	15.5	3	2.3	9	7.0	21	16.3	53	41.1
total		**129**		**40**		**55**		**109**		**333**	

TABLE 5

Significant Relationship between Learning Styles and Frequency of Computer Use

Variables	Degrees of Freedom (df)	Computed Chi-square	Critical Value	Alpha level (a)	p	Decision	Conclusion
Learning Style & Frequency of Computer use	15	31.329	24.996	0.05	0.00793	REJECT HO	There is significant relationship

Table 5 illustrates the data analysis of the second sub-question. The computed chi-square value(x^2) is greater than the critical value, and the p value is less than the alpha level (0.05). In line with this, there is enough evidence to reject the null hypothesis and conclude that this difference observed in students' answers regarding their computer use was significant. In other words, there is a significant relationship between students' learning styles and their frequency computer use.

It is seen that the respondents that the students responds falls under "13 - 18 hours a week" regardless to their learning styles. In the studies conducted with students, teachers and pre-service teachers in various age groups, it is seen that the computer use frequency and attitudes toward computers are connected. It is indicated that the ones using computers more often have more positive attitudes. In the study conducted by Kutluca (2010), it was identified that there are significant differences in the attitudes toward computers, in line with the frequency and level of computer use and possessing to a computer.

Nowadays, it is seen that teachers' and the students' frequency of computer use affects their attitudes towards computer since computers were very accessible inside or outside school.

Regarding the third sub-problem of the study, Table 6 shows the students' response regarding the tools facilitating the process of learning Mathematics.

Table 6

Tools Facilitating the Process of Learning Mathematics

TOOLS*	total	%
Books	177	53.15%
Calculators	249	74.77%
Chart	24	7.21%
Computer	207	62.16%
Dictionary	12	3.60%
Flashcards	10	3.00%
Geometric Objects	36	10.81%
Internet	39	11.71%
Magazine	9	2.70%
Measuring Tools	162	48.65%

*More than one answer was given

Frequencies in high school students' responses about the tools facilitating the process of learning Mathematics were listed, respectively, as follows: books, calculators, chart, computer, dictionary, flash cards, geometric objects, internet, magazine and measuring tools. Two hundred seven (62.16%) of the students stated that computers facilitated the process of learning.

The results of the chi-square analysis made in order to find out whether there are significant differences among the tools facilitating the process of learning Mathematics based on different learning styles are given in Table 7.

All of the respondents with different learning style stated that "the calculator" as the tool facilitating the process of learning. As the responds thedivergers (58.9%), assimilators (14.7%), convergers (32.6%) and accommodators (54.3%) considered computers as the second tool facilitating the process of learning Mathematics. It is determined that there are no significant differences based on learning styles in the analyses of the responses of students who stated the computer category and those who did not.

Table 7

Chi-Square Results on the Tools Facilitating the Process of Learning Mathematics in Different Learning Styles

	LEARNING STYLES*										RESULT		Decision (at 0.05 alpha level)
	Diverger		Assimilator		Converger		Accommodator		total				
Tools	f	%	F	%	f	%	f	%	f	%	$X^2_{(3)}$	P	
Books	**74**	57.4	**14**	10.9	**31**	24.0	**58**	45.0	**177**	53.15	3.02	0.389	Accept ho
Calculator	**93**	72.1	**25**	19.4	**46**	35.7	**85**	65.9	**249**	74.77	1.66	0.646	Accept ho
Chart	**6**	4.7	**7**	5.4	**6**	4.7	**5**	3.9	**24**	7.21	9.13	0.028*	**Reject ho**
Computer	**76**	58.9	**19**	14.7	**42**	32.6	**70**	54.3	**207**	62.16	3.46	0.326	Accept ho
Dictionary	**5**	3.9	**0**	0.0	**6**	4.7	**1**	0.8	**12**	3.60	11.80	0.008*	**Reject ho**
Flashcard	**10**	7.8	**0**	0.0	**0**	0.0	**0**	0.0	**10**	3.00	15.81	0.001*	**Reject ho**
Geometric tools	**10**	7.8	**2**	1.6	**9**	7.0	**15**	11.6	**36**	10.81	4.81	0.186	Accept ho
Internet	**22**	17.1	**3**	2.3	**9**	7.0	**5**	3.9	**39**	11.71	9.49	0.023*	**Reject ho**
Magazine	**2**	1.6	**0**	0.0	**2**	1.6	**5**	3.9	**9**	2.70	3.32	0.344	Accept ho
Measuring tools	**69**	53.5	**18**	14.0	**35**	27.1	**40**	31.0	**162**	48.65	6.47	0.091	Accept ho

* There is significant difference

According to Table 7, it was found that there are significant differences between those stating answers as the "chart", "dictionary", "flash card" and "internet" and others who did not respond to the tools facilitating the process of learning Mathematics based on different learning styles. It is also seen that there is no significant difference about the other tools according to learning styles.

