Effective Teaching Mathematics at School Level: A Perspective from Nepal

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Abstract

Mathematical facilitators across the globe are using fresh approaches and making use of productive results, implementation of research-based methods to teach mathematics in the classroom. A cooperative knowledge-building approach, i.e. Iterative Best Evidence Synthesis Program, is required for classroom instruction. This study gives guidelines for effective educational techniques that promote instructors for varied learners by drawing on results from mathematics, the intuitive notions that have been utilized in the classroom, and recent research investigations. In examining the links between pedagogical practices and a range of social and academic student outcomes, this article draws on the histories, cultures, language, and practices for the Nepali context.

Keywords: mathematics, effective teaching, learners, teacher, knowledge

Introduction

Mathematics has a significant impact on how people interact with the different aspects of their private, social, and civic lives. However, like in the past, many students now find it difficult to engage with mathematics, which leads to their disengagement. Therefore, it is crucial that we comprehend what makes up good mathematics instruction if we want to end this pattern. The pedagogical practices as observed by Anthony & Walshaw (2007), Doig, McCrae, & Rowe (2003) Ingvarson, Beavis, Bishop, Peck, & Ellsworth (2004) have argued for a coherent knowledge base to classroom practice.In response to Anthony and Walshaw (2007; & 2008), we may use that method with Nepal to bring changes how mathematics is taught and learned. The collective notion explored by these researchers builds current mathematics initiatives inside western educational systems. This approach aims to create learning communities where students are actively involved in solving mathematical problems and completing the tasks. Effective teaching within the classroom is the main part of this paper. It aims to answer about the characteristics of effective pedagogy in the mathematical classroom of Nepal; it suggests the facilitators develop a mathematical capability for making an effective learning community.

The ten principles ofeffective mathematics pedagogy, not to be used in an isolated way, are part of a complex web teaching-learning strategies. The following ten-principles of teaching mathematics developed by Anthony and Walshaw (2007; & 2008) is discussed as:

Figure 1

Principles of effective teaching mathematics

The guiding principles we have established are predicated on the understanding that classroom instruction is a complicated endeavor. The learning community in the classroom is neither static nor linear. It is nested inside a dynamic network that also includes the home, the neighborhood, the larger educational system, and the school. The work of post-Vygotskian activity theorists like Davydov & Radzikhovskii (1985) served as inspiration for the notion that education is a part of a layered system. The well-known social practice theory, which places a strong emphasis on the concepts of "a community of practice" and "the connectedness of knowing," is based on an awareness of the intimate connection between social activities and conceptual growth. According to that theoretical framework, individual and communal knowledge develop and change because of the dynamics of the places that people share and are active in.

This paper talks explicitly about the classroom as a community of practice. Our starting point is the awareness that instructors who promote for positive student outcomes do so because they think all students have a right to access mathematics education broadly defined as having a comprehension of the core ideas of the curriculum and an appreciation of their significance and practical application. The most effective mathematical teaching methods acknowledge the importance of helping students form positive mathematical identities and are sensitive to the diversity of cultural heritages, thought processes, and realities. They also maximize several desirable academic outcomes, such as conceptual understanding, strategic competence, and adaptive reasoning for improving several social outcomes in the mathematics classroom that support students' overall development as individuals and enable them to make informed decisions.

For this, students' engagement to facilitate the learning thinking in the classroom is a part of lively community supports for arranging the students for learning. The discussion in the classroom on the right discourse focuses on the good language of mathematics teaching, and it is the right way of teaching mathematics. The assignment is given to the students to make them engage and making discussion among the tutors and with then teachers enhance the mathematical knowledges and skills of students. For this, the knowledge of facilitators to develop teaching tools and making them connection representing socio-cultural value representation becomes fruitful in mathematical classroom teaching.

