

Innovations in Teaching Mathematics to strengthen Mathematical understanding of school students

Dr. Arup Kundu, (W.B.E.S)

Assistant Professor, Department of Mathematics, Government Training College, Hooghly, Chawakbazar - 712103, West Bengal, India

ABSTRACT

.....

In this paper the presenter has tried to discuss innovation and innovative practices in teaching mathematics and enlightens some approaches for teaching and learning in mathematics of the school students. Although most of mathematics teachers are equipped with sufficient content knowledge, teaching method require innovation in their instructional planning. Generally, teachers focus their teaching processes on procedural knowledge rather than conceptual clarity. It is also apparent that most of the students loosen their interest in mathematics up to secondary level (NCF, 2005). NEP (2020) proposed re-shaping in curriculum and pedagogy and recommends the paradigm shift from content basedto experience based learning. The NEP emphasizes on strengthening the foundation of quality education. It focuses on cognitive depth of the learner as an important aspect and on restrains the rote learning system. Resources are available to teachers in terms of curriculum textbooks, etc., but they need to develop innovative teaching learning taking place in mathematics classrooms. Some innovative methods and approaches discussed in this paper can be very useful for the school students and teachers inlearning process of mathematics education.

Keywords: Innovations; approaches; teaching-learning; mathematics education; school students.

INTRODUCTION

According to Nelson Mandela "Destroying any nation does not require the use of nuclear bombs or long-range missiles. But for this, it is necessary to lower the quality of education and give opportunities to students to cheat in examinations....the collapse of education is the collapse of nation" (Beena, 2021; Sharma, 2017). This means that better quality education methods and technology should be used day by day to provide a good quality education, only then education will move towards the goal of sustainable development, otherwise the education system will face a setback. The education system of the state has a huge responsibility to transform a child into a fully developed individual. Over the ages, the educationists and researchers of the country have been working tirelessly to shape an education system that can express, promote and preserve its social and cultural identity, a system that can best meet the needs of the times. Keeping in mind need for such continuous reforms, the National Education Policy (NEP)-2020 emerged as a document to reform the education system in India which significant step towards transforming the education system (Beena, 2021).



Education is an important vehicle for individual and social development. Defective education hinders development. Our education system needs a reform today. The written systemis considered as an important component in the Indian education system. To ensure the pass percentage in this test, students often try to memorize without trying to understand the concept of the subject (Goel, 2022). Report cards may show a decent position in school or board results but this education will not be successful in real life. The new national education policy has come up with new ideas to solve such problems.

Importance of mathematics teaching in perspective of NEP 2020: Mathematics is an important part of the curriculum at every stage of school education due to its numerous applications in all walks of life. The National Policy on Education (NPE, 1986) stated that "Mathematics should be considered as a vehicle for training a child's ability to think, reason, analyse and speak logically" (Walia, 2020). Similarly, the new National Education Policy recognize the importance of mathematics and mathematical thinking in future research- based fields such as artificial intelligence, machine learning and data science (Walia, 2020).

Mathematics is considered as a science of numbers and calculation surrounded by the dominance of a definite answer whereas in the broadest sense it is a matter of inference that leads to logical conclusions. Mathematics is the study of abstract concepts made up of abstract elements. Mathematics is not just a science of numbers or calculation but much more about generalization formation, relationship viewing, logical thinking and the development of reasoning. Many students struggle with it and become dis-satisfied because they are constantly interrupted in their engagement (Anthony & Walshaw, 2009). The National Focus Group on mathematics Education drew attention to problems in mathematics education and provided some important recommendations in 2005 attempting to address them with respect to curriculum, pedagogy, and classroom environment. Although the paradigm shift was recommended in 2005 in all important aspects of the teaching learning process, the effectiveness of mathematics is deteriorating (National Achievement Survey, 2017) across the country (Walia, 2020).