The responses of students who stated the computer category were examined in terms of the learning styles and it was seen that the percentage of the diverger(58.9%) students was the highest while the percentage of assimilator(14.7%) students was the lowest. Even though computer were not chosen as rank 1 as the tools facilitating the learning in Mathematics, it could be said that students' perception of computers is at a sufficient level now that computers have rapidly integrated into the educational system and particularly in the process of learning and teaching Mathematics. This result opposed the study of Özgen and Bindak (2012) that even though computers and technologies are now at hand of everyone, it is still "the board" and "the books" which facilitated the process of learning Mathematics which means they were left behind in the trend of technology in education.

Even if there are no significant differences based on learning styles in the analyses of the responses of students who stated the computer category and those who did not, the fact that the percentage of diverger students is the highest can be the result of students' preference for

learning mostly by observing, watching-listening. On the other hand assimilator students arethe lowest, which may result from their preference for learning by practicing and implementing.

To answer research problem number 5, Table 8 shows the students' answer related to their purposes for using computers in the process of learning Mathematics.

Table 8
Purposes for Using Computers
in the Process of Learning Mathematics

Purpose of Use	f	%
Calculations	**178**	53.45
Research - Investigation	**252**	75.68
Making Projects	**40**	12.01
Downloading Homework	**105**	31.53
Reporting	**70**	21.02
Printing	**31**	9.31
Gaming	**30**	9.01
Math Software Programs	**38**	11.41

Based on the student responses with regard to their purpose for using computers in the process of learning Mathematics, it was stated that the purpose of using computers is mostly research investigation. The purposes of computer use are, respectively, research-investigation, calculation, making projects, downloading homework, reporting, printing, gaming and for Math software programs.

Table 9

The Descriptive Statistical Information for the Students' Purposes for Using Computers in the Process of Learning Mathematics

	LEARNING STYLES										RESULTS		Decision (at 0.05 alpha level)
	Diverger		Assimilator		Converger		Accommodator		total				
Purpose of Use	f	%	F	%	f	%	f	%	f	%	$X^2_{(3)}$	P	
Calculations	**74**	57.4	**19**	47.5	**34**	61.8	**51**	46.8	**178**	53.45	2.260	0.520	Accept ho
Research-investigation	**100**	77.5	**33**	82.5	**47**	85.5	**72**	66.1	**252**	75.68	2.332	0.506	Accept ho
Making projects	**23**	17.8	**4**	10	**5**	9.1	**8**	7.3	**40**	12.01	6.141	0.105	Accept ho
Downloading homework	**37**	28.7	**18**	45	**13**	23.6	**37**	33.9	**105**	31.53	3.922	0.270	Accept ho
Reporting	**25**	19.4	**8**	20	**10**	18.2	**27**	24.8	**70**	21.02	1.125	0.771	Accept ho
Printing	**11**	8.5	**5**	12.5	**4**	7.3	**11**	10.1	**31**	9.31	0.839	0.840	Accept ho
Gaming	**24**	18.6	**0**	0	**0**	0.0	**6**	5.5	**30**	9.01	23.229	0.000	Reject ho
Math software's programs	**20**	15.5	**3**	7.5	**5**	9.1	**10**	9.2	**38**	11.41	3.167	0.367	Accept ho

Table 9 shows the results of chi-square analysis made in order to determine whether there are significant

differences among the responses of the students related to their purpose of computer use in the process of learning Mathematics according to different learning styles.

Students of all learning styles stated mostly research-investigation, calculation and downloading homework as the purpose of using computers, respectively. It was found that there is significant difference between the students' who expressed an answer about using computers for the purposes of gaming and those who did not.

It is an fascinating results that diverger and accommodator students expressed their answers with a higher percentage than the students in other learning styles because concrete experiences are more at the forefront for the diverger and accommodator students. It only means that mathematics education was not based on the concrete experiences with respect to the utilization of computer on learning.