Classroom as Modern Community

Classroom brings many learners in one location. It is an ethical matter. It focuses to achieve on mathematical goals to establish students' mathematical abilities and their community identity. The research shows that successful instructors encourage learning by really caring

about the participation of their tutors (Noddings, 1995). They seek to establish connections to express learners' cultural and mathematical identities. They provide students the chance to raise questions about the purpose of the class's activities and their effects, developing reasonable expectations about improving students' ability to think, reason, communicate, reflect on, and evaluate their own practice (Watson, 2002). The interactions that form in the classroom serve as a resource for the development of students' identities and mathematical abilities. Watkins (2005) talks of classrooms as communities; classrooms as communities of learners; and classrooms as learning communities. It talks about the meta-analysis of the classroom. This variation affects a variety of learner behaviors and capacities. The schools with high community organization ratings always attend to the needs of students for affiliation and provide a rich spectrum of adult roles can have positive effects on the ways both students and teachers view their work. The teachers interact with learners directly and encourage them to take part in school life (Bryk & Driscoll, 1988).

All our efforts become useless if no one else can comprehend our teaching content, regardless of how well we study something or how innovative we are in our field. (Lamon et al., 2001). Caswell & Bielaczyc (2002) view that the purpose of studying is to impart knowledge to others. Learning alone is insufficient. Working with ideas, testing them under various settings, repeating tests, conversing with individuals working on related ideas, and presenting ideas to the entire group are all essential components of good scientific creation. Ingram (2008) states that students always want to learn in a community environment, i.e. togetherness. By appreciating and respecting the cultures and mathematics that learners bring to the classroom, teachers can foster a sense of inclusion among the pupils. Providing a safe environment for all tutors enables them to participate in classroom discussion. The students were better at applying their information, according to Watkins (2005). 'Over time the research students propose more innovative versions of taught concepts combined with more original ideas. However, it is crucial that the warm bonds that form do not lead pupils to rely too much on their professors. According to Angier and Povey (1999), effective instructors foster classroom interactions that encourage students to think critically, ask questions, and take intellectual risks.

The daily classroom routines have a significant impact on how students develop their mathematical thinking. They should have the chance to experience arithmetic difficulties on their own. For instance, just asking students to provide a solution to a mathematical issue could cause nothing other than their cooperation. Students need to know what is expected in terms of who talks, when, and how, as well as what listeners may do (Stipek et al., 1998). The most crucial source for helping students create their mathematical identities (Cobb & Hodge, 2002). The teachers can develop togetherness in the classroom. In the classroom, they affect how students perceive themselves (Walshaw, 2004). Effective instructors consider many things that arise from various home contexts, different languages, and various talents and viewpoints when creating fair arrangements. It makes the students show improved individual results on crucial facets of individual learning in classrooms that function as communities of learners. As their skills rise, their knowledge base is expanded, and their confidence in their ability to study and understand mathematics increases because of the positive attitude that emerges in the classroom. When students are confident in their own understanding, they are more likely to persevere when facing a mathematical issue, explore new ideas that the instructor may provide, and consider the

opinions of other students. They are also more likely to evaluate the validity of various approaches.

Learning in a Collaborative Way

Effective teachers provide a collaborative environment in the classroom. The students are happy with developing a sense of ideas individually and sitting in a collaborative position. Laal, & Laal (2012) opine that to solve a problem, finish a task, or produce a group assignment, the learners participate in collaborative way. It is a teaching and learning strategy. The teaching strategy in which students of different performance levels collaborate in small groups to achieve a shared objective. Positive interdependence, individual and group accountability, interpersonal and small group skills, face-to-face promotional engagement, and group processing are the five core components of it. It gives a chance for pupils to clarify their understanding and a platform for larger interpretations may be found in whole classroom discussions. When a solution is originally unavailable, it can also help pupils resolve difficult tasks. The facilitators should be involved in the dialogue in a significant way. They encourage students to listen and accept one another's answers and assess various points of view while concentrating on effective recording techniques. Giving students workspaces that are accommodating to their requirements is a crucial part of the teacher's job. All students require some quiet time to reflect and work alone, apart from the many and occasionally opposing viewpoints of other students (Sfard & Keiran, 2001). It is the teacher's responsibility to listen, keep an eye on how frequently pupils speak out, and steer the conversation in a certain direction in any type of classroom setting. Students tell professors of what they already know and what they still need to learn when class discussion is a key component of an overall teaching and learning method. Group or partner settings are beneficial for increasing engagement and for brainstorming, testing, and exchanging ideas, as well as for stimulating higher-order thinking (Ding, Li, Piccolo, & Kulm, 2007).