In November 2017, The Government of India conducts surveys to assess the state's school education system, the results of which help guide educational policy, planning and implementation at the national, state, district and classroom levels to improve children's learning and improve quality. One such survey National Achievement Survey-2017 was conducted in Government and Government aided schools across the country in class III, V & VIII. The percentage of correct answers in mathematics was 63% for Class III, 53% for Class V and 43% for class VIII. Here, looking at the third to eight grade results, there has been a decline in the percentage of correct answers in mathematics; most of the students have lost their interest in mathematics up to the secondary level and as a result have deliberately chosen a stream without mathematics at the higher secondary level (Walia, 2020). There are many reasons behind this negative attitude of students towards mathematics such as weak mathematical foundation, irregular study habits, parental noninvolvement etc. (Vijyana, 2014). In addition to these factors, topics, teaching methods, strategies, techniques, motivation, enjoyment and the classroom environment also contribute to developing a positive or negative attitude towards the mathematics (Walia, 2020).

Teachers generally adopt teaching methods and strategies that emphasize informational knowledge rather than conceptual clarity in the mathematics classroom. Explanatory methods,



including lecture and demonstration, that give all the importance to lecture and text, are used by teachers in the mathematics classroom (Khongji & Nongbsap, 2013). These methods are information-centered where students have to memorize previously presented mathematical rules without any hands-on practice (Khongji & Nongbsap, 2013). Relevance to the content and engagement with previous experience is essential to make learning meaningful (NEP, 2020). The NCF, 2005 promoted the paradigm shift in educational practice to allay fears and feelings of failure. It should be planned to make this learning joyful and learning without burden. Dividing students into groups and assigning them a specific task or activity that they will complete through interaction among themselves creates a collaborative environment. Exploratory activities or mathematical games are collaborative learning that will create fun instead of fear (Walia, 2020). NEP (2020) proposes a paradigm shift from information based learning to experiential learning to make education meaningful and provocative. This article highlights the approaches, techniques and methods of teaching mathematics that can be helpful in bringing innovation to themathematics classroom.

SIGNIFICANCE OF TEACHING MATHEMATICS

Mathematics education is an indispensible and integral part of the curriculum, if this subject is taught in a well-organized and proper manner; it plays a vital role in the progress of our nation. All available means should be implemented and practiced to improve mathematics education so that everyone can participate in mathematics education at least at the school level. However, the fact that most students find mathematics difficult to learn and that understanding requires appropriate intelligence makes it imperative for schools to improve the quality ofmathematics education by using all resources and strategies to help students understanding(Algani, 2019). Today's rapid technological advancements in integrating technology into the classroom indicate the importance of innovative strategies in mathematics education, the use and practice of Technological Pedagogical Content and Knowledge (Beena, 2021). According to Sidhu (1995) the goals of teaching mathematics are as follows:

- ✓ To develop mathematical skills like speed, accuracy, neatness, brevity, estimation, etc.
- ✓ To develop logical thinking, reasoning power, analytical thinking, and critical thinking.
- \checkmark To develop power of decision making.
- \checkmark To develop power of problem solving.
- \checkmark To recognize the adequacy or inadequacy of given data in relation to any problem.
- \checkmark To develop scientific attitude i.e to estimate, find and verify results.
- ✓ To develop ability to analyze, to draw inference and to generalize from the collected data and evidences.
- ✓ To develop heuristic attitude and to discover solutions and proofs with the own independent efforts.
- ✓ To develop mathematical perspective and outlook for observing the realm of nature and society.



Mathematics is the only subject whose knowledge inculcates in the minds of students the habit of hard work, concentration, punctuality, regularity, neatness, well-organized and transparency. This habit goes in a long way to train the students in leading a life full of self- restrain and reasoning. This is why a mind trained by mathematics is more disciplined than any other mind that is not trained by mathematics.

NEED FOR INNOVATIONS IN TEACHING MATHEMATICS

Looking to the objectives of teaching mathematics shows that there is more focus on the higher level objectives inherent in the mathematics subject, such as critical thinking, analytical thinking, logical reasoning, computation, decision making, problem solving. Many of these skills are tools for developing life skills. Such objectives are difficult to achieve only through the verbal and mechanical methods commonly used in mathematics classes. Therefore, as somethingshould be taught with emphasis on memorization of formulas and theorems, it should be acquire the met cognitive ability to apply formula and result in specific problem area.

NCERT, CBSE and other state boards are the authorized bodies for designed the curriculum in the school education system of India. These organizations select the curriculum based on comparative considerations with the curriculum of other countries. But still the learning outcomes of students in mathematics are not as expected. Lack of proper presentation on the part of teachers leads to problems of implementation, because choosing one convenient teaching strategy for different types of students and teaching it to all is not successful, it indicates lack of innovative pedagogical planning of teaching.