Aside from this, responses in the downloading homework category were examined in terms of learning styles and it was found that converger had the least percentage while

other students have the same level of answers. It was thought provoking that most of the answers to the purposes of computer use was downloading homework because in this case, students may benefit from the computer in the wrong way. It is also determined that students' answers on computer use in the process of learning Mathematics do not differ in other categories in terms of learning styles. However, the fact that students' responses on the other categories have lower percentages bring some questions to mind. It is clearly understood that these students are not encouraged for the different computer assisted activities by their teachers and do not use computers with the proper purposes in their processes of learning Mathematics.

Chapter V

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of the research undertaken, the conclusions drawn and the recommendations made as an outgrowth of this study.

1. What is the profile of the respondents according to their learning styles?
2. Is there a significant correlation between the frequencies of computer use and different learning styles of high school students?
3. What are the tools that facilitated the Mathematics learning process of high school students with different learning styles?
4. Is there a significant difference between the tools that facilitate Mathematics learning processes of high school students with different learning styles?
5. Is there a significant difference between the purposes of high school students in using computer and their learning styles?

Summary of Findings

The salient findings of the study are as follows:

1. ***Respondents Profile According to Their Learning Styles***

   One hundred twenty nine (38.74%) of the respondents were diverger students, 109(32.73%) were accommodator students, 55 or 16.52% were converger students and the remaining 40 respondents were categorized as assimilator students.

2. ***Significant Relationship Between Different Learning Styles and the Frequencies of Computer Use***

   It was found that students in all learning styles use computers at least "13-18 hours a week". Moreover, it is seen that the accommodator and diverger students use computers more often than the students with other learning styles. There is also enough evidence to reject the null hypothesis and conclude that this difference observed in students' opinions regarding their computer use is significant. Meaning, the relationship between students' learning styles and their frequency of using computers were significant.

3. Tools Facilitating Mathematics Learning Process

All of the respondents with different learning style stated that "the calculator" as the tool in facilitating the process of learning. In the result, divergers (76 or 58.9%), assimilators (19 or 14.7%), convergers (42 or 32.6%) and accommodators (70 or 54.3%) considered computers as the second tool in facilitating the process of learning Mathematics.

The student's answers regarding the tools facilitating the process of learning Mathematics were noted that 207 (62.16%) of the students stated that computers facilitated the process of learning.

4. The Significant Difference Between the Students Learning Styles and the Tools that Facilitate Mathematics Learning Processes

It was found that there were significant differences between those stating their answers as the "chart", "dictionary", "flash card" and "internet" and others who did not express a response among the tools facilitating the process of learning mathematics based on different learning styles. It is also seen that difference between the other tools according to

learning styles is not significant. In other words, there is a significant relationship between students' learning styles and the data on chart, dictionary, flash card and internet as the tools facilitating learning.

5. The Significant difference between the Learning Style and Purposes of High School Students in Using Computer

In the data with regards to the purposes of students for using computers in the process of learning mathematics, it was stated that the research investigation acted as the purpose of using computers. The purposes of computer use are for calculation, research-investigation, making projects, downloading homework, reporting, printing, gaming and Math software programs respectively.

Students of all learning styles stated mostly research-investigation, calculation and downloading homework as the purpose of using computers, respectively. It was found that there is a significant difference between the students' learning styles and the responses on gaming as their purpose for computer use. Based on the data, it is seen that there is no

significant difference regarding the other purposes for using computer according to learning styles.

Conclusion

Based on the data and findings of the study, the following conclusions are derived.

1. Most of the students in SFMNHS were diverger and accommodator. They best learning abilities lies on their concrete experience and they also learn the things through reflective observation (diverger) and active experimentation (accommodator).

2. Most of the students in SFMNHS use the computer "13-18 hours a week" regardless of whether they have or don't have their own personal computer at home. The relationship between the students' learning styles and opinions about their computer use frequency is significant.

3. Computers are considered as the second tool that facilitates the process of learning in Mathematics in SFMNHS. It was followed to the calculator.

4. There is no significant differences between the learning styles and the tools facilitating Mathematics learning process, especially computers.

5. Research-investigation, calculations and downloading homework were noted as the best reasons for using computer in learning Mathematics. It leads to the conclusion that there is no significant difference between the purposes for using computers and learning styles.

The educational sectors have given their attention on learning styles since the 19th century upon learning that knowing the learning styles of students can aid educators in creating or producing relevant materials that will be more effective in teaching. In response to this, many studies have developed teaching styles that are suitable in different learning styles of students. Delivery of teaching for the learners' need than the instructor’s convenience were urged to the educational institution to observe and plan.

