Learning Resources in Mathematics*

Abstract

To disseminate the NCERT's initiatives of developing textbooks for two-year B.Ed. courses offered at Regional Institutes of Education, NCERT, this text on 'Learning Resources in Mathematics' *taken from recently published textbook* Pedagogy of Mathematics *for two-year B.Ed. course by the NCERT is presented here for our readers. Readers may see the details of this book on the back page of this journal.*

Introduction

A resource may be known as a source of aid or support that may be drawn upon when needed. Learning of a subject widely depends upon the availability of resources which plays a vital role in strengthening the understanding of the subject matter and hence, the fundamentals of the subject itself. While in life sciences and humanities, there are physical evidences available, viz., plants and animals in biology; people, laws, countries, social and cultural context in humanities, but in mathematics, evidences are normally invisible. Unlike other subjects, mathematics is basically based on logical reasoning and generalisation and deals with abstract concepts; thereafter their representations through symbols, etc. Further conceptual building on these abstract concepts brings greater vigour and complexity to its structure. So, there is a crucial need for learning resources in mathematics as they are not directly available.

Resources, here, are anything which may assist in understanding, strengthening or extending the subject content. Resource can also be understood as something that one uses to achieve an objective. In case of mathematics learning, these may be textbooks, handbooks, supplementary books, media, visual, audio, audio-visual, community, locality, school, infrastructure, mathematics laboratory, mathematics exhibitions, excursions, tours and trips, mentors, computer softwares, internet, web 2.0 tools etc. There is a basic need to explore more of these resources which may help in learning of mathematics, make it interesting, removing mathematics

* *Pedagogy of Mathematics, Textbook for two-year B.Ed. Course*, NCERT, 2012, pp. 213-236.

phobia from minds of learners, and hence, achieving narrow aims as well as higher aims for school education as mentioned in Teaching of Mathematics Position Paper, NCF–2005. Pimm and Johnston (2005) mention that using learning resources in mathematics, pupils are engaged through stimulating curiosity, communicating enthusiasm, matching the approaches used to mathematics being taught, effective questioning, selecting and making good use of resources and exploiting opportunities to contribute to the quality of pupils' wider educational development. This is the need of the hour as far as mathematics learning is concerned, that equal importance should be given to urban as well as to rural area students. This will strengthen our way, as teachers, in achieving the twin premises of mathematics education, that all students can learn mathematics and all students need to learn mathematics (NCF– 2005). While talking about school mathematics, Romberg (1999) says, for learning of mathematics two problems are required to be dealt with. First, the content and structure of the curriculum should not operate to indoctrinate students with past values, but should be derived from visions of the future. All students should be taught to reason, to design models and to create and solve problems. Second, all children must be taught critical thinking skills. He/she emphasises to press the need for all citizens to become 'mathematically literate'. This can be achieved with the help of better learning resources in mathematics. Conducive to the spirit of mathematics, NPE (1986) reflects, "Mathematics is a vehicle to train a child to think, to reason and articulate logically." In view of making mathematics interesting and understood by all children, teachers/students need to know about plurality of learning resources.

The pluralistic and diverse nature of Indian society definitely makes a strong case for preparing a variety of not only textbooks but also other materials, so as to children's creativity, participation and interest, thereby enhancing their learning. No one textbook can cater to the diverse needs of different groups of students.

Textbook

The most common learning resource in mathematics is a 'textbook'.

Various people conceptualise textbook in various ways. Some of these are:

A textbook is a book used in schools or colleges for the formal study of a subject.

Another statement describes it as a book used as a standard *source of information on a particular subject.*

A textbook is a collection of series of texts on various concerns of a specific area, for example, a textbook on mathematics, will be consisting various topics in mathematics specific to a particular grade and comprising specific text on these topics. A textbook of Class X may differ in various aspects from a textbook at college level for the same subject. In Class X textbook, 'trigonometry' may be one of the several chapters while there may be a complete textbook on 'trigonometry' alone at college level.

Textbook may vary according to the subject, content, student's age level etc. It gives introduction of the content and then tries to inculcate the understanding of the content through various instances, fundamentals, examples, exercises, etc. A textbook should preferably have historical context too, as it sensitises learner to humanistic aspect of mathematics. As Lawrence (2006) reveals that the historical context offers a flexible framework within which it is possible to achieve good results. It may have story also to develop communication skills, empathy, understanding, and above all, the subject knowledge.