Students develop their conjecture-making skills and their understanding of mathematical reasoning and validation in safe and small-group settings. Groups with varied degrees of academic accomplishment are combined, insights are offered at different levels within the group, and these insights usually improve overall understandings. The duties of participants, such as listening, writing, replying, questioning, and critically evaluating, must be understood and carried out, therefore teachers must make clear expectations of involvement (Hunter, 2008). It develops students' thinking habits in effective ways. The knowledge and interests of the students are at the heart of their instructional decision-making. Teachers change their instruction to match the learning requirements of their students based on ongoing assessments of their students' abilities, including language, reading, and listening skills, as well as their capacity to handle complexity. The students have been found to exhibit a high level of what is properly referred to as scientific thinking when they lead group discussions which focus on building knowledge about scientific topics. Independent assessments have supported this judgment from philosophers of science (Hakkarainen, 1995). In a math session, students show genuine curiosity to solve issues. Instead of using algorithms and textbook norms, they engaged in mathematical debates (Elbers, 2003).

Effective instructors can be responsive to their students and discipline by putting an emphasis on developing students' current proficiencies rather than correcting flaws and filling in knowledge gaps (Carpenter, Fennema, & Franke, 1996). They are aware of the consistent, alternate interpretations of mathematical concepts that emerge from learners' attempts to build

meaning. Teachers led talks with classmates or the entire class to draw students' attention to the problems that are already known, assisting students in learning from their mistakes. Learners can compare and re-evaluate their ideas when they are asked to give a range of interpretations or solution options. Effective instructors remove information, require the use of certain representations, place barriers in the way of solutions, or call for generalizations to make tasks more challenging in all classes (Sullivan, Mousley, & Zevenbergen, 2006). When small groups of students support one another in their learning, it becomes a part of collaborative learning. It does not allow students to converse with one another while working on their respective tasks, whether it be face-to-face or over a computer conference. They won't complete the assignment alone before assisting the people who are still working on it. Additionally, it's not having one or a few students complete the assignment, while the others simply sign their names at the end (Klemm, W.R., 1994).

Discussion in the Classroom

Discussion in the classroom creates mathematical discourses in the classroom. It is a part of mathematical communication and effective teachers create this environment to facilitate classroom conversation based on mathematical argumentation. It works for developing shared inquiry, write, and discussion practice, thinking in a new way, making group work in a classroom. Participation in class includes discussion in a class. It is crucial for pupils' ability to learn well. Fatma (2021) views that there are several causes for this. The variables are both personal and situational. It aims to enhance classroom conversation, which promotes effective learning, the growth of students' self-esteem and communication abilities, and promotes engaging and fascinating lessons. The facilitators can also repeat, rephrase, or elaborate on student speech using the method of "revoicing" (Forman & Ansell, 2001). Revoicing is used often by teachers. It draws attention to concepts that students themselves have proposed, aids in the growth of concepts that students already comprehend implicitly, negotiates meaning with students, and adds fresh concepts or steers the conversation in a different direction.

