

# Chapter I

## INTRODUCTION

### **Background of the Study**

Education plays vital role to form the habit of a child. Education is the foundation for all-round development of a child. In education system, multimedia is a media that brings the clearance in understanding the subject-matter to the learner. Multimedia system helps to the teacher to make clear about the concept of any topic. For better understanding of mathematical knowledge, better use of educational multimedia system in classroom is essential.

In 1990, the international community gathered in Jomtien, Thailand, to affirm its commitment to achieving universal education at the world conference on Education for All. As part of the resulting EFA (Education for All) initiative, a broad coalition of governments, NGOs and development agencies committed themselves to six goals aimed at providing education to “every citizen in every society”. Our nation added one extra goal and made seven goals for achieving education.

Mathematics is the common heritage of all people. The position of leadership service to which a nation rises depends largely on the ability of its entire people to understand and apply simple mathematical truths and on the relatively few, by comparison, who need to apply the more advanced branches of mathematics. In contemporary education, mathematics education is the practice of teaching and learning mathematics, along with the associated scholarly research. Mathematics education is the practice of teaching and learning mathematics by using various methods with the help of different teaching materials. The

method or methods used in any particular context are largely determined by the objectives that the relevant educational system is trying to achieve. Method of teaching mathematics include conventional approach, classical education, rote learning, exercises, problem solving, recreational mathematics, computer based mathematics (mathematics education used by multimedia).

Autism is a condition that affects over one percent of the population, and is a condition that has varying degrees of severity (Nigel Newbutt 2010). There currently exist various therapies to help people with autism communicate effectively. As a result some researchers and schools have expanded this provision by creating virtual tools to assist the communication process and allow a greater level of independence and generalization(Society for Information Technology and Teacher Education International Conference 2010(Mar 29, 2010)). Autism is known to be a neurodevelopment disorder characterized by impaired social interaction, verbal and non-verbal communication, and repetitive behavior. Some of the major characteristics of autistic children are as follows:

- **Social development:** Autistic infants show less attention to social stimuli, smile and look at others often, and respond less to their own name. Children with high-functioning autism suffer from more intense and frequent loneliness compared to non-autistic peers, despite the common belief that children with autism prefer to be alone. Making and maintaining friendship often proves to be difficult for those with autism. For them, the quality of friendships, not the number of friends, predicts how lonely they feel.
- **Communication:** Delayed onset of babbling, unusual gestures, diminished responsiveness, and vocal patterns that are not synchronized with the caregiver are

seen at the initial year of the life. In a pair of studies, high-functioning children with autism aged 8-15 performed equally well as, and adults better than, individually matched controls at basic language tasks involving vocabulary and spelling. Both autistic groups performed worse than controls at complex language tasks such as figurative language, comprehension and inference. As people are often sized up initially from their basic language skills, these studies suggest that people speaking to autistic individuals are more likely to overestimate what their audience comprehends (Williams DL, Goldstein G, Minshew NJ (2006)).

- **Repetitive behavior:** Autistic children show many forms of repetitive behavior which are normally restricted. The repetitive behavior shown by such children are as follows:
  - ✓ Stereotypy: The repetitive movement such as hand flapping, head rolling etc.
  - ✓ Compulsive behavior: The intended and appears to follow rules, such as arranging objects in a row or in a line.
  - ✓ Restricted behavior: Limited in focus, interest, or activity, such as preoccupation with a single TV program, toy or game.
  - ✓ Self-injury: It includes movements that injure or can injure the person, such as hand-biting, head-banging, eye-poking, skin-picking etc.

Every child is special. Autistic children are special among special. Several students with autism can be seen in different school. Effective methodology in teaching with special treatment is important for such children. A growing number of studies have investigated diverse application of technology-based interventions with children with autism (National Research Council; NRC 2001). It is being difficult to make mathematics as the interested

subject for most of the students even they are normal. So it is difficult to make mathematics interested for students with autism especially in school level.

As a group, individuals with autism spectrum disorders (ASD) demonstrate relatively strong skills in responding to visual media (Quill 1997; Wetherby and Prizant 2000). This affinity to visual materials underscores the success of interventions that use picture-based cues to help students with ASD organize daily events and activities, communicate more effectively, imitate appropriate behaviors, and acquire both academic and functional skills. In fact, strategies that incorporate visual presentation and that allow for repeated imitation of skills and behaviors currently are considered best practice for educating individuals with ASD (National Research Council; NRC 2001). Due to the increasing number of students with ASD, there is a need to develop and systematically validate new and innovative visual-based interventions. One such method that builds upon the visual learning strengths of students with ASD and can be adapted to fit within a variety of educational contexts is the use of computers.

The use of multimedia systems for enhancing the academic, behavioral, and social outcomes of students with ASD is a relatively new area of research, but one that has great potential. Many parents report their children's fascination with and propensity for learning from visually based media such as computers (Nally et al. 2000). In addition, researchers have identified that individuals with ASD not only demonstrate significant skill acquisition when taught via computers, but also have a preference for instruction delivered through such devices (e.g., Bernard-Opitz et al. 2001; Moore et al. 2000; Shane and Albert 2008). Given such preferences, the use of multimedia system emerges as an ideal method for teaching students with ASD for several reasons. First, students with ASD often find the world

confusing and unpredictable, and have difficulty dealing with change. As such, educational practices should make every effort to describe expectations, provide routines, and present immediate and consistent consequences for responding (Iovannone et al. 2003). Computers not only provide a predictable learning environment for the students with ASD, but also produce consistent responses in a manner that likely will maintain interest and, possibly, increase motivation. Second, viewing of instruction through electronic media may allow individuals with ASD to focus their attention on relevant stimuli (Charlop-christy and Daneshvar 2003; Shipley-Benamouet et al. 2002). Because students with ASD have difficulty screening out unnecessary sensory information (Quill 1997), focusing on a computer, where only necessary information is presented, may maximize their attention. Third, the use of computers likely creates an environment for learning that appears to individuals with ASD as less threatening (Sansoti et al. 2010). That is, computers are free from social demands and likely can be viewed repeatedly by the student without fatigue.

Educational multimedia system has a potentially important role to play in the education of student with autism. This potential has thus far, however, been largely unexplored. This paper therefore targeted a case for the use of multimedia systems for such students, and reviewed the current state of the field. This case based study was to find out the impact of educational multimedia system in teaching mathematics for two autistic students of grade nine in private school.

### **Statement of the Problem**

Education is the process of facilitating learning and learning is the act of acquiring new, or modifying and reinforcing, existing knowledge, behaviors, skills, values, or preferences and may involve synthesizing different types of information. Education is the

foundation for the development of the nation and therefore, each nation in the world, are giving emphasize in Education. As all the countries, giving emphasize in Education, Nepal is also. But the literacy rate of Nepal is 65.9% (census report 2068 B.S). This means most of the people in Nepal are still illiterate.

Autistic people live a normal life span. Since symptoms change, and some may disappear with age, periodic re-evaluations are necessary to respond to changing needs (Edward R. Ritvo). The sever form of the syndrome may include the most extreme forms of self-injurious, repetitive, highly unusual, and aggressive behaviors. Such behaviors may be persistent and highly resistant to change, often requiring unique management, treatment, or teaching strategies. Special educational programs using behavioral methods are designed for specific individuals have proven most helpful. Most of the people/parents even to the teachers, do not know about autism. They behave with autistic students as normal students at home as well as at school. Disable people, either physically or mentally, they occupy certain space in nation. If the nation fixes the goal “Education for All”, it should fulfill their responsibilities too.

