Preamble
Mathematics, an indispensable component of human life, has contributed to the growth and development of human civilization and holds an indomitable position among all academic subjects. Ever since the existence of human race in the world, mathematics has found an impeccable position in human civilization. As civilization developed, mathematics also grew simultaneously to cater to the growing demands of the mankind, classic examples being emergence of number system and geometry. Learning of mathematics is considered vital because of the complexity involved and its application value in day-to-day life. One of the major objectives of teaching mathematics is to develop computation skills, to emphasize logical thinking and to enable the child to participate in day-to-day activities of the family and community. The utility value of learning of mathematics is something phenomenal, considering the amount of application of mathematical concepts in one’s life. The importance of learning mathematics, not only for the sighted but also for children with visual impairment has been emphasized in many forums across the globe.

Mathematics for the visually impaired - Then and Now
Psychologists estimate that over 90 percent of learning, which obviously includes mathematical concepts too, during infancy occurs through visual sense (Kagan, 1971). The role of vision is so vital during the early years of life to learn concepts. Devoid of the sense of vision, it is an accepted fact that the children with visual impairment are in a disadvantageous position. However, teaching methodologies including multi-sensory approaches wherein the remaining senses are utilized optimally to compensate the loss
of vision comes in handy. Louis Braille’s invention of a reading system for the blind in 1832 and Helen Keller, in spite of being a deaf-blind securing a university degree in 1904, are milestones in the field of education of the blind, revealing success stories in spite of visual impairment.

Lowenfeld (1975) reveals that blindness restricts the range and variety of experiences, thereby the person with visual impairment gets a reduced experience and therefore loss of sight cannot be interpreted as loss of experience. Hence in the context of learning of mathematical concepts, the notion that children with visual impairment cannot learn mathematics due to loss of vision loses ground. Therefore, loss of vision certainly does not imply loss of opportunities for learning mathematical concepts.

Ever since the first school for the blind was established in Paris way back in 1784, the possibility of learning mathematics by children with visual impairment is debated in a score of forums by highlighting some of the areas in the subject that demand vision. However, the visual ideas could be converted to non-visual experiences so as to enable children with visual impairment to get the required learning experiences. Research reveals that children with visual impairment can also learn mathematics when they are taught in an appropriate manner by making necessary adaptations in the curriculum without altering the learning outcomes. Therefore special efforts, especially conviction of the teacher teaching mathematics and an effective application, would bring out useful adaptation techniques to enable children with visual impairment to achieve the same learning outcomes.

Evidently, learning of mathematics is considered to be a complex process even for the non-disabled children too. Worldwide, mathematics has the highest failure rates, and lowest average grade achievements. Almost all students regardless of the school type or grade cannot perform in mathematics on par with their intellectual abilities. (CTLM, 1986). While mathematics for the sighted children itself is in a mercurial state, the same for children with visual impairment is further compounded due to loss of vision. However, teaching mathematics to children with visual impairment has undergone transition over a period of time, resulting in optimistic views toward learning of mathematics by children with visual impairment. What was considered as impossible for children with visual impairment is proved to be feasible and is gaining an optimistic momentum world over. In reality, it is not the difficulty of the child with visual impairment to understand mathematical concepts, but it is the difficulty of the teacher teaching mathematics to make suitable adaptations in teaching the concepts. Days are gone when stereotypic attitudes existed in the society, that learning of mathematics is difficult for children with visual impairment. Moreover, a silver lining even for a worst performer in mathematics is that, because such a minute fraction of our intellectual potential is only utilized, scientists believe that even the worst mathematics performance can be improved considerably. (CTLM, 1986). At the school level, especially for children with
Factors contributing to learning of mathematics
A good mathematics curriculum must possess carefully chosen objectives that stress a balance among cognitive, affective and psychomotor domains as part of the instructional strategies. Following are the key factors considered important for effective learning of mathematics by children with visual impairment, among others (Mani, 1992).

1. Selection and teaching of suitable mathematical Braille codes.
2. Adaptation of text material to children with visual impairment.
3. Teaching of mathematical devices such as abacus, Taylor frame etc.,
4. Provision of right mathematics text material.
5. Preparation and use of appropriate teaching aids.
6. Provision of simulating experiences, creation of situational approaches etc.,

Hence a good and effective classroom, conducive for teaching of mathematics to children with visual impairment must adopt a multi-sensory approach using a plethora of teaching learning materials with necessary adaptations in the curriculum and must include children with visual impairment as active participants. Children learn primarily by manipulation till the formal operational stage. If children are not taught mathematics with hands on methods up to the age of 12, their ability to acquire mathematics knowledge is disturbed at the point when hands on explorations were abandoned in favour of abstractions. (CTLM, 1986) Hence learning by doing, wherever feasible, is the right approach in teaching mathematics to children with visual impairment.