If teachers introduce appropriate strategies through proper planning such as teaching using innovative practice, then the education system will lead to proper implementation. Ma'abrah (2018) recommends that teachers take care to implement study material with proper planning and consider presenting it in innovative ways. According to Coe, Christie (2018) there are a verity of methods that can be employed and teachers can use innovative and creative ideas in the classroom to encourage students to study and understand mathematics in the best possible way. This requires a periodic review of the nature of the mathematics curriculum, the quality of the methods used to teach it, and ultimately the extent to which students acquire their learning content and how well they achieve results at the end of each semester (Algani, 2019).

It is very important to employ different techniques and innovations to teach mathematics. Although teachers talk about their limitations or obstacles in the classroom such as: constrains to complete the teaching process efficiently in time, lack of proper motivation, lack of interest in students, inadequacy of programs required for professional development in innovative teaching learning resources etc., they focus not only on completing the syllabus but also on teaching with innovative strategies and proper planning of the teacher. Creative attention should be given to which has proved to be very effective in learning mathematics.

OBJECTIVES OF THE STUDY

Objectives are as follows:

i. To study various strategies and teaching practices in school level mathematics education.



ii. To study various innovative approaches of teaching practice in school level mathematics education.

INNOVATION IN TEACHING MATHEMATICS

Innovation in mathematics education can be diversified in terms of teaching method, pedagogical resources and some modern approaches used in the teaching learning process.

METHODOLOGY

Method is a style of presenting content in the classroom. Following are the innovative methods and approaches that can be used to make the teaching-learning processes of mathematics effective.

Inductive -to-Deductive Method

It is a combination of inductive and deductive methods. In inductive method one proceeds from particular to general, from concentrate facts to abstract rules and from the special examples to the general formula. In deductive method one proceeds from general to particular, from abstract rules to the concrete cases and from the general formula to the special example. Classroom instruction usually starts directly with abstract concepts and is taught in a way that most students do not understand. Formulas, theorems, examples, results are derived, proved and used. But the teacher should start with specific examples and concrete things and then move on to generalizations and abstract things. Then the teacher should show again how to generalize and make it true through specific examples. This approach will help students understand better; students will not have to cram things and will have a lasting impact.

Example: To teach that sum of angles of a triangle is always equal to two right angles.

Ask the students to draw a few triangles. Ask them to measure the angles of these triangles and find out the sum of angles of each triangle. They will find the sum is same in all the cases and is equal to 180° (i.e., two right angles). Thus they can easily conclude that the sum of angles of a triangle is always equal to 180° .

Analytic to- Synthetic Method

This method is combination of two separate methods i.e., analytical method and synthetic method. Analytical Method proceeds from unknown to known. "Analysis" means "breaking up" of the problem in hand so that it ultimately gets connected with something obvious or already known and Synthetic is putting together known bits of information and moving from known to unknown. These methods are basically used in providing the results and solving sums. Text- books mostly use synthetic method, we start with a particular known thing to prove something unknown, but it leaves students wondering why we started with that step and used this particular known thing. So the teacher needs to use coordinator to logically explain and relate each step.

Example: If $\frac{a}{b} = \frac{c}{d}$ prove that $\frac{ac+2b^2}{bc} = \frac{c^2+2bd}{cd}$ Synthesis: $\frac{a}{b} = \frac{c}{d}$ (given),



Add $\frac{2b}{c}$ to both sides (Why? It is not explained)

 $\frac{a}{b} + \frac{2b}{c} = \frac{c}{d} + \frac{2b}{c}$ $\frac{ac+2b^2}{bc} = \frac{c^2+2bd}{cd} \text{ (It was to be proved)}$ **Analysis:** Here we start from what is to be proved $\frac{ac+2b^2}{bc} = \frac{c^2+2bd}{cd} \text{ (It is to be proved)}$ Expected answer: $\frac{ac+2b^2}{c} = \frac{c^2+2bd}{d}$ (cancelling off common from both sides)
Or, $acd+2b^2d=bc^2+2b^2d$ (by cross multiplication)
Expected Answer $acd+2b^2d=bc^2+2b^2d$ will be true
If $acd=bc^2$ (cancelling common from both sides)
Or if ad=bcExpected Answer: This will be true if $\frac{a}{b} = \frac{c}{d}$