Teacher centered learning/rote learning is still using in our educational system. This system makes easy to teacher but it kills the creativity of the students. The field of gaining knowledge is being broad. Most of the mathematical concepts would difficult to understand even for students that are interested in related subject if the teacher taught without any teaching strategy and any teaching materials. Only chalk and talk method does not give the solution of today’s burning issue about the misconception of mathematics to pupil and does not help to achieve the effective mathematical knowledge to the students. On the other hand, educational multimedia system is not reached easily in each and every school of nation.

Children of rural school generally in under developing and developing countries, are still behind the facilities of IT, Educational multimedia system, computer based education etc. Thus, this study was targeted to explore the impact of the educational multimedia system in mathematics teaching in school for autistic students.

### **Objectives of the Study**

The major objective of this study was:

- ) To explore the impact of multimedia use in teaching mathematics for autistic students.

### **Significance of the Study**

Mathematics is one of the basic sciences of life. Mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. For some people, and not only professional mathematicians, the essence of mathematics lies in its beauty and its intellectual challenge. For others, including many scientists and engineers, the chief value of mathematics is how it applies to their own work. Because mathematics plays such a central role in modern culture, some basic understanding of the nature of mathematics is requisite for scientific literacy.

Mathematics plays vital role to induct the creativity of the learner. To think creatively and to give logical answers, mathematical knowledge helps to the students. Autistic students need special treatment for their better life. It cannot be said that autistic students are not talent in mathematics. But in case of getting opportunity, they can do better than how much they were in previous phases. Various teaching strategies and methods together with different teaching materials have been practiced in teaching field for effective teaching learning

process. Among them Educational multimedia system is the modern teaching learning system and saying the best way to teach practically about newly generated subject-matter.

Mathematics can be a difficult subject for any student to learn. Technology offers a mechanism for replacing the stress of human-to-human social interaction and for using motor skills by creating a learning relationship between student and computer (Slavin & Lake, 2008). Experienced and new teachers need more information and support to teach this population. Technology offers non-human instructional methods that can complement a teacher. Visually-supported learning via a computer considers the preferences and strengths of individuals with ASD to process non-transient and visual-spatial information (Aliasgari, Riahinia & Mojdehavar, 2010). Researchers have shown positive results from using CAI to teach ASD students English and Communication (Armstrong, 2009; Gulchak, 2008; & Myszak, 2010). Travers (2010) compared tradition teacher-led instruction to CAI for ASD students and the results concluded that both forms of intervention were effective for ASD students and that there was a greater recognition of alphabet characters among the study group using CAI. The following points were categorized as the significance of the study.

- ) It helps to find out the mathematical activities of students with autism who are in the class of digital multimedia.
- ) The study helps to study the behavior shown by autistic students in different situation in mathematics classroom.
- ) It helps to find out the importance of educational multimedia system in teaching mathematics for ASD students.
- ) The study provides the data relating of autistic students' current skills of mathematical activities.



) It supports to bring new education policy for students with autism.

Thus, it is essential to find out the basic mathematical activities done by autistic students from their own way. The study becomes useful to provide the data relating of autistic students' skills of mathematical activities. It supports to bring innovation in mathematical curriculum.

### **Delimitation of the Study**

The study was focused on the activities of Autistic students of school of Madhyapur Municipality in Bhaktapur district.

) Students with Autism were selected for the study.

) The study was of (16-18) year's students only.

) The study was about 2 students.

) The study was in private boarding school of Bhaktapur district.

) This study was based on case based action research.

## **Definition of the Related Terms**

**Autism:** a neurodevelopment disorder characterized by impaired social interaction, verbal and non-verbal communication, and repetitive behavior.

**Autistic students:** In this study, autistic students refer to the children who are affected by low-functioning autism.

**Literate:** According to NESP (1971), literate means being to at least read and write General Nepali and perform fundamental mathematical operations in daily life.

**Illiterate:** Illiterate are those (person) who cannot read, write and solve their general mathematical problems of daily life.

**Impact:** Changed behavior that may positive or negative towards mathematics learning.

**IT:** Information Technology

**Educational multimedia system:** The digital teaching multimedia like computer, overhead projector (OHP), calculator etc.

**Computer added instruction:** Mathematical software that is added in computer to visualize, CD, DVD etc.

## Chapter II

### REVIEW OF RELATED LITERATURES

Literature is the source for the new research. It gives the way and raw materials for new research. Literature is reviewed to know the works carried out in the area of the research project. Such studies construct the platform for standing to the research which gives the theoretical support for the study. The various research studies concerning Educational multimedia system, Constructivism and Student with autism that help researcher to draw necessary conclusion on the concerned topic.

In this section, related empirical and theoretical literatures were reviewed.

#### Review of Empirical Literature

**David Moore; Paul McGrath; John Thorpe, (2000)** conducted the research on “Educational multimedia system for students with Autism”. The aim of this research was to find out the fruitful way of furthering research and development in the area to develop systems that directly address autism-specific impairments. They concluded that their research paper makes a case for the use of multimedia systems for such students, and reviews the current state of the field. This research paper has been suggested that systems should be developed that directly address autism-specific impairments and considers autistic student education in the context of equality of access to education.

**Maria Isabel Santos, Ana Breda and Ana Margarida Almeida (2015)** have written a journal on a topic: Preliminary proposal of a conceptual model of a digital environment for developing mathematical reasoning in students with Autism spectrum disorders. This paper was presented preliminary proposal of digital environment, specifically

targeted to promote the development of mathematical reasoning in students with Autism spectrum disorder. According to this paper, given the diversity of Autism spectrum disorders, the prototyping of this environment requires the study of dynamic adaptation process and the development of activities adjusted to each user's profile. Guidelines for future research are discussed in this journal.

**Frank J. Sansosti, Mary Lynn Doolan, Brittany Remaklus, Alison Krupko and Jenine M. Sansosti (2014)** have reviewed a research of topic: Computer-assisted interventions for students with Autism spectrum disorders within school-based contexts: A quantitative meta-analysis of single-subject research. This research was conducted examining the effectiveness of computer-assisted interventions for teaching a wide range of skills to students with Autism spectrum disorders within the school-based context. In this study, intervention effects were measured by computing improvement rate difference (IRD), which was a simple approach to visual analysis that correlates well with both parametric and non-parametric effect size measures. The research suggested that computer-assisted interventions may be a promising approach for teaching skills to students with Autism spectrum disorders. However, several concerns make this conclusion tenuous. Recommendation for future research were also discussed in this paper.

**Subedi (2009)** has done the research on “mathematics concepts used by wicker worker”, a qualitative study. The major objective of this study was to find the mathematics concepts and idea of wicker worker. He found that wicker worker used various mathematical concepts in their work and they get mathematical concept and ideas from practice from their culture.

**Panday, (2012)** conducted the research on “effectiveness of manipulative material in teaching probability at secondary level”. The main objectives of this study were to compare the mathematics achievement of the students of secondary level in probability with and without using manipulative materials and to analyze the effectiveness of manipulative materials. A pre-test post test, equivalent group design were adopted for students of the study. In his research experimental and control groups were determined.

**Pandey, (1985)** did an experimental research on use of visual aids in teaching fraction: development of teaching fraction in grade VI with the aim to develop a teaching model for teaching fraction in grade VI, selection proper visual aids see how effective the prepared model was. A teaching model with visual aids and a plan verbal exposition model were prepared. Sixty students were randomly chosen for teaching twenty days. A pre-test and post test research design was chosen and t-test was applied to concluded that the teaching model with visual aids was found to be more effective than the plan verbal exposition model.

**Upadhyay, (2001)** has done his qualitative research on “Effects of constructivism on mathematical achievement of grade V students of Nepal”. The research has been conducted with three key works- Action, Reflection, and Scaffolding. The aim of the research was to advocate and adopt constructivism in mathematics teaching in Nepal. The major tool of data collection on this study was interview observation. From this research it is concluded that there is the possibility of constructivism in Nepalese school with significant difference in achievement than conventional method of teaching.