(i) Need and Importance

From the above discussion, it can be said that a textbook is a very important learning resource as it not only introduces the content, but also builds a platform on which the entire structure of the concept and content knowledge stands firmly. It also gives a framework of a particular area of a course of study. It may be made easily available to all students irrespective of their socio-economic background. Now a days, textbooks are available in hard as well as soft forms. It can be in the form of a paper book or an e-book.

(ii) Handbook and Reference Book

Apart from the textbook, there are other types of books, such as handbooks and reference books. A handbook is a complete book in concise form on a particular task, profession, or area of study etc. A reference book may consist of details or further explanation on a particular topic of a textbook, extension of the topic, further examples/problems and further suggestive texts. Such books may be used to supplement to any resource and also to expand and strengthen the content. As an example, the book 'The Mathematics of Egypt, Mesopotamia, China, India and Islam: A Sourcebook' edited by Victor J Katz (2007), can be used as a reference book to know historical development in mathematics. In continuation of handbooks and reference books, supplementary books, viz., 'Exemplar Problems in Mathematics' and 'Laboratory Manuals in Mathematics' by NCERT for various classes, may also be seen as good learning resources.

Audio-Visual Multimedia

Basically, there are five senses: to see, to hear, to smell, to taste and to touch. These are perceived with the help of different body parts like eye to see, ear to hear, nose to smell, tongue to taste and skin to touch. But for all these, a medium is must, for example, to hear 'a sound' should be there, to see 'some image' or picture should be there.

In case of teaching-learning process, we can talk of various media like picture, image, sound, still and moving clip art, silent and audible video. 'Multimedia' is the combined use of media, such as movie, music, lighting, CD-ROMs and the internet for education or entertainment.

So, *a multimedia can be understood as the combination of more than one type of media, for example, sound alongwith image. When we use audio as well as visual media simultaneously, it is called audio-visual multimedia. It can also be viewed as multimedia designed to aid in*

learning or teaching by making use of both hearing and sight, for example, a video clip with audio, a movie clip, a power point presentation with sound effects, a video film or a television programme. Multimedia is a form of Information and Communication Technology (ICT) (Cohen, Manion, Morrison, 2005). There are many ways in which ICT can be used to enhance the teaching-learning experience in mathematics. Some of the educationists are more concerned with the efficiency and attitude of mathematics teachers towards use of multimedia and ICT. Crisan, Lerman and Winbourne (2007) conducted a study and concluded two types of factors – firstly, factors pertaining to contextual nature, and secondly, factors pertaining to personal nature, if dealt and facilitated effectively, can help the integration of ICT into teaching of mathematics at secondary school level. Factors of contextual nature are school context, availability and accessibility to ICT tools and resources, teacher's ICT skills, department ethos and key persons' and teacher's ICT professional development. Factors of personal nature are ICT content conceptions, ICT curricular conceptions, conceptions in mathematics, pedagogical content, conceptions and teacher's own learning experiences with ICT.

(i) Why Multimedia?

When we use more than one media simultaneously, it helps in learning better than just one media. When audio-visual multimedia is used, two senses work together: to see as well as to hear. So, learning in this case is acquired through coordination of both the senses. In this way, more than one sense can be activated to make effort to understand the content simultaneously. It may save time too than using single media at a time. Interaction of different senses help in linking of various information simultaneously and thereby stimulates the process of concept formation which is essential for the formation of an abstract concept, for example if a student observes a lion's picture (visual) along with its voice (audio) and if repeated a number of times, the student may recall either when presented one of the two. Similarly, when a student observes a five rupee note (visual) along with somebody pronouncing as five rupees (audio), she/he would learn better.

Traditionally, we are using materials like chalk, blackboard, simple paper charts, mathematical geometry box, etc. in teaching-learning of mathematics. Multimedia has opened a new window, as far as, teaching-learning aids are concerned. Use of multimedia in teaching stimulates our senses for better coordination and metacognitive processes. There are various advantages of using multimedia than that of traditional aids. 'CALtoonz2006' looks at it as follows:

Multimedia can

(i) animate the static,

(ii) simulate the hazardous or costly experiment,

(iii) capture reality,

(iv) add movement to static concepts,

(v) add dimension to abstract concepts,

(vi) add an element of fun in sometimes boring situations,

(vii) include audio/video clips of the original person/ event, such as the speech of eminent mathematicians and educationists.