Problem- Solving Method

This method aims to present the knowledge learned in the form of a problem. Students while studying mathematics have to make constant efforts to find solutions to assigned problems. Problem solving method adopts a systematic and orderly process. The process begins with perceived difficulties or problems. The student is then forced to think of all possible scenarios of the problem faced based on what he knows. His inability to find solutions with the help of his prior knowledge and experience led him to engage in serious exploration through self-study, mutual discussion and independent practical work. He tries to examine the possible alternatives and solutions to his problem one by one and then possible solution to his problem through his continuous efforts. The effectiveness and validity of this solution can be further verified based on its applicability and reliability in solving similar problems in other identical situations. This approach will help them develop divergent thinking. Example: Instead of deriving the formula for volume, solve the problem of finding the volume of water in a given container (cylinder filled with water).

Play-way Method

This method consists of activities that are a kind of fun or play and give pleasure to the students. From the very beginning, children love to play. They live in their play world. They are naturally drawn to and engaged in playtime activities for long periods of time. This is the nature of children, which has forced the educators to use the game as a medium and center for imparting the desired education. They provided different experiences related to different curricular subjects through play-way activities. This approach helps create interest in mathematics, motivates students to learn more, and reduces the abstract nature of the subject.

This method includes play and fun activities that are related to numbers. Example: i. checking of



divisibility of one number by another number, 123456712345688 is divisible by 4 (Khongji & Nongbsap, 2015)

Laboratory Method

This method includes the most aspects of teaching such as 'learning by doing', 'learning by observing' and 'concrete to abstract' etc. It provides a practical basis for our inductive reasoning. Present day education is heavily criticized on the grounds that it provides a bundle of theoretical knowledge without any practical basis. Laboratory method is quite efficient for testing this evil. It can help us learn mathematics as it is used in our daily life. In this way theory and practice can go hand in hand and hence it can make the teaching and learning process as interesting, useful and lively as possible. Laboratory methods require a well-equipped laboratory and a laboratory-conscious, competent mathematics teacher. Emphasizing the necessity of a laboratory in this manner, 'Young' remarked that a room specially furnished with drawing instruments, suitable tables and desks, good blackboards and necessary equipment for course experiments is really essential for the best success of this course.

Therefore, at school level, the introduce of laboratory components in to the teaching of mathematics can promote a better understanding of the subject for all mathematics disciplines that have the potential to work in a laboratory environment.

APPROACH TO ENHANCE MATHEMATICAL CONCEPCION IN MATHEMATICS CLASSROOM

There are enough ways to teach and learn mathematics, and each method is unique in evoking mathematical thinking. Before unveiling the gateways, one must understand the human information processing system. In the context of young students, the main features of the system are involved:

Learner is the constructer of knowledge rather mere receiver: The learners are actively involved, the environment is democratic, the activities are interactive and student centered, the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

Experience leads to learning: Learning by induction is the key process for learning of a human being. Learning that encourages students to engage in problem solving and experiential learning: A learning process that engages students by connecting to the real world through exploration and high level questions. For example, during an inquiry based lesson the teacher cansee how each student sees a problem and what steps they take to find a solution in their own unique way.

The human being have a limited capacity of working memory i.e. More focus on understanding and skill acquisition and less focus on memory.

Enable children to adjust to their own pace of learning: Student who needs extra time may spend more time practicing until they understand where students with less ability can move on. It frees the teacher to help children who need more help at the individual level.

Focus on learning how to learn, not just learning i.e. meta-cognitive abilities of the human needs to be explored.

The method can either have steps or features or the method present an idea that teachers can share to motivate the learning process. In the present study, an idea has been presented in some



methods and the responsibility of formulating a plan using innovative efforts rests with the teacher whereas in some methods the steps and features are discussed in detail. Appropriate gateways to the NEP 2020 approaches for young students are discussed below:

Constructivist Approach

The National Curriculum Framework 2005 recommends an approach that facilitate student learning that is constructivist approach. Despite this being the latest trend in education, most of the school teachers are still not aware of this method. The latest Indian Education Policy 2020 encourage these latest teaching methods such as constructivist approach which emphasizeshigher order thinking rather than rote memorization. Research from different parts of the world reveals that constructive approaches are a successful way to provide students with meaningful learning experiences in a classroom (Brooks & Brooks, 1999; Johnson & Johnson, 1994). The constructive approach is believed to increase children's creativity, increase interest in mathematics and is considered more effective than traditional methods in developing social skills(Navak & Senapaty, 2011, McCray, 2007). Instead of only abstract teacher-dependent teaching, this constructivist approach has radically changed the teaching and learning process of mathematics to studentcentered education and integrated it into everyday life. (Vinetere, 2018). In a constructivist classroom, teachers create situations where students will question their own and each other's assumptions. Similarly, a constructivist teacher creates a situation where he is able to challenge the assumptions on which traditional teaching and learning are based. It is a learner centered approach where the student is not merely a receiver but a creator of knowledge. Teacher acts as a facilitator and provide students with experiences that allow them to guess, predict and manipulate mathematical information. Under this approach tasks such as research, investigation, imagination, innovation and questioning are performed by the student (Gray, 1997). Through repeated mathematical tasks and interactions with other students, the student's own intuitive mathematical thinking gradually becomes more concrete and potent. (Clements & Battista, 2009 cited in Vintere, 2018). Constructivist approach is easily distinguished from a conventional classroom teaching methods as Constructivist approach has identifiable qualities such as student activism, democratic environment, interactive and student-centered activities. According to constructivism, students are encouraged to construct their own knowledge from their own prior experiences. Observations like best learning are possible when the student is trying to understand the concept through prior experience (Sims, 2002). Hmelo-Silver, Duncan, and China (2007) emphasizes the importance of constructive approaches to problem based and inquiry learning methods for learning science in a better and more effective way. Teaching mathematics through constructivist approach has a positive effect on their mathematics achievement and at the same time they have a positive attitude towards mathematics. (Clarke, 1997; Simon & Schifter, 1997, Calleja, 2016). There are many teaching methods that the basic principle of teaching method is based on constructivist approach like inquiry based learning, problem based learning, experiential learning. An ideal teacher must use the above strategies appropriately to bring innovation to his classroom. In this way, the teacher can encouragestudents to improve their skills and help them develop a positive attitude towards mathematics. Teacher must use these strategies for innovation in the classroom so that a typical teacher becomes an innovative teacher through his/her work. (Callejia, 2016; Walia, 2020).



5 E's Learning Model:

The 5 E's Learning Model comprises five phases:

Engagement Phase- Learners are engaged in any task in any form of classroom where it serves as an opportunity for students to build relationship between previous knowledge and existing concepts.

Exploration Phase- Learners discuss and explore in groups, engaging in events and materials. They create a platform for general experience and therefore a vast field of experience.

Explanation Phase- Students with general experience begin to lay the groundwork for abstract experience and to clarify their miscommunication under the teacher's interpretation.

Elaboration Phase- Students describe their knowledge in detail and therefore expand their knowledge. In fact, students apply the acquired ideas to connect with other related fields and therefore gain real world perceptions.

Evaluation Phase- In evaluation stage determines whether the student has acquired the necessary knowledge and perception (Aggarwal, 2022).

The 5E instructional model serves as a flexible learning cycle that helps curriculum developers, classroom teachers, and school librarians create STEM lessons that illustrate constructivist, reformoriented, best teaching practices. Each stages of instruction details the ideas, concepts, and skills needed for student inquiry.

Experiential Learning:

Mathematics is undoubtedly a difficult subject. Even great minds like Albert Einstein know that there are difficulties in learning. It is not surprising that mathematics teachers have difficulty teaching students. The lecture system where teachers allow students to memorize mathematical information is long gone. Today, teachers are called upon to teach new and effective teaching methods so that not only master, but also boot comprehension is developed. The National Education Policy 2020 mentions the need to promote experiential learning for all levels of school education. Mathematics requires experiential learning where students engage with their own understanding of mathematical concepts and practices. Experiential learning is a learning method where students learn the subject matter by doing hand -on activities themselves. It encourages students to gain experience by directly engaging with the material rather than learning by reading textbooks or listening to lectures i.e.by sharing the experiences of others. Experiential learning focuses on personalized learning where the pace of leanings based on each student's abilities and interests. It is defined as learning through reflection where students are given time to reflect on what they have learned, how they have learned and what they have experienced. When compared to activity learning, problem learning and discovery learning, this experiential learning provide one extra step for reflection over other strategies such as time to reflect on what they have learned, how they have learned and what they have experienced for reflection. Experiential learning method can be helpful in teaching subjects such as mathematics that rely on students' own understanding of mathematical concepts and practices. Incorporating experiential learning into mathematics classrooms can create innovative classroom environments, a way to help students overcome mathematics anxiety and increase students' self-efficacy in mathematics. (Walia, 2020). Activities need to be linked to teachers' ideas so that students can engage and reflect on their actions e.g. if