### **Review of Theoretical Literature**

In this section, theoretical discussion which is relevant for the interpretation of the finding of the study is introduced. Various learning theories related to children cognitive

aspects have developed. Classical conditioning theory, trial and error theory, gestalt theory, cognitive theory, social constructivism etc. are some major learning theories that are practiced in teaching learning process. The theory, constructivism and cognitive theory of multimedia learning are relevant for the concerned topic so these theories and social constructivism are reviewed below.

### **Constructivism**

Constructivism is one of the most popular schools of thought in the world of theory of learning. Learners need to construct their own understanding of each mathematical concept, so that the primary role of teaching is not to lecture, explain, or otherwise attempt to transfer mathematical knowledge, but to create situations for learners that will foster their making the necessary mental constructions.

Basically, constructivism is a learning theory based on observation and scientific study about how the learners learn. Constructivism involves the regulative principle that only mathematical entities which can be explicitly constructed in a certain sense should be admitted to mathematical discourse. In this view, mathematics is an exercise of the human intuition, not a game played with meaningless symbols. Instead, it is about entities that we can create directly through mental activity. Constructivism stands on the following axioms:

- ) Learners gain knowledge trying to convey their solution to others (Upadhyaya 2001).
- ) Learners learn knowledge from their active participation.
- ) Learners gain knowledge while reflecting on their own action.
- ) Experience and the environment play a huge role in how well the learner learns and that language plays a key part in the attainment of understanding the knowledge (Draper, 2002).

## **Lev Sumyonvitch Vygotsky and social constructivism**

Lev Sumyonvitch Vygotsky (1896-1934), psychologist of the early Russian Soviet period, has had continuing(though politically troubled) influence in Russia since the late 1920's and since the mid- 1960's has been gaining increased attention in the United States and throughout the world. Particularly relevant to writing is his interest in the higher psychological functions, developed in the use of symbolic tools.

Vygotsky examined how minds develop within social interaction, transforming the individual's biological legacy through the group's cultural legacy. External forms of activity and social relationships he saw internalized as human mental activity; with the social nature of any psychological function preserved when it becomes internalized. Symmetrically, he saw culturally-transmitted tools as the externalization of psychological functions. The area of interaction Vygotsky calls the zone of Proximal Development (ZPD). One's ability as a learner, for example is not to be measured simply by what one already knows, but by the extensiveness of the new situations one is able to enter into successfully and thus learn from. Similarly, to make learning available for students, instructors must bring new material and skills into a zone of intelligibility, possible participation, and motivated interaction. The child/learner needs some mediator like parents or peers to uplift their knowledge that existed with them. The assuming process is known as ZPD. Vygotsky's theory is one of them that regard social interaction between peers and adults as important aspects in creating meaning making sense and covering culture within the shared context (wood et.al 1986).

According to social constructivism, culture is the main source that influences the knowledge and the means of thinking. Language plays vital role in social learning. Individual difference in classroom is not a problem but it is a source of knowledge. In social learning,

learner learns about ‘what to think’ and ‘how to think’. Constructivism is a part of collaboration and collaboration is a part of learner’s views act as learning framework. Collaboration is a group work. It is co-operative learning between learners. Collaboration is an active process that helps to construct new knowledge. The external thought process in which the discussion take place is known as collaboration. Social constructivism also leads to web learning. Web projects which are unstructured and student designed and Web quests which are structured and teacher designed are the examples of web learning.

**Mayer’s cognitive theory of multimedia learning**

Mayer’s Cognitive Theory of Multimedia Learning (Mayer & Alexander, 2011) allows children to use their auditory and visual channels in the learning process. It involves active use of their sensory, working and long-term memory to process multimedia elements into logical mental constructs. This theory assumes the following:

- There are two main channels for processing information; auditory and visual.
- Each channel has a finite capacity for cognitive load.
- Filtering, selecting, organizing and integrating information is an active part of the learning process.

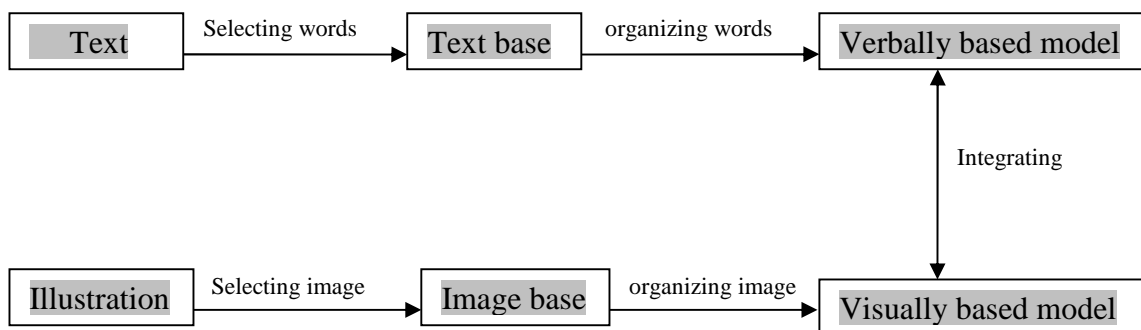


Figure1: Cognitive process of multimedia model



According to Mayer, there are three important cognitive processes, which the multimedia learner engages in. The first one involves selecting verbal and visual information to yield a learning base, the second involves organizing verbal and visual information to form into coherent mental representations, and the third one includes integrating the resulting verbal and visual representations with one another.

### **Implications of the Review for the Study**

Literature review is the most important section for this research. It gives the platform for the study. Different literatures give various ideas and methods for better and successful research so the literatures are the sources for new research. The review of the literature mentioned above was implemented in this study as follows.

- ) Case study was implemented as qualitative research in this study.
- ) Social constructivism was implemented as paradigm because the informer in this study was the knowledge constructor.
- ) The study was focused in individual difference.
- ) Multimedia systems were taken as the teaching learning tools.

### **Theoretical Framework**

Students learn by their own way. Learners from different community are different. They have their own culture. They have their own idea to solve every type of problem also. Different culture influences the knowledge and means of thinking too. Individual difference was taken as the source of knowledge. Students learn different ideas by collaborating each other with the friends coming from different culture. Cultural transmission is the knowledge construction and it is possible in collaborative class. For this, Constructivism and Vygotsky's social constructivism were taken as theoretical basis. According to Vygotsky's social

constructivism society is the carrier of cultural heritage. Without its presence, it is impossible for the development of human mind.

### Factors Affecting Learning Mathematics for Students with ASD

Persons with autism hold many common characteristics but because they are labeled as autistic it does not mean that they display all of them. The most obvious characteristic of students with autism that affects in learning are delayed language development and systematic communication (Grandin, 1996). Another characteristic which is commonly found throughout the autistic students is the fact that they need and want their environment to be the same (Schreibman, 1988). Thus the following factors that affect on learning mathematics for students with ASD were taken as the major factors on this study.