Multimedia can add effects, create virtual situations, arouse interest among learners, give concrete representation for learning of abstract concepts, use pictures, texts, images, audio, video, animations, etc. It adds beauty and variety to mathematical concepts. So, it can be easily concluded that use of multimedia can be highly advantageous for the learning of mathematics as it tries to transform its abstractness into sort of presentable concreteness. It helps in making mathematical concepts more real and accessible to learners.

(ii) Multimedia in Mathematics

There are various organisations and bodies which are producing audio-visual multimedia packages or video CDs in the field of mathematics, viz. Central Institute of Educational Technology (NCERT), Electronic Media Production Centre (IGNOU), and different Government Directorates/Departments of Education. For instance, CIET has produced multimedia packages like 'Mathematics for Secondary Classes: Locus' and 'Mathematics for Primary and Upper Primary Classes: Construction of Geometrical Shapes', etc. It has produced many audio and video programmes both for teachers and learners. There are some non-government organisations (NGOs) and private sector educational institutes too which produce and make available the audio-visual multimedia for mathematics. It can be effectively used even in the absence of teacher, any number of times with a freedom to manage own time schedule. This ultimately enables learners to become independent learners.

(iii) How to Select a Multimedia?

Whatever is the content or whatever be the media, learner is always our main concern. So, while selecting any multimedia, the learner should be at the central place.

There are several aspects which should be kept in mind while selecting an appropriate multimedia:

1. *Pertaining to the learner*
   (i) Learner centeredness: It should be the learner who actively participates and takes decisions during execution of content through multimedia.
   (ii) Motivation and encouragement: Learner should get motivated and encouraged by the multimedia to be used.
   (iii) Readiness and mental set: Learner should be made ready and mentally prepared to learn from multimedia to be used.
2. *Pertaining to the multimedia material*
   (i) Usefulness: The content of multimedia should be useful for the learner.
   (ii) Cost effectiveness: Multimedia should be cost effective.
   (iii) Availability: Multimedia should be easily available to all.
   (iv) Relevance: Multimedia should be relevant to the subject and topic.

(v) Accessibility: Multimedia should be easily accessible to all.

(vi) Duration: The duration of multimedia should be appropriate with respect to need of content topic and learner. It should be neither too short nor so long.

3. *Pertaining to the formal and non-formal setting*

(i) Physical conditions: Physical environmental conditions should support the multimedia to be used.

(ii) Apparatus and equipments: Availability of apparatus and equipments for multimedia should be kept in mind.

(iii) Learner friendliness: The setting in which multimedia is to be used should be learner friendly.

(iv) How to Design a Multimedia?