the teacher in primary school wants to teach the duration and timeof sunrise and sunset, s/he will ask them to prepare a chart of the rising and setting of the sun for a few days which will give them a deeper idea about the duration of a day rather than telling them directly. Considering an activity related to selling self-made food items in secondaryschool, students are guided in experiential learning by reflecting on the process they haveadopted for purchasing source of cost, measuring ingredients and all the activities involved. In secondary school the basic concept of probability can be taught through experiential learning involving these related activities with some examples using concrete items such as coins, cards, and dice (walia, 2020).

Interpretation Construction Design Model (ICON)

The teaching and learning methods of the ICON model emphasize the students face to face authentic problems in groups when it comes to construct explanations or searching for information groups and encountering different interpretations of the problem in the group; the process of individual learning is an evidence and therefore dual purpose education is an acceptable model. It is a model which contains seven steps:

Step 1 *Observations:* Students observe the situation or problem before proceeding to solve it. Step 2: *Interpretation Construction*: Students relate the situation or problem to previous experience.

Step 3: *Contextualization*: Students collaborate to discuss in groups and explore to understand their analysis and interpretations.

Step 4: *Cognitive Apprenticeship*: Students collaborate to discuss in groups and explore to understand their analysis and interpretation.

Step 5: *Collaboration:* Students analyze the knowledge that is created and create an explanation of their own.

Step 6: *Multiple Interpretations*: Students use interpreted knowledge and multiple interpretations are given by them instead of solving problems.

Step 7: *Multiple Manifestations*: Students apply multiple interpretations to get multiple solutions to the problem.

Pedagogical Resources - Blended Learning

Blended learning is not only a combination of online and face to face modes, but also a wellplanned one and a combination of meaningful activities in both modes. The mix demands consideration of a variety of factors, focusing primarily on learning outcomes and the studentcentered learning environment.

Role of Learner in the Blended Learning Environment:-

Increase student interest: When technology is integrated into school lessons, students are more likely to be interested, concentrated and excited about the subject studying.

Keeps students focused for longer: The use of computers to search for information and data together is a tremendous life saver including access to resources such as the internet to conduct research. This engagement and interaction with resources keeps students focused for a long time then they will be with books or paper resources, this engagement also helps in the development of learning exploration and research.

Provides student autonomy: The use of e-learning materials enhances a student's ability to



determine appropriate education take responsibility for the goal and his own learning, which develops a power which will be translatable across all subjects.

Instill a disposition of self-advocacy: Students become self-driven and responsible, tracking their personal achievement, which helps them to develop the ability to find resources or get the help they need, self-advocacy so they can reach their goals.

Promote student ownership: Blended Learning evokes a sense of 'student ownership over learning' which can be a powerful force driving learning; it is this sense of responsibility that helps to feel ownership.

Allow instant diagnostic information and student feedback: Give teachers the ability to quickly analyze, review, and respond to students' work, the teacher has the ability to create his own teaching methods and responses for each student improving time efficiency.

Enables students to learn at their own pace: Due to the flexibility of Blended Learning and the ability to access internet resources allow students learn at their own pace, which means a teacher can help speed up the learning process or provide more advance resources if needed.

Prepare students for the future: Blended Learning offers many real-world skills that translate directly into life skills (Blended Mode of Teaching and Learning: Concept Note-UGC):

Research Skills

Self-learning

Self-engagement

Helps to develop a 'self-driving force'

Decision making

Provide a greater sense of responsibility

Computer literacy

Role of teachers in Blended Learning Environment:-

Blended learning takes the role of teacher from knowledge provider to trainer and mentor. This change does not mean that teachers play a passive or less important role in students' education. In contrast, to Blended learning, teachers can have a deeper impact on students' learning if teachers can complement the use of technology and instruction.