RECOMMENDATIONS

Based on the findings and conclusions presented, the following recommendations are suggested:

1. The computer should be integrated in the process of learning Mathematics. This would be appropriate to use in designing different activities and different settings that will cater all the differences and learning styles of the students.

2. The teaching of Mathematics must be in a student-centered approach where students do the talk and actions more than the teachers. It is also important to consider that all learning preferences such as learning by watching, thinking, feeling and doing are all necessary as in the Kolb model of learning styles. In line with this, mathematics teachers should know their students and recognize the learning styles of each, and plan to teach them with a multidirectional approach.

3. Teachers should be sent to pre-service trainings or seminars that will help them understand more about

students' learning styles and will make them apply the necessary strategies in teaching Mathematics

4. It is suggested that sample sizes in wider and across more varied age groups be chosen for further research as well as the attitudes of students with different learning styles towards computer use in Mathematics education.

5. The causes of students' adverse and wrong ideas concerning computer use for learning functions in Mathematics ought to be examined very well, and upon examining, solutions ought to be mentioned.

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Appendix A

Slovin's Formula

$$n = \frac{N}{(1 + Ne^2)}$$

Where;

n = sample size

N = population size

e = margin of error

Appendix B

January 17, 2014

MS. MARCIANA A. DAET
Principal II
Sitero Francisco Memorial National High School

Madam:

Greetings!

I am a graduate student taking Masters of Education in Educational Technology at Philippine Normal University. I am currently undertaking a study entitled "Students Opinion towards the Use of Computer in Mathematics Education Based on Different Learning Styles".

May I have the honor to request permission from your good office to distribute survey questionnaire during Math time to the randomly selected students from grade 7 to fourth year students.

Rest assured that the facts and information about my respondents will be used solely for the purpose of the research and will be dealt with strict confidentiality.

Thank you very much for your approval and support. More power and God bless!

Very truly yours,

MELIZA M. ROQUE
Graduate Student

Approved:

Marciana A. Daet
Principal II

Appendix C

KOLB'S LEARNING STYLE INVENTORY

Name: _____ **Year/ Grade:** _____

Learning Style:
_____
(to be fill after taking Kolb's Learning Style Inventory)

Know Your Learning Style

Put a numeral "4" next to the description that is most like you, a "3" next to the description that is second most like you, a "2" next to the description that is third most like you, and "1" next to the description that is least like you(4=most like you; 1 least like you). Be sure to assign a different rank number to each of the four words in each set; do not make ties.

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
1	___ **discriminating** I am particular about what I like	___ **tentative** I like to take my time before acting	___ **involved** I like to get involved	___ **Practical** I like things to be useful
2	___ **receptive** I like to try things out	___ **relevant** I like to analyzed things and break them into parts	___ **analytical** I am open to new experiences	___ **Impartial** I like to look at all sides of issues
3	___ **feeling** I like to feel	___ **watching** I like to watch	___ **thinking** I like to think	___ **Doing** I like to do
4	___ **accepting** I accept people and the situations the way they are	___ **risk taker** I like to take risk.	___ **evaluative** I like to evaluate	___ **Aware** I like to be aware of what is around me
5	___ **intuitive** I have gut feelings and hunches	___ **productive** I am hard working and get things done.	___ **logical** I am logical	___ **Questioning** I have lot of questions
6	___ **abstract** I like ideas and theories	___ **observing** I like to observe	___ **concrete** I like concrete things, things I can see, feel, touch or smell	___ **Active** I like to be active
7	___ **present-oriented** I prefer learning in the here and now	___ **reflecting** I like to consider and reflect about them	___ **future-oriented** I tend to think about the future	___ **Pragmatic** I like to see the result of my work
8	___ **experience** I rely on my feelings	___ **observation** I rely on my own observations	___ **conceptualization** I rely on my own ideas	___ **Experimentation** I have to try things out myself
9	___ **intense** I am energetic and enthusiastic	___ **reserved** I am quiet and reserved	___ **rational** I tend to reason things out	___ **Responsible** I am responsible about things

The four columns of words corresponding to the four learning style scales: concrete experience(CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). To compute your scale scores, write your rank numbers in the boxes below only for the designated items. For example, in the third column (AC), you would fill in the rank numbers you have assigned to items 2,3,4,5,8 and 9. Compute your scale scores by adding the rank numbers for each set of boxes.