Although there are varieties of multimedia resources available in the

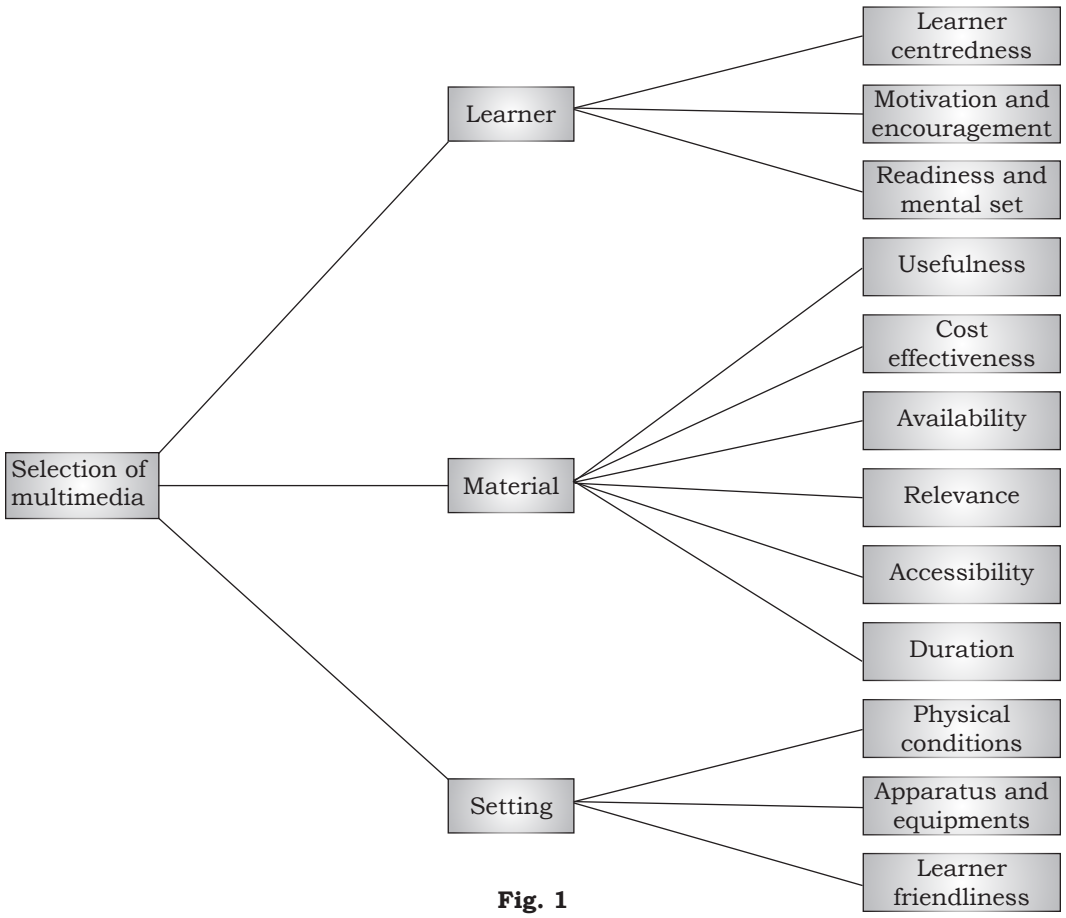

Fig. 1

market, it is always better if a teacher designs a multimedia resource keeping in mind the learning demands of the learners. Such individualised resources will have better impact and results. A multimedia can be designed through systematic steps, along with steps mentioned by various stakeholders, as follows:

(i) Defining end point behaviour
(ii) Assessing the learner or learner group
(iii) Defining specific objectives
(iv) Planning materials and objectives
(v) Planning optimum utilisation of available resources and alternative arrangements
(vi) Planning teaching strategies and methods
(vii) Evaluation process and recycling

Directorate of Education, Government of National Capital Territory (NCT) of Delhi along with Earnst Young Foundation (EYF) launched a project 'CALtoonz2006' for preparing multimedia for school students. It gave a sequence of steps for multimedia content development as follows:

(i) Defining the learning objectives
(ii) Gathering information
(iii) Preparing information for steps of preparation
(iv) Preparation of material for guided and independent practice which includes:
  (a) Database of questions
  (b) Games
(v) Art work and animation
(vi) Voice over
(vii) Finishing touches
(viii) Review and field test

These above mentioned steps can be used to design a good multimedia.

Community Resources

(i) What is Community?

Community, the term has evolved from the old French word etymologically 'communite' and classical Latin word 'communitas' or 'communis' which means common.

As revealed from various sources, *Community is a group of people sharing a common understanding who reveal themselves by using the same language, manners, tradition and law. It can be seen as the condition of having certain attitudes and interests in common.*

It can also be viewed as a particular locality, considered together with its inhabitants or a group of people within a society with a shared ethnic or cultural background, especially within a larger society. It also gives a sense of the people with common interests living in a particular area. So, as a whole it can be understood as a society in general.

National Curriculum Framework for Teacher Education (2009) emphas-ises upon the role of community knowledge in education. It says, "It is important for the development of concepts in children as well as the application of school knowledge in real life, that formal school knowledge is linked with community knowledge." Community knowledge, here, refers to the knowledge that people construct, develop and amass as a result of their everyday and ecological

experiences. So, indigenous and local knowledge should be given ample importance for the learning.

(ii) Mathematics Learning begins at Home

The best initial resources for mathematics learning can be found at home and immediate environment itself. The home, as first exposure of informal community to the child, provides ample opportunities where mathematical ideas are experienced, explored and learnt. There are various objects available at home and that too with ease, which can help in learning of mathematics. Currency notes can be used to develop the understanding of number system. These can be used to learn fundamental operations in mathematics. The walls, floor, ceiling, electrical wires, table, chair, utensils, etc. can be used to develop spatial understanding and formation of geometrical shapes. Wall and gate can be used to learn trigonometry. Playing cards and glass balls can help in learning of probability. Distribution of biscuits and chocolates, etc. can make the learner understand the basic operations in statistics like presenting information in terms of numbers and making a frequency table. Not only this, even rituals at home can be used as learning resources in mathematics. There are many books written by Qvarsell and Wulf (2003) mentioning how rituals can be used for learning.