Mathematics for the visually impaired - a right based approach
The Biwako Millennium Framework (2002) advocates an inclusive, barrier free, rights based society for the persons with disabilities. In the run towards the provision of a rights based society, three key areas of access, equity and quality need to be focused upon. It is no denying that by treating education as the right of children with disabilities, the society will be able to see the 'ability of children' rather than harping on their 'disability'. The human rights approach does not label children on the basis of disabilities. The human rights approach to education embrace the following key factors among others:

- The human rights approach in education recognizes the fact that every child is special in one-way or the other.
- A teacher who believes in human rights approach facilitates peer-to-peer learning.
- In an effective classroom, the teacher makes optimum utilization of the available teaching aids and assistive devices.
- A good teacher will adopt multi-sensory approach in learning.
The basic principles of the human rights approach to education underlie key ingredients of an effective teaching learning process of mathematics for the children with visual impairment. The concept of every child is unique advocates an Individualized Education Plan (IEP) for each child with visual impairment. Use of proper teaching learning materials to enhance the understanding of concepts is also emphasized and is very much in the offing. Also, facilitating peer-to peer learning and using of multi sensory approach are vital factors contributing to effective learning of mathematics.

**Effective ways of teaching mathematics**

Mathematicians advocate the development and use of a mathematical language in mathematics classrooms, which certainly pave way for the students including children with visual impairment to know about various terms and symbols being used in a mathematics course. Further, a rich mathematics vocabulary needs to be in the offing and integrated into each mathematics lesson and course of study. The subject matter in mathematics needs to be taught developmentally and sequentially in order to provide learners with background information to master each new objective.

Transfer of learning is a proven teaching strategy, wherein prior knowledge of the student can be effectively correlated to the current topic of discussion thereby paving way for better understanding of the concepts. There are a plethora of situations in which previously achieved ideas in mathematics may be used while introducing a new concept.

In everyday life too, the children with visual impairment need to use what has been learnt in mathematics classrooms to practical situations. When stationeries and other items are purchased, knowledge of mathematics is needed in these transactions. So, any concept being taught in a mathematics classroom is to be correlated to daily life situations thereby enabling the child with visual impairment to understand the application value of the concept taught, which can be executed by an effective teacher of mathematics.

**Effective mathematics teacher’s role**

Research studies reveal that student achievement is strongly influenced by teacher’s level of expertise. An expert teacher’s student performs 40% better than students of an ill prepared teacher. (USDE, 1998). In any teaching learning process the teacher is an indispensable entity, which cannot be substituted. Teachers need to be aware of the latest developments in learning theories and mathematics conceptualization, and also must be aware of using technology as a learning tool. Teachers need to realize that if the students are realizing difficulty, they should ask themselves the following questions:

1. Is my teaching style excluding students with certain learning styles?
2. Are the methods and materials I am using appropriate for and compatible with the student’s cognitive level and learning style?
3. Has the student mastered requisite skills and concepts? (Sharma, 1989).

This logic is very much applicable for teachers teaching mathematics to children with visual impairments too. Hence an effective teacher of mathematics for children with visual impairment needs to be abreast of:

1. Effective teaching methodologies
2. Use of mathematical devices such as abacus
3. Mathematical Braille codes
4. Suitable adaptation techniques without affecting the learning outcomes
5. Preparation and effective use of teaching learning materials
6. Technology aiding mathematics education

In addition, a good mathematics teacher of children with visual impairment must be an effective learner too. Knowledge of latest, proven teaching strategies when implemented in the classrooms will certainly transform an individual to become a better mathematics teacher. Creative mathematics, which has taken a leaf from the traditional art of Origamy comes in handy in teaching numerous mathematical concepts which are otherwise considered as abstract in nature. Such novel ideas that transform the teaching learning process enjoyable with the active participation of children with visual impairment need to be learnt and practiced by mathematics teachers. In a nutshell, teaching of mathematics to children with visual impairment needs to be child centered and must address the expected learning outcomes of the course of study.

**Conclusion**

Mathematical concepts and the components included in mathematics for children with visual impairment are to be practiced continually to gain mastery over the subject. Unlike other subjects, mathematics warrants enormous amount of attentiveness, reasoning ability, problem solving skills, ability in drawing conclusion etc.,. Further, the mathematics teacher and the children with visual impairment need to be aware of novel ideas and technological advancements in the field of mathematics. Adoption of suitable teaching methodologies, proficiency in mathematical Braille codes and skill in using mathematical devices, knowledge of adaptation techniques with relevant instructional strategies supplemented by right teaching learning materials etc., will certainly transform the teaching learning process of mathematics, to be visual impairment friendly, thereby transforming learning of mathematics effective and enjoyable.

**REFERENCES:**