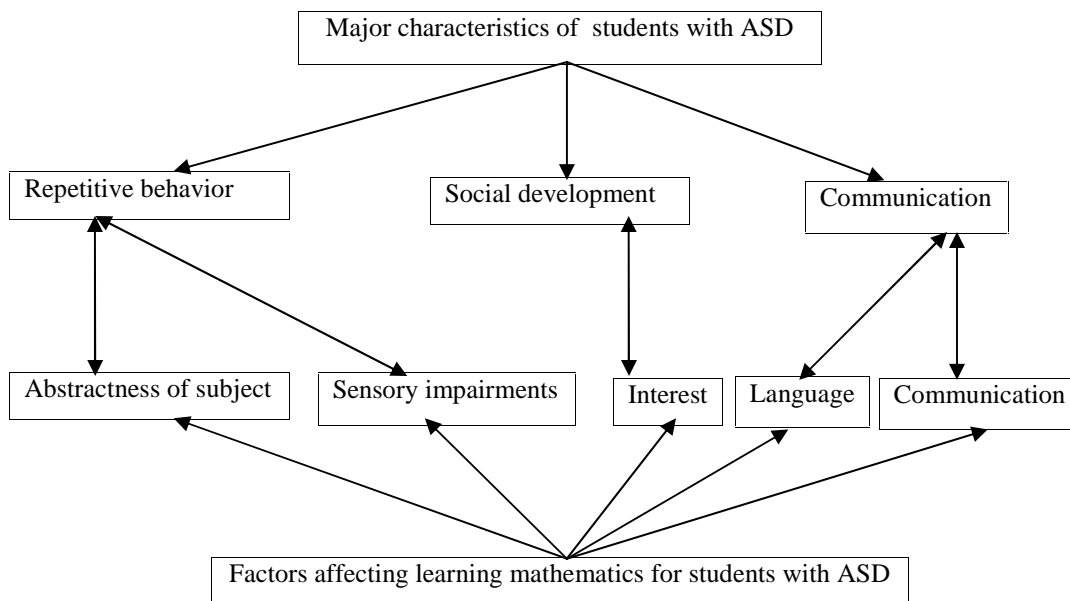


Figure2: Factors affecting learning mathematics for autistic students

The primary factors on learning mathematics for ASD students mentioned above were conceptual basis for this study.

## **Chapter III**

### **METHODS AND PROCEDURES**

The design of the study was qualitative and descriptive case based study. This study is about person's life stories and behavior. Case study is in-depth study of any social unit to find out reality. It is the study to find out the impact of educational multimedia system for student with autism. For data collection, both primary and secondary sources were used in research. Generally; in-depth interview schedule, observation form, field notes etc. were taken as primary sources and the various documents were taken as secondary sources.

#### **Design of the Study**

The purpose of this method was to understand the important aspects of the life cycle of the unit. As pointed out by Ghesquie're, Maes, and Vandenberghe (2009, in Ghesquie're, & Van der Alsvoort, 2009), in special education, "the complexity of studying schools as a system requires qualitative case studies involving interviews, observations, and field participation". This study was designed as a qualitative research that includes a case 'autism'.

#### **Site Selection of the Study**

Autism is a condition that affects over one percent of the population, and is a condition that has varying degrees of severity (Nigel Newbutt 2010). A growing number of studies have investigated diverse application of technology-based interventions with children with autism. It is being difficult to make mathematics as the interested subject for most of the students even they are normal in elementary school.

#### **Participants**

The following participants were included in this study

## Students

Two students enrolled at grade IX with autism spectrum disorder were participated in this study. They were interested on using computers like electronic devices.

Table1: List of students with ASD and their profile details

S.N	Name of students	Address	Parents name & Qualification
1	Medina Shrestha	Madhyapur-16,Bhaktapur	Dhan Bahadur. Shrestha, Lalita Shrestha, literate
2	Alean Oli	Namunabasti-15,Bhaktapur	Madan Kumar Oli & Nisha Oli, literate

**Parents:** The father and mother of students were also taken as the participants in the research.

**Principal and teacher:** Principal of the school was also taken as the participant in this study. And some teacher's views towards the targeted students were included.

## Data Collection Tools

There are many techniques for the qualitative research to get the primary information from the people about their experience, idea, believes. Besides documents, case, histories, personal diary are also evidential substances. In-depth interview with ASD students and their parents, observation form, field notes etc. were taken as primary tools and the data taken from attendance records, obtained marks recorded register, individual record files of punctuality and participation records of them in extracurricular activities, were taken as secondary tools.

## Observation

There are number of techniques to get information. Observation is one of them. Observation is the most useful tool for data collection in any kind of research studies.

Through observation the researcher had established interaction with them to understand their emotion and feelings. This observation was focused on interest on subject, sensory impairments, abstractness, language, and communication.

### **Interview**

It is an effective data collection procedure in qualitative research. Interview is phase to phase interpersonal role situation in which one person, the interviewer asks a person being interviewed and the respondent questions design to obtain answer pertinent to the purpose of the research problem. The researcher took interview from students, principal and their parents. The interviews were conducted individually for collecting data.

### **Secondary source**

Secondary sources are the auxiliary sources that help to the researcher to find out the affective factors that distract to the respondents' achievements. The data taken from respondents' personal diary, their attendance records, records of them participating in related programs are very useful to find out their feelings and emotions, punctuality, their activeness, as well as their interest on related subject. Secondary sources are taken to collect those types of data that help to bring out the respondents' recessive factors.

### **Reliability and Validity of Tools**

The tools used in research are the gold standard tools for qualitative data collection and were the pre-tested tools for data collection. The subject expert, specialist and supervisor checked the reliability and validity of the tools and necessary ones with the help of supervisor replaced the unnecessary notation.

Cross match or triangulation method gives an accurate and reliable picture of situation. So the validity of tools was maintained by cross matching or triangulating the data collected from classroom observation and interview with students and parents.

### **Data Collection Procedure**

The researcher had taken the daily multimedia class to the students along with daily observation and the semi-structured interview was taken thrice; before the study, at the middle of the study and in the end of study. The interview was taken to the students and their parents. Students' attendance register and their participation in mathematics related extracurricular activities were also reviewed. The researcher spent 30 days time duration for collection of data for this study. Researcher followed the following procedures for collecting data for this study:

- i. Mathematics class was taken and observed by using classroom observation form "Appendix D" to note the events of classroom of ASD students. The research observation list was administered to collect data about ASD student's activities in real situation. The researcher also maintained a diary to note down information during observation. The detail data of learning environment, student's interest on multimedia, individual activities regarding subject matter and the students thought on mathematics were obtained by observing and filling the observation forms "Appendix-D".
- ii. In research interval, the researcher had taken field notes about the events and then has interviewed the participant students, principal and parents of them using interview guideline "Appendix-A", "Appendix-B and "Appendix-C" one by one to collect identical information of both respondents. The interview was taken in the following interval of research time:

- ) Before starting the study
- ) Middle of the study
- ) In the end of the study

The interview with students, have mainly focused on what and how they learn different mathematical activities through educational multimedia system related to everyday activities. Views of principal were also taken separately about each respondent. Also frequent interaction was conducted with parents, teachers and the respondents. Ultimately, the researcher prepared the individual respondent records separately.

- iii. The unpublished documents like school record files, attendance register, and obtained marks recorded register of respondents were studied thoroughly to collect secondary information from the school.

### **Data Analysis and Interpretation Procedure**

After collecting the information from observation form, interview and related written document, the researcher categorized those information according to themes such as: the interest of the ASD students on learning mathematics, how much the students enjoy the multimedia class, their communication, language, sensory impairments, abstractness of mathematics, computer added instruction (CAI) and the students attention on learning mathematics in multimedia class. Different views and the behaviors of the respondents related to the above mentioned themes was collected together under same theme and explained in their perspective by cross triangulation method. The data was analyzed and interpreted by using a framework which the researcher had developed.

## **Chapter IV**

### **ANALYSIS AND INTERPRETION OF THE DATA**

This chapter deals with the analysis and interpretation of the collected information derived from the case study during the research period.

As it was qualitative study, the descriptive method was mainly used in the research process. The researcher has attempted to describe and analyze the information acquired in the research process. The collected information was analyzed and described in their perspective under the following points.