(iii) What are Community Resources for Mathematics Learning?

Community in a generalised sense can be viewed as the society. The local context of the learner can be viewed as the best resource for learning. Community resources give an opportunity for better inquiry system for learning.

For developing and schematising concepts through various sources of evidence like reasoning, observation, representation, dialectic and ethical values, community resources can play a vital and facilitating role. Students are advised to explore more upon these sources of evidence.

At formal stage, school, block and the district, as parts of community, play significant role in shaping mathematical world of the learner. At all these levels, various resources are there which can help in learning of mathematics. At school level, these may be school premises and school buildings, corridors, verandahs, classrooms and walls, mathematics laboratory or corner, mathematics club or forum, group of mathematics teachers or mentors and mathematics exhibitions. Group coordination and cooperation among mathematics teachers can help better teaching-learning of mathematics and improve performance in mathematics as revealed by Horn (2008). At block/ cluster level, there may be cluster level exhibitions, cluster level mathematics centres, a panel of all mathematics teachers at block level, block level mathematics competitions. At district level, there may be mathematics centres, mathematics exhibitions, mathematics fairs, committee for mathematics activities, mathematics laboratory at District Institute of Education and Training (DIETs). This is how, we can create opportunities for sharing or exchanging experiences and ideas among

thinking community of mathematics practitioners and learners.

Pooling of Learning Resources

As our everyday experience, we find various concrete and abstract sources of learning, all around us, which act as learning opportunities for meaningful construction of knowledge. One can find everywhere around her/him the sources for learning, and everything (either concrete or abstract) around the learner can make the learner experience so many concepts. Mathematics learning too is not an exception in this case. Though mathematics learning opportunities and resources are available in plenty as part of our everyday life, still there is a need for pooling these resources in some organised and orderly, formal and informal manner, so that they become more accessible and transparent. This pooling can be ensured at various levels viz., school level, block level, district level, state level, national level and international level. Pimm and Johnston (2005), while talking about resources and ideas for enhancing the teaching-learning of mathematics, enlist various resources like textbooks and schemes, practical apparatus, homework, parents, learner's room, the history of mathematics, role play, simulation, video and television, school libraries, mathematics clubs and trails.

At national and international levels, science centres, museum, seminars, conferences, symposium, journals, teachers' association etc. can be good resources for mathematics learning. These will be later dealt in Unit 10 of this book. Here, we will talk about learning resources at:

(i) School level
(ii) Block level
(iii) District level

Let us discuss these in detail.

(i) School Level

(i)a: Mathematics Laboratory/Corner

In every school, a mathematics laboratory or corner can be established, which will have various equipments, apparatus, charts, models: working and static, etc., that can help in building the learning of abstract concepts in mathematics by having experimentation, activities, hands on experience, verification, etc. In mathematics laboratory, electronic calculator, graph machines, mathematical games, puzzle boards, mathematical kit, mathematics videos and clinometers, etc. can be made available. Mangal and Mangal (2009) has given an elaborated list of hardware instructional aids, viz., magic lantern, epidiascope, projector, radio, tape recorder, television, closed circuit television, video cassette recorder, motion pictures, computers and software instructional aids, viz., blackboard or chalkboard, bulletin board or information board, flannel board, pictures, charts, graphs, maps, globes, diagrams, photographs, cartoons, posters, newspapers, flash cards, models, slides, filmstrips, transparencies, programmed learning packages, many of which can be a part of mathematics laboratory. The need is to think how these can be used for better learning of mathematics.

As NCF–2005, too mentions that one of the important aims of mathematics education is "to develop the child's resources to think and reason

mathematically to pursue assumptions to their logical conclusion and handle abstractions." Mathematics laboratory or corner can best develop the habit of thinking, reasoning and rationalising through logical conclusions and handling abstractions.

(i)b: Mathematics Club/Forum/ Community/Society

In school, a club of mathematics students can be established under the guidance of mathematics teacher. The attention should be more towards ensuring membership to all, especially to them who are not thought to be good in mathematics.