First Column					
Score Items:					
2	3	4	5	7	8

CE = _____

Second Column					
Score Items:					
1	3	6	7	8	9

RO = _____

Third Column					
Score Items:					
2	3	4	5	8	9

AC = _____

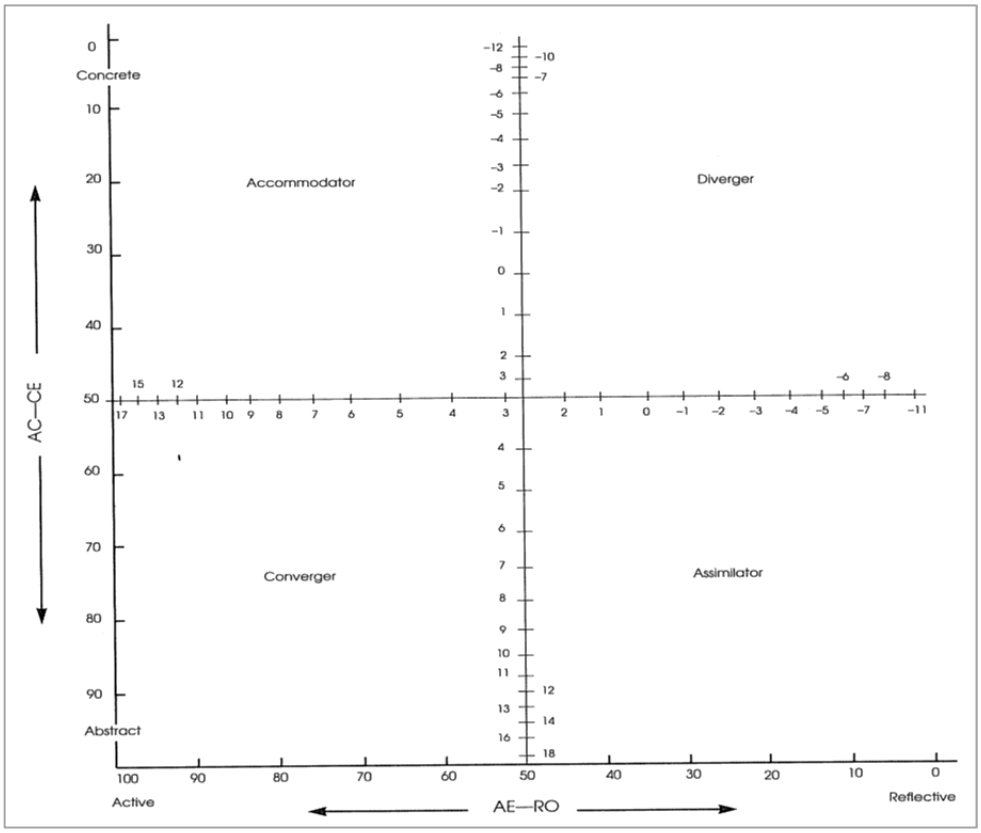
Fourth Column					
Score Items:					
1	3	6	7	8	9

AE = _____

To compute the two combination scores, subtract CE from AC and subtract RO from AE.
Preserve NEGATIVE SIGNS if they appear

AC - CE = **AC** [ ] - **CE** [ ] = [ ]

AE- RO = **AE** [ ] - **RO** [ ] = [ ]



LEARNING STYLE TYPE GRID (Copyright by 1976 by David A. Kolb)

The following is a description of the characteristics of the four basic learning styles based both on research and clinical observation of these LSI scores. (Adapted from The Kolb Learning Style Inventory—Version 3.1 (2005))

The ***divergent*** learning style has the opposite strengths of the convergent style and emphasizes concrete experience and reflective observation. The greatest strength of this orientation lies in imaginative ability and awareness of meaning and values. The primary adaptive ability in this style is to view concrete situations from many perspectives and to organize many relationships into a meaningful "Gestalt". The emphasis in this orientation is on adaptation by observation rather than by action. This style is called "diverger" because a person of this type performs better in situations that call for generation of alternative ideas and implications such as a "brainstorming" idea session. Persons oriented toward divergence are interested in people and tend to be imaginative and feeling oriented. This style is characteristic of individuals from humanities and liberal art backgrounds. Counselors, organization development specialist, and personnel managers tend to be characterized by this learning style.

In ***assimilation***, the dominant learning abilities are abstract conceptualization and reflective observation. The greatest strength of this orientation lies in inductive reasoning, in the ability to create theoretical models and in assimilating disparate observations into an integrated ezplanation. As in convergence, this orientation is less focused on people and more concerned with ideas and abstract concepts. Ideas, however, are judged less in this orientation by their practical value. Here it is important that the theory be logically sound and precise. This learning style is more the applied science. In organizations, persons with this learning style are found most often in the research and planning departments.