#### **Introduction of Case Students (Respondents):**

##### **Respondent A**

Medina Shrestha, daughter of Dhan Bahadur Shrestha and Lalita Shrestha was an autistic student with ASD of grade 9. She was 16 years old living in Madhyapur municipality ward no. 16, Bhaktapur. She was living with her parents in rent near from the school. She has one younger brother and one elder sister who were free from ASD, studying together in same school. She sometimes displays self-stimulatory (A type of behavior that has no function but to provide sensory or kinesthetic feedback, example: rhythmic body rocking, jumping, hand flapping, gazing at lights, waving fingers, using objects to spin, or playing with body parts) and self-injurious (A self-injurious behavior is when an individual inflicts physical damage on their own body, example: head banging, biting, slapping, or pulling) which have detrimental effects.

She started studying when she was two years in this school. She got fail two times when she was in grade 5 and grade 7 due to fail in mathematics both the times. She used to sit



in first bench usually alone and asks un-relevant questions frequently to all the teachers of her in class. She was an important respondent for the study.

### **Respondent B**

Alean Oli was the student with ASD of grade 9 in the school. He was only one son of Madan Kumar Oli and Nisha Oli living in Namuna Basti, madhyapur-15, Bhaktapur. He was 18 years old. He started studying when he was three years old and came to study in present school from grade 6. He was very poor in mathematics so he failed in grade 6 and grade 9, two times. He was living with his parents in his own home.

He had unique characteristics related to their learning, among them stimulus over selectivity, diminished motivation, and abnormal responses to reinforcement. He also used to display restricted attention to the environment. He used not to attain to people but instead to objects and treat people as objects. He was unresponsive to the physical environment. He often over-reacted and threw a tantrum or not even noticed a loud noise. This means he usually displayed flattened, excessive, or inappropriate affect and had little emotional reactions in varying situations. Sometimes he used to demonstrate irrational fears.

He also had an inability to relate to others in a normal way. He often had deficits in social attachment especially with teachers, peers and parents. He also used to sit in first bench alone in class but staring just on board instead of asking questions to the teacher. All these points made him as respondent for this study to the researcher.

### **Major Factors that are affecting the Students with ASD in learning Mathematics**

The interview schedule was applied. The observation was done in class while teaching day to day. Observation at school and home was also done to collect the relevant data. Interview to the respondents and their parents were done before starting the study along

with the observation of related document. The interview was taken at the middle and thus at the end of the study to the respondents and their parents. Finally, it was found that there were numerous factors affecting students with ASD in learning mathematics which are being described separately.

### **Interest**

Willing power is the major element to learn everything. If anybody is interested to learn something, nothing is impossible. Even the person with disability can learn perfectly if he/she shows his/her willing power to learn. Students are getting enjoyed in the subject matter or not, are the important aspect to make them clear about the activities which are done in class.

*"I know most of the formulas of mathematics. But cannot catch the theme of questions and apply formulas. It makes me bore to do the homework. In classroom, I feel irritate to solve the mathematical problems."*

*-Views of respondent A*

*"Are all the topic of mathematics necessary to learn? I don't get enjoy in mathematics class. It does not mean that you are not teaching well. But I do not understand your explanation. I think, it is better if we do not need to learn this subject."*

*-Views of respondent B*

No two autistic individuals are the same, and it is difficult to generalize about autistic people. However, these autistic students tended to do well with numbers. They were generally able to recite and order off numbers, which may be due to an enhanced ability to understand systems. Since every autistic student is unique, we shall need to tailor their learning to their individual needs.

*"The entire teachers of our school say that Alean and Medina do not show his interest in learning everything in classroom. But when I took class nine students in hall showed them a video about the needs of ICT through overhead projector (OHP). He was sitting in first Row and focusing in OHP. He requested me to take them always in hall and teach in such a way".*

*-View of principal of school*

Autistic students also have an inability to relate to others in a normal way. They often have deficits in social attachment especially with parents and other family members. Infants often do not cry to get attention as other babies do but instead only to get their basic needs met. Also, as babies they may not show any emotions to being held and cuddled. As they grow older they often fail to engage in eye contact and other crucial social skills. Often they are found by themselves in their own worlds. Also, they usually do not feel comforted by their parents or families. Students with autism have also demonstrated a lack of peer contact and play. And it was also seen on both the autistic students.

*"Medina always sits alone in class. If any friends of her come to sit with her, she ignores even the friends are girls. In spite of playing with her friends, it is good to bow down the head on desk and spend the time for her. Some time she plays as a small kid with geometry box, books, and bag alone."*

*-View of one of the teachers of her*

By analysing the above views and observation form, students with autistic spectrum condition showed excellent ability in the 'number' area of mathematics, as far as reciting and ordering numbers. This was common as the number system as a sequence was rational and structured which fitted nicely with the way students with autism learnt and remembered facts.

They usually found it relatively easy to learn by rote, responding well to imitation techniques and repetition.

### **Communication**

Communication was a basis for learning and without intervention students with autism was not develop an organized language system. A very detailed program like modeling video, expressive picture prompts etc. for use in the home and school in their study time was provided. Initially it was essential to teach the child the importance of a communication exchange since they did not spontaneously initiate simple exchanges such as pointing at a desired object. It was necessary, prompts and cues to attain the behaviors. Modeling and picture prompts worked well but physical guidance often was necessary.

*"Both the students did not understand the lateral surface area and total surface area of prism, cylinder and cone when it was taught in the class without using multimedia. But when it was taught by the help of multimedia, they were responding their views and they became clear about the surface area of solid figures."*

*- A success story while teaching mathematics through multimedia*

Communication encompasses a broad range of challenges for individuals with autism, from intake and processing of information, verbal or representational output, to reading and writing skills. Picking up on non-verbal cues, body language and subtle intent, intonation, and interpretation are also difficult for individuals with autism. The ASD students were predominantly auditory learners, they tended to be visual learners, meaning they understood or retained what they saw more effectively than what they heard. Visual supports were often helpful since they provided extra processing time.

A social teacher once told me *"I have reviewed the information on the districts of eastern region many times and Alean still does not know what the headquarters are, and I have reduced the amount of districts he needs to know."* I asked *"Well, how do you ask him?"* She said *"I say, what is the name of headquarter of X? And he either does not know or gives the same answer, Diktel."* So I printed out a large map of the eastern region, wrote down the headquarters on stickers, and gave Alean three at a time. He was able to put every headquarters in the right district with the exception of mixing up Ilam and Solukhumbu. *The teacher was dumfounded and Alean was thrilled and smiled!"*

*- A Success Story*

*"It was difficult to communicate with him. While helping on doing homework of him. He did not understand my explanation and even he was not able to express his views on related question. He was not trying to share his ideas on solving procedures. But, now a day, he tries different ideas on solving problems. I think this is the positive impact of multimedia class."*

*-Parents of respondent B*

Hence, from the above views it is clear that the lack of communication between teacher-students and students-students was the major problem to understand them mathematics to ASD students. From the day to day observation it was also seen clear that when the students communicate each other and when they express their views to the teacher, their result in terminal examination was seen satisfactory. And it was also seen that they were active to communicate when they were in multimedia class.

## **Language**

Students with autism hold many common characteristics but because they are labeled as autistic, it does not mean that they display all of them. The most obvious characteristic of

students with autism was delayed language development. This delay is often the first sign to parents that something is abnormal with their child's development. A child with the most serious form of autism may never learn to speak or understand the spoken word. Others may develop language but show serious limitations. One common behavior was repeating the phrases of others because they couldn't understand the rules of communication that make it possible to create statements of their own or expressed themselves in a meaningful manner. Their symbolic language was also usually lacking. These wide ranges of language deficits, such as mutism, echolalia, and lack of expressive language, made it extremely difficult to educate and relate to these students. Echolalia is the repetition of words spoken by others and it is usually non-communicative.