Various sorts of activities, discussions, quiz at school level, mathematics excursion and tour, lectures by experts, workshops, competitions can be organised and coordinated by such a club/forum. It can be in the form of a club or forum, community or society. Various activities are mentioned by Thomson and Hartog (1993) in 'Activities to teach mathematics in the context of environmental studies' pertaining to number and number relationship, computation and functions, algebra, statistics, probability, geometry and measurement.

The students who are good at linguistics too can be motivated to establish a reading club, and they can meet weekly to discuss the beauty, nature and recent development in mathematical concepts, and hence, it will help in mathematics learning. Group projects can be taken in such a forum which can pave the way for better learning of mathematics with a shift from independence to interdependence, from structured to freedom, from disciplinary to interdisciplinary, and from product to process.

(i)c: School Library

School library can be visualised as one of the prominent learning resource for mathematics. There are various textbooks, reference books, activity books and puzzle books that can be made available in the library. These books can be issued to students. Various journals pertaining to mathematics learning can be put inside the library for awareness about mathematics learning and pedagogy of mathematics teaching.

(i)d: Mentoring

Though mentoring is still a developing concept in Indian context, but it can be effectively used as one of the learning resources in the school.

As revealed from the various sources, a mentor is an experienced person, trusted counsellor or guide who provides information, advice, support and encouragement to a less experienced person, often leading and guiding by example of his/her success in an area.

Working definition of mentoring can be, *A one to one learning relationship between an older person and a younger person for the development of the later.*

Mentors help in strengthening academic skills in general leading to student's success.

Mentoring is a structured one to one relationship or partnership that focuses on the needs of the mentored participant.

Daloz (1990) views effective mentorship as similar to "guiding the

student on a journey at the end of which the student is a different and more accomplished person. In a formal learning situation, mentoring functions can be understood as providing support, challenge and vision."

During mentoring too, formal and group work can be given ample emphasis. Mac Bean, Graham and Sangwin (2004) had a study on school and university students namely 'Group work in mathematics: A survey of students' experiences and attitudes' and concluded that students show a very positive attitude towards group work, but with utilitarian view of its benefits.

(ii) Block Level

(ii)a: Interschool Collaboration

There can be collaboration among schools to provide a place to establish a platform for mathematics. This collaboration will give rise to opening of new opportunities for mathematics learning. This collaboration may be at two different levels: Student's level and Mathematics Teacher's level. Studies have revealed that collaboration of mathematics teachers gives rise to better understanding of learners and learner's problems in mathematics. They discuss various problems pertaining to pedagogy, methods, fundamental problems and sharing available facilities.

(ii)b: Cluster Level Competitions or Exhibitions

Cluster level competitions are other learning resources in mathematics. At cluster level, we can have mathematics exhibitions, mental mathematics quiz competitions, mathematics table writing competitions, etc. All these competitions can develop a healthy attitude towards competition, cooperation and coordination among students.

(ii)c: e-Learning Laboratory cum Block Resource Centre

e-learning can be understood as learning through electronic means, modes and resources. This may be online or offline, synchronous or asynchronous, etc., but the type, the learner uses, must be an electronic form. In Indian context, if it is not easy to have e-learning laboratories at each school, then as an alternative, we can have e-learning laboratory at block level. While talking about e-learning, Bhatia (2009) mentions that e-learning should be used to supplement and not supplant traditional forms of teaching-learning.

Main features of e-learning are:

(i) connectivity or networking
(ii) flexibility
(iii) interactivity and collaboration
(iv) virtual learning environment like texts, visuals, quizes, etc.

Various e-learning tools can be used for mathematics learning like e-mails, blogs, wikis, e-portfolios, animation, videos, links, specialised softwares, etc. Noss (1988) had a study with 13 years old LOGO experienced children, on and off the computer. Children were asked to solve ratio and proportion problems using computer as well as paper and pencil. He used pencil and paper for ratio test. It was found that the performance was better in case of students solving the problems on the computer. Along with these computers related facilities, other learning aids can also be put in block resource centre. Students

are suggested to go through various packages produced/being produced by Regional Institute of Education (NCERT), Bhubaneswar and CIET for pedagogy-technology integration discussing various e-tools and their integration in teaching-learning process.

(iii) District Level

(iii)a: Science Centre

At district level, there are some science centres. These centres inherit mathematics as a science component. There are exhibitions and several other activities at science centres pertaining to mathematics also which may really help in learning of mathematics.