The teachers' help should include suggestions that encourage students to collaborate more successfully, to defend their positions, and to share their thoughts and opinions. Both students and teachers must practice active listening and discussion to reach consensus. According to Lobato, Clarke, and Ellis (2005), careful listening to student ideas enables instructors to decide whether to intervene or remain silent, urge for comprehension, settle conflicting student claims, and address misconceptions or uncertainty. Students become less focused on obtaining the solutions and more with the reasoning that leads to the answers as their focus moves from procedural rules to making understanding of mathematics (Fravillig, Murphy, & Fuson, 1999).

Individuals whose contribution rates are noticeably different in large group settings have relatively similar contribution rates in small groups, resulting in more balanced patterns of contribution than those in teacher-centered classes. Rafal (1996) observes that compared to whole-class discussion, provided a fairer chance for its members to participate in high-level debate about science. We must teach the proper mathematical explanations and justifications for solutions to students. Effective teachers guide students into mathematical norms by modeling, explaining and justifying, and encouraging the use of oral, written, and tangible representations. It is crucial that the classroom learning community allows for disputes and facilitates conflict resolution when directing students toward mathematical argumentation strategies (Chapin & O'Connor, 2007).

Assignment and Mathematical Language

Effective teachers are aware of how particular activities and examples affect the students to comprehend mathematics. For this reason, the usage of mathematical language enhances their capacity for thought and develop reason. Students must comprehend the mathematical language used in the classroom if they are to understand mathematical concepts. Fostering the use and comprehension of proper mathematical terminology and expressions is a fundamental responsibility of the instructor. It is necessary to model and employ conventional mathematical terminology so that, over time, it can go from the instructor to the pupils (Runesson, 2005). Students' implicit understandings of the prevalent mathematical language are taken into consideration during explicit language training and modeling.

The grammar of mathematical discourse is challenging for students. Students often struggle with prepositions, word order, logical constructions, and conditionals. It's possible that students are ignorant of the settings in which issues have been raised. It has been showed that language or code swapping, in which the instructor uses a word from the student's native tongue in place of a mathematical term, improves student comprehension, particularly when teachers can use it to grasp the precise subtleties of mathematical language (Setati & Adler, 2001). In an interconnected society, integrated learning is increasingly seen as a cutting-edge method of imparting information and skills that are appropriate for the global era (Mehisto, 2008). The relevance of content and language integrated learning is rising in the sectors of education and language acquisition. It describes circumstances in which topics, or portions of subjects, are taught using a foreign language with dual-focused goals, namely the simultaneous acquisition of a foreign language and the study of content. Marsh et al. (1999) talks about the link between mathematics and lesson planning and discussion.

To track student progress, diagnose student learning, and identify what can be done to enhance learning, mathematics teachers employ a variety of formal and informal evaluations. Teachers gather data on how students learn, what they appear to know and be able to perform, and what they are interested in over the course of their regular classroom activities. By using this data, instructors may assess the effectiveness of certain activities and make judgments about how to best satisfy the educational requirements of their pupils (Wiliam, 2007). Feedback that is useful explains why something is correct or wrong, what to do next, and suggests ways to improve. Effective teachers provide their pupils the chance to review and critique their own work. Students are involved in creating exam questions, the creation of success criteria, the writing of mathematical journals, and the presentation of portfolios as proof of mathematical development. Effective instructors observe students while they work individually or in groups, chat with them, and gain knowledge about them. They monitor their pupils' comprehension, take note of their preferred teaching methods, and pay attention to the language they employ. They may decide what questions to ask next, when to step in during student activity, and how to respond to queries thanks to the moment-by-moment evaluation. An effective technique to gauge students' present knowledge and ways of thinking in the classroom is through thorough questioning (Steinberg, Empson, & Carpenter, 2004). For instance, problems with many solutions or those that may be answered in multiple ways might aid teachers in understanding how pupils' reason and think mathematically.