In ***convergent*** learning style has the opposite strength of the diverger style. It relies primarily on the dominant learning abilities of abstract conceptualization and active experimentation. The greatest strength of this approach lies in problem solving, decision making, and the practical application of ideas. We have called this learning style the "converger" because a person with this style seems to do best in such situations as conventional intelliegence tests where there is a single correct answer or solution to a question or problem. In this learning style, knowledge is organized in such a way that, through hypothetical-deductive reasoning, it can be focused on specific problems. Convergers often have specialized in the physical sciences. This learning styles is characteristic of many engineers and technical specialist.

In ***accommodative*** learning style has the opposite strengths of assimilation, emphasizing concrete experience and active experimentation. The greatest strength of this orientation lies in doing things, in carrying out plans and tasks, and in getting involved in new experiences. The adaptive emphasis of this orientation is on opportunity seeking, risk taking, and action. This style is called "accommodation" because it is best suited for those situations in which one must adapt oneself to changing immediate circumstances. In situations where the theory or plans do not fit the facts, those with an accommodative style will most likely discard the plan or theory. (With the opposite learning style, assimilation, one would be more likely to disregardor reexamine the facts.) People with an accommodative orientation tend to solve problems in an intuitive trial and error manner, relying on other people for information rather than on their own analytic ability. Individuals with accommodative learning styles are at ease with people but are sometimes seen as impatient and "pushy". This person's educational background is often in technical or practical fields such as business. In organizations, people with this learning style are found in "action-oriented" jobs, often in marketing, sales, or management.

Appendix D
Survey Questionnaire

Learning Style Identified: _____

Survey Questions:

1. Do you have a personal computer at home?

   ____ Yes, I have ___ No, I don't have

2. How often do you use computers?

   _____ never
   _____ 1- 6 hours a week
   _____ 7 - 12 hours a week
   _____ 13 - 18 hours a week
   _____ 19 - 24 hours a week
   _____ more than 24 hours a week

3. What are the tools that help you learn in mathematics?Enumerate some teaching and learning tools that help you to learn the Mathematics easily. (*You can give more than one answer*)

4. How computer helps you to learn Mathematics?
   What is/are your purpose/s in using the computer in studying Mathematics?
   (*You can give more than one answer*)

Appendix E

Certification of Edited Work

Appendix F

Certification of Authenticity Test

Appendix G

Curriculum Vitae

Meliza M. Roque

357 F. Andaya St. Wawangpulo Valenzuela City

E-mail Address: melizaroque_15@yahoo.com

WORKING EXPERIENCE

Secondary Mathematics Teacher
Sitero Francisco Memorial National High School (2006 – present)

School Registrar
Sitero Francisco Memorial National High School (2008 – present)

EDUCATIONAL BACKGROUND

Masters Degree: Master of Education in Educational Technology
Philippine Normal University

Tertiary Degree: Bachelor of Science Major in Mathematics
Philippine Normal University (2001-2005)

ACHIEVEMENTS

Second Place in the Classroom Based Research Contest
Division of Valenzuela (March 2014)

Demonstration Teacher in PGCB Programme for Philippine Leaders and Educators Regional Seminar
Ateneo de Manila (April 2012)

Service Awardee
Sitero Francisco Memorial National High School (March 2012)

First place in the Search for the Best Strategic Intervention Materials in Mathematics
Division of Valenzuela (March 2012)

Most Admired Teacher – Teachers' Month
Sitero Francisco Memorial National High School (October 3, 2011)

Second Runner up in the Search for Best Demonstration Teacher in Mathematics –
"High-Tech and Teacher ko" – Division of Valenzuela (December 2009)

Faculty Officer – Auditor
Sitero Francisco Memorial National High School (August 2011-2013)

Technical Planning Committee Co-chairman
School Based Mathematics Festival 2011 (January 2011)

Technical Committee
Regional Population Quiz SY. 2012-2013
Division of Valenzuela (February 2013)

Technical Committee
Regional Population Quiz SY. 2011-2012
Division of Valenzuela (April 2012)

Speaker in Seminar – Workshop for Teachers
"Be a Competitive and Innovative Teachers of the 21st Century"
Casa de Soleil Child Development Center (May 2011)

Discussant in the Three-day School-Based Management Summer Training for Mathematics Teachers of Valenzuela City
"*Using Visual Models in Teaching Algebra"*
Division of Valenzuela (May 2009)