(iii)b: DIET

At district level, there are District Institutes of Education and Training (DIET). These institutes have enriched mathematics laboratories which can help prospective teachers to learn more about mathematics and teaching of mathematics, which in turn will help learners. Most of the models and aids in these institutes are being prepared by student-teachers. It can be revealed from NCFTE (2009) that student teachers learn to integrate ideas, experiences and professional skills through hands on experience of developing learning materials.

(iv) Open Educational Resources, Web Resources and Virtual Classrooms

Now a days, more emphasis is being given on open educational resources. Since most of the resources on internet are paid resources, it is not possible for all to access and use these resources for learning. While it is very important that everybody should learn mathematics in the current era, how can we deprive a major section of the society new technology and resources for learning of mathematics? The answer to these questions is open learning resources. There are several websites which make web content freely available for all. A very well known name is 'wiki'. Wiki means 'what I know is'. This is a very large project and comprises of various components. The most popular open education resource is Wikipedia. Its website address is http://wikipedia.org. It comprises editable text material and information on almost every topic. If it is not there, anybody can create a page for that particular topic. The information can be seen in almost every language, including English and Hindi. Wikipedia also hosts a number of sister projects which are equally important. Some of these are Commons, Wikiquote, Wikispecies, Wikinews, Wikibooks, Wikiversity, Wiktionary, Wikisource and Meta-wiki. All these resources are open for all anytime, anywhere, and that too free of paid services. These sources give freedom to edit and express for every individual. There are Google applications too as other resources.

Some other good web resources in mathematics are:

http://mathforum.org
http://www.algebasics.com
http://www.cutescience.com
http://mathworld.wolfram.com
http://www.ipl.org
http://www.emis.de
http://www.mathmistakes.com
http://www.nctm.org
http://www.awm-math.org

http://www.eric.ed.gov
www.e-book.com.au
www.dli.ernet.in
http://wikieducator.org

There is another resource known as virtual classroom. In virtual classroom, people interacting simultaneously are not face to face, but still there is a sort of synchronous communication among all people. In such a classroom, anybody can express anything anytime, during the class and all others will come to know and respond to the query or views expressed. It all happens when people are sitting at their respective places either at home or at likewise setting. So, in such a learning situation, they are not required to assemble altogether at the same place. While talking about importance of virtual classroom, Amin (2010) says "Teachers' physical presence is not needed all the time. Even at higher education level, a person from one country can have their mentors or teachers from other country. This has created a greater impact and given broad outlook to education." The versatility of such resource is that there can be learners sitting in different continents like Asia, America, Africa and Australia simultaneously and interacting with each other. A website as an example for such classroom can be given as:

www.wiziq.com

Students, while using any website, are advised to be cautious about their possible harms too, as some of the websites may hack their computers, misuse their data, transfer virus to their computers. One of the possible solutions/precautions may be that the computer should have been installed with latest updated anti-virus. One of the free anti-viruses is 'Clam Win', which may be downloaded from link provided on website of UNESCO (2011). Students are suggested to check the current status for this anti-virus.

Handling Hurdles in Utilising Resources

While utilising all above mentioned resources, there are some hurdles felt by either teacher or students. A hurdle, in general, can be understood as a difficulty or obstacle that has to be overcome. So if we want to utilise these for better learning of mathematics, we will have to overcome these hurdles. Broadly we can categorise these hurdles into two categories: first, social and ethical hurdles, and second, technical hurdles. CALtoonz2006 and Roblyer (2008) talk about various aspects of these hurdles. Let us discuss these in detail.

(a) Social and Ethical Hurdles

As ethics are basically related to the society, so these hurdles can be put together with social hurdles due to their complementary nature. Various hurdles or attention seeking issues with reference to CALtoonz2006 and Roblyer (2008) can be mentioned as:

(i) Secularity of the Content: India is a secular country as mentioned in our Constitution. So, we have to maintain secularity in the content of the resource. No resource can be utilised and accepted which harm our secularism.

(ii) Gender Equity: Gender equity is another very important issue. Our resource should be based on giving equal importance to both the genders, male as well as female.

For the evolution of a modern and developed society, gender equity is important.

(iii) Democracy: Democracy is giving equal opportunity and equal rights to all. Our resource content should provide ample instances for reflecting democracy. If it does not reflect, it may not be accepted by the society.