*"I like to do the homework of algebra because in algebra, no need to write the language. By using the formulas, we can solve the problems of it. I feel difficult to write language while solving the problems of mathematics."*

*-Views of respondent A*

*"Alean does not write the language while solving the problems of mathematics. He does not understand the problem due to poor in language. If we make clear about the questions to him, he solves the problems without writing language. So most of the home work time, he chooses the topic in which the language is not to write."*

*-Parents of respondent B*

Another language problem, autistic students display was pronominal reversal or total literalness. For example total literalness would be when someone said *"it was raining, cats and dogs"* an autistic student thought *cats and dogs were falling from the sky*. Also, fifty

percent of autistic persons never develop functional speech (Schreibman, 1988). Language delay alone does not automatically indicate that a student has autism.

*"As like we have learnt the way of letting and by drawing the figures, I have practice more than ten questions of height and distance. Now days I start writing with language and solve properly."*

*-Respondent B*

*"Now days, she tries to understand the questions clearly and write appropriate language while solving problems. She tries to make different types of question as she has learnt in multimedia class. I am sure that she is getting enjoyed on learning mathematics at present days. It's all due to the change in teaching method and the impact of multimedia class."*

*- Parents of respondent A*

The views of respondents and their parents mentioned above clarify that mathematics is the difficult subject due to its unclear language as well as the language problem of ASD students. While observing them in class, the difficulty of writing mathematical term into language was the major problem to ASD students.

### **Sensory impairments**

*"Both the students take daily same type of tiffin. In assembly, Medina sits I third position and Alean sits in seventh position. In their leisure time, they repeats the same activities what they have done on previous days. Walking always by using one way, sitting in same bench daily, taking the tiffin always same. I think it affects on their learning style too. This is the major factor on learning mathematics also."*

*-Principals view*

Another characteristic which is commonly found throughout the autistic students was the fact that they needed and wanted their environment to be the same. This made it extremely challenging to parents and educators. If any change in a daily schedule or routine was made, it was potentially upsetting to them. Even if the change was slight, it could still be enough to cause the person to tantrum or refuse to engage in the varied activity. Some examples of this need for the sameness in the environment were that autistic students may always want to take the same route to school, have the same bus driver, or eat with the same utensils.

*"He always needs the same tiffin, always sits in same place in room. While doing homework of mathematics, he always does the same questions especially of arithmetic. He shows his anger when we give advice to do the exercise of algebra also"*

*- Parents of respondent B*

*"She knows all formula of the chapters of mathematics and always reads the formulas at home but she has no idea to solve the problem contained in exercise. When we request her to do the exercise, she replied the answer that she knows all formula and no need to do exercise."*

*-Parents of respondent A*

By analyzing the above views of participants and the observation form, it can be concluded that students with autism deal better with change when they adapt to a new environment with gradual exposure. It is also helpful if someone explains to them beforehand what changes are going to occur that day.

### **Abstractness**

Mathematics is the study of quantity, structure, space, and change. Mathematicians seek out patterns, formulate new conjectures, and established truth by rigorous deduction



from appropriately chose axioms and definitions. In comparison, Mathematics is abstract subject than the other. The terms and the subject-matter on mathematics are totally different than the literature subjects. Even most of the normal students do not achieve the success in this subject and they also do not show their interest on doing mathematics in class as well as at home. Most of the subject matter of elementary mathematics can not apply in real life situation.

*"Most of the mathematical terms are abstract that are not matching in real life. In my view, the simplification of algebraic terms and trigonometry like terms are rigorous and difficult to use in practical life. That's why; the students do not show their interest on it."*

*-Principals view*

Through the use of abstraction and logical reasoning, mathematics evolved from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exists. Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. Mathematics is the science of patterns and relationships. As a theoretical discipline, mathematics explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the real world. The abstractions can be anything from strings of numbers to geometric figures to sets of equations.

*"Some mathematical terms are abstruse even for normal students. I think, my child is not the only one who finds mathematical terms of his course abstruse."*

*-Parents of respondent B*

Because of its abstractness, mathematics is universal in a sense that other fields of human thought are not. It finds useful applications in business, industry, music, historical scholarship, politics, sports, medicine, agriculture, engineering, and the social and natural sciences. The relationship between mathematics and the other fields of basic and applied science is especially strong. Often, abstract patterns that have been studied for their own sake by mathematicians have turned out much later to be very useful in science. Science and mathematics are both trying to discover general patterns and relationships, and in this sense they are part of the same endeavor.

*"That event was really a remarkable even for her when she understood the formula  $a^3-b^3 = (a-b)(a^2+ab+b^2)$  through the video in computer that was given to her by her teacher. In my view the abstractness of mathematics can be understood through multimedia. Even I also understood such formula through that video. It was amazing."*

*-Parents of respondent A*

By analyzing the above views and the observation form taken from class, abstraction of mathematics deduct the interest of the ASD students towards it. And the multimedia system helps to bring up the interest of students and motivate them to learn it.

### **Computer-aided Instruction**

The primary stressor in the educational setting for autistic students is the social interaction with other humans. Replacing teachers and peers with technology can make learning more comfortable and help reduce the majority of their stress, thus promoting academic success. There have been significant changes and advancements in technology since Reffert's 2008 study, making a more current test of CAI as a tool for learning relevant (Moosavi, 2009). An interesting fact is that both the documented number of children with

ASD and the innovations to technology have grown significantly over the past decade. CAI as a category includes software tools that use graphics and illustrations and is commercially available in the forms of simulations, games and video modeling.

The inclusion of CAI as a teaching tool for ASD children is a worthwhile study, as is the comparison of this teaching mode to the traditional teacher-led instruction (Dille, 2009). Robbins (2010) also evaluated the efficacy of these two types of instruction. His work identified that most teachers surveyed approved of using technology as a teaching aid for autistic students, however the majority admitted to feeling unprepared to use this tool or any other, specifically for their ASD students. The findings supported the need for much more research in this area, as teachers admitted to needing teaching aids as well as professional development for working with ASD students.

*"I got different ideas of solving problems by searching in internet. The slides and different videos are helpful for solving the problems and for the clearance of mathematical concept. Now days, I am practicing the mathematical problem by the help of computer added instruction specially the DVD 'midas'."*

*-Respondent A*

Robbins (2010) evaluated the efficacy of CAI to teacher-led instruction and identified that class size is typically large, (20-30 students on average), standards of assessment are rigid and external aid is minimal. Additionally, Balbo (2010) identified a critical need for timely and accurate paperwork for children with special needs. An increase in the number of ASD children is evident in school across the country. This increase has led to a need for further studies focused on this population and their needs (Robbins, 2010; Quinn, 2011).

*"Most of the leisure time of her, she takes my mobile and play the game, watches the video and read the news, when I am busy in computer, she comes near and asks numerous questions like how and why. When she is alone, she watches the cartoon on TV and play with remote".*

*-Father of respondent A*

The typical characteristics of autistic students may hold the key for finding successful interventions in the classroom. CAI offers a technology tool that is heavy in graphics and needs no communication skills to operate. CAI has been evaluated as a tool for teaching ASD students, with most of the focus on language and vocabulary skills. Rhee (1997) conducted an investigation of using hypermedia to teach whole number addition to students with learning disabilities. The focus was on pre- and post-testing to compare results for both baseline and intervention groups of students taught basic math addition via CAI. Although the results of the Rhee study were supportive of using CAI to teach math to students with learning disabilities, few studies followed.