An experimental study conducted by Lin, Tseng and Chiang (2016) to see the effects of Blended Learning on high school mathematics students in Taiwan. Blended learning not only had a positive impact on learning performance but also changed students' attitudes towards mathematics. Awodeyi, Akpan & Udo, (2014) and Abramovitz & Berezina (2012) in their research, they gave an opinion in favor of blended learning in mathematics classroom for their mathematical achievement and positive attitude towards mathematics. Moodle classroom learning is generally used for blended mode of learning environment in which teacher interactiveactivities for online group discussion, testing and evaluation has also been shown in this method has given fusibility in terms of time and space (Walia, 2020).

However, this study is only an attempt to bring new ideas to make the subject more interesting and attractive to the students, the above progressive approaches can benefit the students in increasing proficiency and motivation by teachers and students choice.



CONCLUSION

Innovation involves a different way of looking at problems and solving them. It improves learning because it forces students to use higher level thinking to solve complex problems. Mathematics at the most elementary level helps students develop problem solving skills, critical thinking, and analytical skills of students. It is therefore essential to keep students interested and engaged in their mathematics classes. We can no longer afford to follow outdated teaching methods and bringing simple innovations into the classroom can help motivate students. One such method of innovation is the use of technology in the classroom. Using digital media, suchas educational instructional videos, is a method of innovation in the mathematics classroom. It moves away from the traditional way of teaching mathematics by bringing in kid-friendlylearning videos, which will not only hold the child's attention but also use interesting topics to convey the message.

There may be some limitation behind the low use of innovative educational practice in real school classrooms. The main reasons that have emerged are excessive students in the class, overloaded curriculum, lack of proper professional training of teacher for professional growth, lack of infrastructures facilities, over burden teachers and administrative ignorance towards innovation. This paper discussed some of the approaches of innovative mathematics teaching which are concerned with the proposed approach of NEP 2020. With the help of these approaches the teacher will be able to shift the learning from memorization to deep understanding of concepts that make mathematical learning joyful rather than burden. The professional development programs such as pre- service and in-service teachers training may shift an ordinary teacher to an innovative teacher.

REFERENCE

- Abramovitz, B., Berezina, M., Bereman, A., & Shvartsman, L. (2012). A blended learningapproach in mathematics. In A. Ajuan, M.A. Huertas, S. Trenholm, and C. Streegmann (Eds), Teaching mathematics online: *Emergent technology and methodologies* (pp. 22-42). Doi: 10.4018/978-1-60960-875-0.ch002.
- Aggarwal, R. (2022). Approaches to Enhance Mathematical Thinking to Realize NEP 2020 Vision for Young Learners. *International Journal of Innovative Science and Research Technology*, 7(4), 557-561.
- Anthony, G., Walshaw, M. (2009). Effective pedagogy in mathematics. USA: The International Academy of Education.
- Awodeyi, A.F., Akpan, E.T. & Udo, I.J. (2014). Enhancing teaching and learning of mathematics: adoption of blended learning pedagogy in University of Uyo. *International Journal of Science and Research*, 3 (11), 40-45.
- Beena, A.V., (2021). Innovative practices in Teaching Mathematics, International Journal of Multidisciplinary Educational Research, 10, 7(12), 18-23.http://s3-ap-southeast-1.amazonaws.com/ijmer/pdf/volume10/volume10-issue7(12)/4.pdf
- Brooks, J.G., Brooks, M.G. (1999). In search of understanding: The case for constructivist classrooms. *Alexandria*, VA: ASCD.
- Bulun, M., Gulnar, B., Guran, S.M., (2004), Mobile Technologies in Education. *The Turkish Online Journal of Educational Technology-TOJET*, 3(2), Article-23.
- Calleja, J. (2016). Teaching Mathematics through Inquiry. Journal of The International Society for Design and Development in Education, 3(9), 1-19. educationaldesigner.org/ed/volume3/issue9/article30/pdf/ed_3_9_calleja_16.pdf