(iv) Respect for Elders: The resource should give space for and should inculcate value of respect for elders. Our Indian culture is well known universally for respect for elders. So, if our content of resource reflects respect for elders, it will be heartily accepted by the learners as well as their parents.

(v) Respect for the Disabled: This era is the era of inclusion of all in every aspect of our society, including the field of education and betterment of life. Our resource should show equal opportunity to all, and it should pave a way giving respect to the disabled.

(vi) Respect for all the Religions: The resource content should give respect to all the religions. The content should not have any material which shows disrespect to any religion. This may help in fostering fraternity among learners.

(vii) Concern for Animals: Our society is more concerned about animals and their welfare now a days. The resource should respect such concern in its content and presentation.

(viii) Respect for the Environment: While we are stressing for eco-friendliness of everything we are using or producing, how can we leave our resource away from such an important issue. Our resource should be eco-friendly, encourage eco-friendliness, hence, should have respect for the environment.

(ix) Plagiarism and Cyber Cheating: Plagiarism is using and mentioning work of some other person without acknowledging that person, or mentioning in the name of oneself. This is just like cheating, and unethical that the work of some other person is being used or published in the name of self. So, using any resource in such a way should be avoided.

(x) Illegal Downloads/Software Piracy: Software and media companies are prosecuting offenders of illegal downloading and piracy of softwares. Hence, one should avoid illegal downloading and piracy of softwares.

(b) Technical Hurdles

Some of the technical hurdles are:

(i) Colour: Colour used should not be hot colours. Most of the colours should be soft colours and eye friendly. The learner should not feel stress while going through the content as well as pictures and figures.

(ii) Speed: In case of multimedia resource, the speed should be optimum enough to provide learners with ample time to go through the content and concept. If speed will be too fast, learner

would not be able to go through the entire slide, and if it will be too slow, learner would feel like wastage of time and it may create disinterest.

(iii) Smoothness of Animation: In case of animation, it should be smooth enough to facilitate learner for better learning. It should not create a sense of irritation among the learners.

(iv) Use of Screen: Entire screen should be efficiently used. It should not be like that the entire content or picture is lying on a corner and majority of the space of the screen is lying vacant or useless. If only text is there, it could have its orientation beginning from centre. In case of books and e-books too, each page can be considered as one screen.

(v) Special Effects: Special effects, if any, should be learner centred. It should be in consideration with the age level, mental level, previous knowledge, attitude and aptitude level and readiness of the learner.

(vi) Music: Music, sound and voices used should be appropriate with respect to validity, timing and relatedness. It should be soft and ear friendly. Under no circumstances it should be harmful or irritating to the learner.

If all these social, ethical and technical hurdles can be overcome, then not only learners and teachers, but everybody related to the field of mathematics will use these resources for betterment of learning, and hence, for the betterment of the entire field of mathematics.

Some suggestions for overcoming the hurdles could be as follows:

(i) Narration: It can be better, if the text for using at school is in the form of narration. A narrator should always be present over there. It means, if a text is being represented, it should be shown in such a way that it is being narrated by some character instead of simply writing the text in open space.

(ii) Teacher Friendliness: It should be easy for the teacher to handle the resource. If the teacher, will not feel comfortable using the resource, it may create disruption from using the resource in future again.

(iii) Teacher Training and Skill Development: A teacher should be trained and provided with ample skills to use resources in learning of mathematics. It must be compulsory part of a teacher training programme, that prospective teachers be given training for skills to handle learning resources.

(iv) Attitude and Ease of Access: The source should be easily accessible to all the students and teachers. They may not have a positive attitude towards utilising these resources in learning and teaching, but ease of access will surely motivate them for utilising these resources in learning, 'teaching of mathematics.'

If all these social, ethical and technical hurdles can be taken care, then not only learners and teachers, but everybody related to the for field

of study of mathematics will use these resources betterment of learning and hence, for the betterment of the entire field of mathematics.

Summary

Learning resources play a vital role in learning of mathematics. Here and there, several resources are spread which can be used for learning of mathematics. These can be in the form of textbooks, hand books, reference books, supplementary books, audio-visual multimedia or community resources. Sometimes, there is a need of pooling these resources at formal and informal levels. Various resources, mentioned here, provide powerful vehicles to engage and sustain children's interest in mathematics. If these resources are properly used as learning opportunities for mathematics learners, it will surely empower our learners to think like mathematicians.

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