Pitts-Lathan (2006) developed her own CAI software tool, *The Math Training Station*, to teach basic math skills to a small group of middle school students with learning disabilities. The software contained both audio and video components and the study followed twenty-four participants for a semester. Pre- and post-testing were used to demonstrate skill progress, and statistics supported using CAI as a teaching tool of math for students with learning disabilities.

In 2009 Wild investigated the usage of CAI for teaching phonological skills to elementary pupils with autism (Wild, 2009). Her investigation compared a group of ASD students, who were taught using the intervention to a control group of students, taught the

same math skills via a paper-based format. Pre- and post-testing was used to assess specific math skills and the ASD students taught using the intervention showed better phonological skills than the control group.

*"It's amazing. Now days, Medina and Alean are seeing happy to learn mathematics as well as participate in mathematics related activities. I think the multimedia class by using CAI worked properly for them. The result in their third terminal exam is quite good in comparison with second term."*

*-Principals view*

CAI offers an interactive, customizable training mechanism that is also measurable.

*"When he is alone at home, he always opens computer, search different videos and watches. If his friend calls him in phone to play, he requests me to receive the call and say them that he is not at home".*

*-Mother of respondent B*

*"What's the reason behind it? Medina and Alean do not write anything in science but they are achieving good marks in mathematics" science teacher told in staff room. Another teacher added "Yes, they are very poor in language subject too. They always practice mathematics in classroom. If they did better in all the subjects like in mathematics, no more time is needed to achieve the good position."*

*-views sharing in staff room*

From this, it is seen that technology in education is a valuable tool for teaching children with social interaction sensitivity. CAI also removes social interaction, the primary stressor for ASD students. Enhancing the learning of mathematics for young, autistic students is important, and there is a vast selection of available CAI tools for this discipline.

## **Multimedia Attracts Students' Attention and Brings Fun to the Classroom**

What is needed is a learning environment that could maintain the level of teacher interaction whilst incorporating digital technologies that teachers could readily implement in the applied setting. The qualitative data revealed that those students who have a computer at home are more familiarized with it and they know its potentials and appreciate its contribution in fulfilling their educational duties. ASD students typically get stressed and anxious when dealing on a social front with other people, so the ability to interact with a computer lowered the anxiety and allowed these students to concentrate on the lesson and tasks at hand.

*"When he is busy in computer, he forgets to eat. At that time if we call him, he does not response. His focus will be in study in computer."*

*-Parents of respondent B*

It was found, from the observation and the interview with respondents and their peers that the students were paying more attention in the class teaching with computers. The CAI did attract the students' attention and the teachers noticed that the students behaved better than ordinary mathematics classes. Even though the materials presented in the CAI is from the text book, students seemed to have more interest in the CAI than the text book. After observing the multimedia class, principal shared

*"It might be because of the sound", added in the multimedia system "It brought about a more vivid atmosphere to the class"*

*-View of principal*

In staff meeting, principal explained about multimedia system in learning and said,

*"A good teacher should try the best to motivate pupils to learn. With this in mind I explained about computer added instructions. No matter how simple the CAI program was, it is the first and the important step for the teacher to teach with IT".*

*-Principals' view*

The research literature to date in the area of affordances of computer technology has shown that many students with ASD enjoy technology. The views of the participants given in different stage of study, by analyzing the observation form, and by analyzing the document and literature regarding multimedia system, it is seen that the relative ease with which these technologies use clear rule-based systems made digital and visual technology an ideal way to support individuals with ASD in various areas of functioning. Thus, it has been found in the clinical trials that the use of predictable, routine, systems-oriented visual technologies can help support the learning of students with ASD.

*"After school, she comes and starts doing homework of mathematics. Whenever she is busy in computer, she searches different ideas and methods of solving problems. She plays puzzles and games in computer. She used to ask us interesting questions related with mathematics. Her changing habit makes me happy."*

*-Parents of respondent A*

It was found, from the interview, which was taken at the middle of the study to the parents that their children were more interested to learn mathematics and most of the time they were busy to do the homework of mathematics at home. Instead of watching cartoon, seeing video related music, they were watching mathematical game, different slides and the ideas of solving mathematics problems by searching in internet and by using the materials

given by teacher. The CAI did attract the students' attention and the teachers noticed that the students behaved better than ordinary mathematics classes.

*"Now days she tries to do some exercise of mathematics in spite of reading just the formula. Once at late night, she was searching the solution of one problem of mathematics by typing the full questions on Google. When she solved the problem, she felt amazing"*

*-Parents of respondent A*

*"Sir, Raman requested me to solve the question of time and work, as I learned through you in extra class, I solve it. This chapter was the difficult chapter of mathematics for me before taking the class through overhead projector. When I learned through the slides provided by you at home thrice it became easy for me".*

*-View of respondent B*

It was also found, from the observation that they were asked some mathematical problems of arithmetic by their peers to teach them in class. Students with ASD were able to solve the questions easily which was asked by their peers to them. After solving the questions, he came near to the teacher and shared that event.



## **Chapter V**

### **SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATION**

In this final chapter, summary and conclusions have drawn regarding the use of an intervention in the form of multimedia as an ancillary resource for teachers of ASD students. Findings and recommendations have made regarding the impact of the findings as the teacher applies to public education and specifically the subject of Mathematics. Ideas for future research regarding the use of multimedia in public education have also presented.

#### **Summary**

The present study was concerned with the impact of Educational Multimedia System in teaching mathematics for students with autism. This study, therefore, was intended to answer the question whether the use of EMS affects on mathematics learning for students with autism.

The research was qualitative in nature. The purpose of the study was to explore the impact of EMS in learning mathematics for students with autism.

A small group of two ASD students was adopted to fulfill the objective of this study. The major factors that affect on learning mathematics for ASD students were drawn. Interest, communication, language, sensory impairments and abstractness of the subject were major affecting factors. The major tools; daily observation form, semi-structure interview (taken three times to the respondents individually), and school written gray documents were used. The respondents of this study were ASD students, their parents, teachers and principal.

Data Analysis was used to measure the impact of multimedia system in teaching mathematics. Data were accumulated using the observation of multimedia class and the interview with ASD students, teachers/principal and parents of ASD students. The observations by school personnel and support professionals assisted in assuring the best learning conditions for the participants in the class. The observations of the effects of using multimedia system were measured and the emotional impact on the students and their attitudes toward learning mathematics in the school were observed.

Aside from the data collected based on mathematics assessment scores, the students benefitted by interacting less with teachers and fellow students, thereby decreasing their angst at being in a classroom with others. Unambiguous questions were asked of parents, teachers and principal to evaluate benefits to the ASD students using the EMS in learning mathematics. The qualitative comments made by principal validated the lessened anxiety of these ASD students based on the use of EMS in teaching to ASD students. It was commented many times, by the ASD students, the preference to use the EMS and CAI software over sitting listening to a teacher explain lessons and exercises.

## **Findings**

From the existing qualitative analysis of the data leads towards the following results as the major findings of the study:

- The anxiety of the ASD students was decreased due to the lessening of their need to interact with teachers and fellow students.
- This is a significant finding, as the comfort and stress level of a student identified as ASD is an important identifier in their ability to be successful with academics.

- The findings showed that the ASD students asked no more questions regarding text than the other students from their class after benefited by EMS.
- There were also implicit advantages on improving their communication skill and language problem for ASD students who interact with a computer versus with a teacher or fellow student.
- The students made it clear that they would prefer learning all lessons via the CAI and the EMS, with interaction amongst teachers.
- The qualitative data proved that the stress level, and therefore the social and emotional satisfaction, of the ASD students increased as a result of the intervention.
- The ability to interact with a computer lowered the stress and anxiety when dealing on a social front with other people and allowed the ASD students to concentrate on the lesson and tasks at hand.
- As ASD students have a preference for learning from machines versus humans, this study showed students' focus seemed better when learning from the computer than when being distracted by other students in a classroom.
- The use of multimedia-enhanced learning had been found to be extremely beneficial for students with ASD, as well as practical and efficient for their instructors.