- Clarke, D.M. (1997). The changing role of the mathematics teacher. *Journal for Research in Mathematics Education*, 28(3), 278-308.
- Clements, D.H., Battista, M.T. (2009). Constructivist Learning and Teaching. In Vinetere, A. (2018). A constructivist approach to teaching of mathematics to boostcompetencies needed for sustainable development. *Rural Sustainability Research*, 39, 2-7.
- Dodge, B. (2001). FOCUS: Five rules for writing a great Web Quest. *Learning and Leading with Technology*, 28(8), 6-9, 58.
- Goel, N., (2022). Mathematics in NEP 2020: Initiative to Strengthen Foundational Literacy and Numeracy Skills. *ISOR Journal of Research & Method in Education (IOSR-JRME)*, 12(1), Ser. V, 48-51.
- Gray, A. (1997). Constructivist teaching and learning. *SSTA Research Center Report*. Online Retrived from <u>http://saskschoolboards.ca/research/instruction/97-07.htm#</u>
- Johnson, D.W., & Johnson, R.T., (1994). Learning together and Alone: Cooperative, *Competitive and Individualistic Learning (4th Ed.)*. Boston, New England: Allyn and Bacon.
- Hmelo-Silver, C.E., Duncan, R.G., & Chinn, C.A. (2007). Scaffolding and achievement in problem based and inquiry learning: *A response to Kirschner, Sweller, and Clark. Educational Psychologist*, 42(2), 99-107.
- Khongji, P., & Nongbsap, W. (2013). Some innovations in teaching of mathematics. *International Journal of Science & Research*, 4(7), 1345-1349.
- Lin, Y.W., Tseng, C.L. & Chiang, P.J.. (2016). The effect of blended learning in mathematics course. *EURASIA Journal of Mathematics Science and Technology Education*, 13(3), 741-770. <u>the-effect-of-blended-learning-in-mathematics-course-4688.pdf (ejmste.com)</u>
- Mangal, S.K. (2016). Pedagogy of Mathematics, *Tandon Publications*, Books Market, Ludhiana, 141008.
- McCary, K. (2007). Constructivist Approach: Improving Social Studies Skills Academic Achievement (Postgraduate Dissertation) Marygrove College Detroit. Retrieved from <u>http://files.eric.ed.gov/fulltext/ED499380.pdf</u>
- Ministry of Human Resource Development (1986). National Policy on Education. New Delhi: MHRD. <u>http://ncert.nic.in/pdf/nep/policy_1986_eng.pdf</u>.
- Ministry of Human Resource Development (2020). National Education Policy. NewDelhi: MHRD. <u>http://ncert.nic.in/pdf/nep/NEP_2020.pdf</u>.
- NAS 2017 Report- NCERT: https://ncert.nic.in/pdf/NAS/withReleaseDate_NPPTL.pdf.
- National Council of Educational Research and Training (2005). National Curriculum Framework for school education. New Delhi: NCERT. <u>www.ncert.nic.in</u>
- NCERT (2006). Position Paper by National Focus group on teaching of Mathematics. NCERT, New Delhi.
- National Education Policy (2020). National Education Policy, Ministry of Human Resource Development, Government of India. <u>NEP_Final_English_0.pdf</u> (education.gov.in)
- Nayak, R.K., & Senapaty (2011). Effect of constructivist approach in fostering creativity of primary school children. *Journal of Indian Education*, 37(3), 85-93.
- Sharma, M. (2017). Speaking Tree, Times of India, Dt. 14.10.2017
- Simon, M. & Schifter, D. (1993). Towards a constructivist perspective: The impact of a mathematics teacher in service program on students. *Educational Studies in Mathematics*, 25(4), 331-340.



- Sims, R.R. (2002). Teaching Business Ethics for Effective Learning. *California: Greenwood Publishing Group.*
- Singh, C., & Rohatgi, R. P.,(2005). Teaching of Mathematics. Dominant Publishers and Distributors, 116-A, South Anarkali, Delhi-110051.
- UGC- Blended Mode of Teaching and Learning: Concept Note, New Delhi, <u>https://www.ugc.ac.in/pdfnews/6100340 Concept-Note-Blended mode-of-Teaching-and-Learning.pdf</u>
- Walia, P. (2020). Paradigm Shift in Pedagogical Practices in Mathematics Classroom: NEP 2020, *International Journal of Creative Research Thoughts*, 8(12), 2902-2908.
 <u>Paradigm-Shift-in-Pedagogical-Practices-in-Mathematics-Classroom-NEP-2020.pdf</u> (researchgate.net)

Polyphony: Bankura University Journal of Education Vol. 01, Issue 01, July 2023, pp. 95-108