Applying social constructivism theory in math instruction is fraught with difficulties. This hypothesis holds that social interaction is how math knowledge is created. To learn mathematics, mediation is crucial. The emphasis is on encouraging children to actively engage with others and society through involvement in group or peer activities. For learners, scaffolding and direction are important. Tasks explain the purpose of mathematics. According to Hodge, Zhao, Visnovska, and Cobb (2007), the students form opinions regarding mathematics and mathematics learning. Effective teachers make effort to make sure that assignments encourage mathematically sophisticated thinking and cumulative learning across all students (Henningsen & Stein, 1997). Teachers support learners in developing proficient methods of doing, and learning mathematics (Ainley, Pratt, & Hansen, 2006).

Assignments and learning experiences allow students to perform creative thinking about significant mathematical topics & relationships. Tasks entail applying the algorithms that have been taught, and they should provide students the chance to confront significant mathematical concepts. The development and application of an increasingly complex variety of mathematical thinking and reasoning processes is encouraged in pupils when assignments with the right level of mathematical difficulty are given to them (Watson & De Geest, 2005). Student understanding of the settings and the mathematics included into the tasks is put to the test via modeling exercises (English, 2006; Galbraith, Stilman, Brown, & Edwards, 2007). Working with actual complicated systems teaches students that mathematics includes more than just getting the right answers; by using mathematics in real-world contexts, students get an understanding of the importance of mathematics in society and its contributions to other fields. Due to the social, cultural, and political changes that have impacted educational policies and practices over the last forty years, our period of studying mathematics and teaching mathematics has changed drastically. One of the most important concerns in Nepali mathematics education is the assessment of the pupils. Formative assessments, such as project work, classwork, homework, attendance, unit tests, remedial supports, extracurricular activities, field trips, group discussions, weekly tests, and use of summative evaluations and formative assessment tools are currently used in the context of Nepal (Acharya, 2019).

Making Connections and Representation in the Classroom

Effective teachers encourage their students to make connections between various approaches to problem-solving, mathematical topics, and everyday experiences. Effective educators choose their tools and representations with care to aid in students' conceptual development. Students must comprehend the many connections between a concept or skill and other mathematical notions (Askew, Brown, Rhodes, Johnson, & Wiliam, 1997). By giving students the chance to work on challenging assignments, setting expectations that they explain their reasoning and problem-solving processes, and listening to others' ideas, effective instructors help their students discover connections (Anghileri, 2006). When illustrating important mathematical concepts, teachers can help students establish connections by utilizing carefully sequenced examples, including examples of the students' own solution processes (Watson & Mason, 2006). Teachers might stress the connections between various mathematical concepts by gradually introducing adjustments that build on students' previous understanding. For the conceptual comprehension of mathematics, linkages between different mathematical disciplines are crucial.

Since mathematical ideas, concepts, or techniques are interrelated, it is impossible to fully comprehend them in isolation. Students have the chance to relate mathematical ideas, concepts,

meanings, and methods to one another as well as to view mathematics as a cohesive whole when mathematical connections are formed in the classroom. However, not all math teaching methods fulfill this need. According to the research, mathematicians who are instructors are more likely to relate their lessons in the classroom (Hatisaru, 2022). According to Businskas (2008), a mathematical link is viewed as a relationship between two or more mathematical concepts. Math teachers make these linkages by relating mathematical and non-mathematical settings by relating mathematical ideas, concepts, methods, or representations.

Teachers can aid students in connecting their learning to actual events. Students see mathematics as relevant and engaging when they realize they can use it as a tool to address serious issues in their daily lives. Effective educators choose their tools and representations with care to aid in students' conceptual development. Effective instructors use a variety of methods and representations to aid students' mathematical growth. The number system itself, algebraic symbolism, graphs, diagrams, models, equations, notations, pictures, analogies, metaphors, tales, textbooks, and technology are only a few examples of the various tools available to support and enhance mathematical thinking and sense-making.