## **Conclusions**

Worldwide statistics show that the number of ASD pupils has grown to at least 1 in 68. Autism is a complex and confusing disorder, researchers have made significant progress in the last ten to twenty years. Educators must keep up with these current findings so that they

can give these students the best education possible. It is also extremely important that special education teachers have a good working relationship with the parents and other assistants that work with the autistic students.

Observations by professionals, including teachers, parents all agree that the anxiety level associated with ASD students was effectively lowered by the use of computer-aided materials as an alternative to human interaction in the classroom. The Qualitative feedback from professionals was clear that the EMS, in the form of computer instruction, is a viable addition to classroom-teaching ASD students. On the other hand, the qualitative results focused on the day to day observation and the interview with affected people, where it was apparent from comments that the EMS was a preferred method of instruction for ASD students. The students made it clear that they would prefer learning all lessons via the CAI instruction, along with interaction amongst fellow students or teachers

The qualitative results showed improvements in mathematics skills due to the use; teaching through multimedia. Some of the lack of efficacy is attributed to the fact that the sample size was small (only 2 students), On the other hand, the qualitative results focused on the observation and interview. Change Inventories, as well as the daily class teaching through multimedia, where it was apparent from comments that the multimedia treatment was a preferred method of instruction for ASD students.

## **Recommendations**

As the economy grows slowly and technology improves quickly, it is only realistic to look at EMS as a plausible means for instructing students who benefit from CAI over human interaction. Children with disabilities are part of our general population and therefore

deem it necessary for academics and professionals to review options to traditional classroom teaching. The government has enacted protocols to ensure equality in our school system. Technology is already in most of our public school systems, so it seems viable to look at this resource as an answer to assisting ASD students and their teachers with classroom instruction so that the ASD students are more focused and are more successful in the academic setting.

It is recommended that continuing research investigate a variety of CAI. Another recommendation would be to increase the number of respondents so that more ASD students are evaluated and over a longer time period than one month. This longer time period would allow for the usage of nation assessment scores. Last, it is recommended that an investigation look at traditional subjects other than English, Mathematics and Social Skills. For any mandated program to be effectively provided to all students there needs to be ancillary tools available to teachers to meet the needs of all students.

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## APPENDIX- A

### Semi-structured interview questions for students

Name of students:

Date: .....

Address:

Age:-

#### Questions asked to students

##### Interest

- What do you know about mathematics subject?
- How long do you spend time for mathematics at home?
- Which parts of mathematics do you like the most?
- What makes you bored to learn mathematics?
- Have you ever used any materials instead of book to do homework of mathematics?
- What are your weaknesses that you feel in learning mathematics?
- Are you willing to learn mathematics by the help of computer?

##### Communication

- What is the most important problem regarding mathematics learning?
- Do you like to talk with your friends, teachers and parents for long time?
- You like sitting alone or with friends at school?
- What do you do mostly if you are alone at home?
- What do you do if you are with family members at home?
- Have you ever asked any mathematics questions to your parents at home?



## **Language**

- Can you explain about yourself?
- Can you explain about mathematics subject?
- Which parts of mathematics do you like to practice in exercise copy mostly? Why?
- Why don't you like to do the exercise of word problem of mathematics?
- What is the most important problem that you are facing while practicing mathematics?
- Do you enjoy the TV programs? If yes then what programs?
- Have you ever noticed the spoken words while watching the videos related with mathematics?

## **Sensory impairments**

- Do you practice the mathematical problems by different methods?
- What makes you difficult to solve the problems of mathematics?
- Do you know anything that we have done in today's class?
- Can you write one question that we practice last week in multimedia class?
- Do you know all formula that we learnt in class at the initiation of this month?
- Do you like doing different things at different time?
- Do you revise the old topics while practicing mathematics?

## **Abstractness**

- Which subjects do you like the most?
- Why do/do not like the mathematics subject?
- Which part of mathematics do not like? Why?
- Are you performing your class work and homework regularly? If not then why?

## APPENDIX- B

### Semi-structured interview questions for principal

Name of parents:

Date: .....

Address:

Qualification:

Training:

Experience:

#### Questions asked to principal

- How long have you been working in this school as principal?
- Have you ever taught the students as subject teacher? If yes then which subject?
- Can you tell me please about these two students?
- What are your views about learning mathematics?
- Have you ever thought that these students can do better in mathematics?
- Do you have any experience on teaching for these types of students?
- What are your views about educational multimedia system in teaching?
- Is it beneficial to teach the students by the help of multimedia system?
- Have you ever noticed about the behaviors of these students?
- Are they sharing their problems to you any time?
- Are they participatory in extracurricular activities?
- Have you ever practiced the extra classes for them?
- What type of change that you are seeing in them after multimedia class?

## APPENDIX- C

### Semi-structured interview questions for parents

Name of parents:

Date: .....

) Fathers name:

Age:

) Mothers name:

Age:

Qualification of parents:

) Father:

) Mother:

Address:

#### ) **Questions asked to parents**

1. How would you describe yourself and your child?
2. Tell me a little bit about your child regarding on his/her study.
3. How is your child doing socially?
4. How is your child doing mathematics at home?
5. What are your child's weaknesses in learning mathematics at home?
6. Has your child been doing his/her homework and does anybody help her on doing homework especially of mathematics?
7. Has your child showing his/her interest on doing mathematics homework properly?
8. Has your child ever asked questions related in mathematics?
9. Is he/she ignoring your help on doing mathematics homework?
10. What areas of mathematical work to your child enjoy most?
11. What do you see your child doing in mathematics five years from now?

12. Have you ever noticed about your child's interest on playing calculator/computer like educational multimedia system?
13. What is the most important problem the child is facing regarding mathematics learning?
14. What additional assessment training or experiences does your child want or feel he/she need?
15. Do you have computer at home and is there the facilities of internet? , If yes then who spend most of the time in computer in your family?
16. Have you ever allowed your child to use computer/calculator/mobile/video game like materials? If no then why?
17. Have you ever seen that your child enjoy lot while playing mathematics related games on computer? If yes then what type of game he/she enjoy a lot? And did you focus on them in such activities of your child?

## APPENDIX-D

### Observation Form for Each Respondents of the Study

Name of respondent:-

Date:-.....

Time:-

Address:-

**Interest:-**

Observation Area	Excellent	Satisfactory	Offensive
Participation on discussion			
Regularity of students in math class			
Interaction about subject-matter in math class			
Completion of daily homework and class work			
Curiosity on mathematical problem			
Discussion with teacher and classmate after class			
Participation in extra activities of mathematics			

**Communication:-**

Observation Area	Excellent	Satisfactory	Offensive
Interaction between students-students			
Practice of group learning			
Interaction between teacher and student			
Questions raised in class by students			
Participation in discussion regarding mathematics			

**Language:-**

Observation Area	Excellent	Satisfactory	Offensive
Clearance of spoken language in math class			
Clearance of language in homework copy			
Clearance of language in class work copy			
Response on different stimuli			
Balance between spoken and body language			
Babbling while talking			

**Sensory impairments:-**

Observation Area	Excellent	Satisfactory	Offensive
Short term memory			
Long term memory			
Repetition of activities			
Sameness on doing homework			
Negligence on practicing math			
Irritate feeling on doing tasks			

**Abstractness:-**

Observation Area	Excellent	Satisfactory	Offensive
Understanding of math terminology			
Practice to apply math practically			
Interest on abstractness of mathematics			
Systematic study			
Motivated on multimedia class to know abstractness			