To organize students' mathematical thinking and help their sense-making, teachers must ensure that tools are used properly (Blanton & Kaput, 2005). Many representative discussion encourage pupils to become more flexible in their thinking and computation. Learners may work through an issue or test ideas using the right model. To guarantee that all pupils can understand the materials in the mathematically intended way, care must be taken, especially when employing pre-designed concrete materials. Ideas that are ordinarily challenging to talk about or write about can be communicated more effectively using tools. Teachers and students may help others understand what they are thinking by using representations, including tales, drawings, symbols, real objects, and digital manipulatives.

Effective teachers recognize the need of pupils creating and using their own representations in addition to pre-made tools, whether it be an original notation or a graphical, pictorial, tabular, or geometric representation. For instance, before adopting the more formal graphical tools that are essential to the statistics curriculum, young children commonly make their own pictorial representations to tell tales (Chick, Pfannkuch, & Watson, 2005). There is a growing selection of new electronic resources accessible for use in math classes. Besides calculators and computer programs, modern technologies also include the Internet, digital and mobile technologies, and presentation tools like the interactive whiteboard (Zevenbergen & Lerman, 2008). These interactive graphical, numerical, and visual technology applications give instructors and students new ways to communicate, express, and explore mathematical ideas. When deciding when and how to employ technology to promote learning, teachers must be competent decision-makers (Thomas & Chinnappan, 2008). The choice-making process for technology-based techniques is shared with students by effective instructors who take the time to do so. They mandate students to keep an eye on their own inefficient or excessive usage of technology. Technology may enable autonomous research and the creation of common knowledge under the direction of teachers.

Conclusion

Teachers' ability to plan lessons in the classroom heavily depends on their understanding of mathematics. It helps the pupils comprehend the teaching and learning of

mathematics. They have strong expertise and provide solid stuff. They apply their knowledge to decide critically on mathematics assignments, classroom materials, conversations, and activities that support or result from the learning process. The teachers determine the best way to assist their pupils in understanding fundamental mathematical concepts. They must know how to stretch and challenge students' thinking besides having clear ideas about how they might improve students' procedural skills. They require solid pedagogical material knowledge and a solid grasp of how kids learn. It makes it possible to prepare more tightly and collaboratively, listen and question more skillfully, and assess student replies more perceptively.

The efforts of the larger school community to strengthen teachers' knowledge of mathematics and mathematics teaching and learning have a significant positive impact on teacher development. The instructors' expertise helps students study mathematics in a classroom setting that fosters community. I have explored the study on successful mathematics instruction in western educational systems in this essay. The type of mathematics instruction in the classroom has a major impact on the character and course of student learning, according to recent study findings. As we move away from dictating educational behavior and toward an understanding of pedagogical activity as causing student outcomes, we see teaching as nesting inside a systems network. We have provided significant research-based insights on how that occasion could occur in this work. We have been able to highlight some patterns that distinguish the actions and behaviors of a successful instructional practice. Each component of the teaching layered system is only one piece of evidence and must be understood as accounting for one variable among many others. We are fully aware that while the principles focus on pedagogical techniques in the classroom, it will take a team effort to significantly enhance student learning results.

Changes must be discussed and implemented in math teams, departments, or faculties, as well as teacher preparation programs. They require resources to support them. To improve kids' mathematical ability, everyone involved in mathematics education-teachers, administrators, teacher educators, researchers, parents, specialist support services, school boards, and policymakers-must work together. Schools, communities, and countries must make sure that teachers have the training, resources, and incentives necessary to offer kids the finest learning experiences. Every learner will improve their mathematics skills in this way. Every student has the chance to strengthen their perception of themselves as a capable math learner in this way as well. An essential goal of mathematics education is to identify successful teaching practices. By synthesizing the material, we show what kinds of educational strategies help different students achieve their goals. The analysis demonstrates that the structural, content, and intellectual decisions teachers make in their classrooms are supported by strong teacher knowledge. It also demonstrates how well-informed teacher choices help kids build their mathematical identities and abilities.A cooperative knowledge-building approaches required for classroom mathematical teaching.

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