

Fostering Engaged Pedagogical Innovation for Meaningful Learning: A Literature Review

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<p><i>Article Info:</i> Received: August 7, 2023 Revised: September 12, 2023 Accepted: September 27, 2023</p> <hr/> <p><i>Keywords:</i> Pedagogy, STEAM approach, project-based learning, integrated pedagogy</p>	<p>ABSTRACT: Teaching and learning of mathematics become unpractical and meaningless while students are treated as passive beings and teachers are treated as the knowledge transformers. In this paper, I have explored some key ideas regarding meaningful pedagogical approaches in teaching mathematics based on the in-depth study and critical analysis of the efforts of various authors together with my reflective ideas. Students' performance in mathematics appears deficient, largely due to the limited implementation of pedagogical approaches that cater to their interests and establish meaningful connections to their daily lives in the classroom. Furthermore, instead of applying engaged pedagogical approaches; disengaged and decontextualized pedagogical approaches seem in daily practice. As the result, mathematics is not becoming as the subject of the interest of most of the student. This paper is intended to explore the different techniques of teaching and learning of mathematics effectively to foster active involvement of the learners. Moreover, through this study, I have critically analysed and reflected the contributions of many authors regarding enabling pedagogical approaches demonstrated by them to reach in final conclusion. From my critical self-reflection with reference to many authors, I have concluded that there are some pedagogies that inspire students to engage in learning mathematics.</p>
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Introduction

The act of teaching mathematics does not imply a one-way transfer of teachers' knowledge and ideas into students' minds, treating them as passive and silent listeners. Furthermore, to facilitate effective mathematics learning from their daily life perspectives, students need to be actively engaged in the learning process. Indeed, pedagogy is "any conscious activity by one person designed to enhance learning in another" (Watkins & Mortimore, 1999, p.3). Therefore, pedagogy involves such activities that evoke changes in the learner. It is essential

to design the pedagogical activities intending them to develop the potentiality according to the need and interest of students (Mentari & Syarifuddin, 2020) so that the knowledge gained from learning access them in solving their real-world problem easily. In addition, pedagogy “is a sustained process whereby somebody acquires new forms or develops existing forms of conduct, knowledge, practice and criteria from somebody or something deemed to be an appropriate provider and evaluator” (Bernstein, 2000, p.78). Under the participation of learners in the learning process, if the teaching and learning process is moved forward; obviously, it becomes supportive in getting meaningful knowledge and make a positive impact on their overall learning outcomes (Mentari & Syarifuddin, 2020). According to UNESCO (2005), the classroom pedagogy used by teachers is consistently seen as “the crucial variable for improving learning outcomes and is critical in any reform to improve quality” (p.152). Thus, it seems that the pedagogical practices implemented in the classroom play an importance role in educating the people and enable them in solving their daily life problems.

In the context of Nepali classroom practices the existing pedagogical practices seem disengaged and decontextualized in nature in which the individual subjects are taught by the so-called experts the less attention of needs and interests of learners (Pant, 2017) in one hand. On the other hand, generally we cannot find interdisciplinary and multi-disciplinary relations at the time of teaching. Moreover, there found a wide gap between the expected goals of curriculum reforms and actual progress achieved (Chisholm & Leyendecker, 2008) in our context. As the result, the products seem unable to address the real-world issues raised by 21st century. In addition, the lack of well-planned education process according to the need-based and context-based approach of education appear as the major factor of or not to gaining intended outcomes in education as well as particularly in mathematics. In this regard, it is essential to reform pedagogical practice in day-to-day classroom activities that encourages more learner-centered, active and competency-based education. Furthermore, teaching and learning activities are required to be connected at the local cultural context as the means for achieving educational, economic, social and political goals (Chisholm & Leyendecker, 2008) so that the products able to sustain their lives easily. Therefore, in this study, I have tried to explore some specific ideas regarding engaged pedagogical approaches from the in-depth study and critical analysis of works of many authors with my own reflections.

Although the amount of research works on pedagogical perspectives in mathematics has increased with the expansion of target area, the approach of finding solution becoming more challenging (Koskinen & Pitkaniemi, 2022) day by day. To solve real world problems of individual, the core knowledge of an isolated subject becomes insufficient and inappropriate. For this, learners are needed to engaged at the time of learning from the perspectives of multiple disciplinary by means of teaching and learning activities. But, in our context such types of efforts seem insufficient conceptually, contextually as well as empirically from all perspectives with regard to improve our pedagogical practices in mathematics. Therefore, the purpose of this study is to explore the innovative pedagogical perspectives in mathematics that contribute to empower learners’ engagement in learning mathematics

Methodological Aspect: Data Collection, Review, and Analysis

I have taken different literatures as a sample of this study and the themes generated by various authors in their creations act data of my study. Moreover, the theme building and critical analysis are done for data analysis process. In addition, the analysis process is going on the data and critical analysis on the theme analogously that I have explored indirectly in this section.

To prepare 21st century competencies from holistic approach; it is necessary to focus on teaching of creative and critical thinking skills, reduction of curriculum content, revision of assessment modes, and greater emphasis on process instead of outcomes in learning and teaching (Tan et al., 2017). For this, the pedagogical practices are needed to revise and update even for increasing the participation in local, global, and virtual societies. Moreover, in the existing pedagogical practices the priority is needed to be given on “how teachers understand the nature of knowledge and the student’s role in learning, and how these ideas about knowledge and learning are manifested in teaching and classwork” (Elmore, 1996, p. 2 as cited in Tan et al., 2017) rather than providing core and unpracticable content knowledge. The education process should encourage learner-centred constructivist pedagogies such that it helps to develop students’ sense of agency. It is essential to make in use such pedagogical practices that encourage students to discuss in teams, pose problems, and make connections to real-world scenarios, which empowers learners to become more active, more engaged and critically reflectors.

Indeed, the teaching and learning of mathematics cannot be effective unless students are fully engaged in it. Moreover, to address the demand of the recent daily lives the nonlinear pedagogy which is learner-centred and facilitates social skills, teamwork, collaboration and provides students more freedom to explore competence in their learning as well as more opportunities to demonstrate problem solving and creativity (Tan et al., 2017) seems more supportive in education process. In addition, teacher-centred pedagogical approaches support learners in drill and memorizing mathematical facts rather than meaningful understanding with active involvement. Therefore, such pedagogical practices are needed to replace by student-centred approaches that support students’ engagement with conceptual issues of inquiry, collaboration and problem solving (Bature, 2020) because of enabling learners to tackle their daily lives’ challenges.

Furthermore, it is imperative to prioritize the introduction of pedagogical approaches that support learners from multiple/diverse perspectives, empowering them to promote understanding and reflection on problems, and help students to develop higher-level thinking, analysis, and synthesis skills (Zhang et al., 2023) such that they can easily solve their real-world problems. In order to make pedagogical approaches relevant to present scenario many efforts have been made by many authors. Some of them have claimed regarding integrated pedagogy such as STEAM (stands for Science, Technology, Engineering, Arts and Mathematics) that empowers learners to learn mathematics by connecting it with other disciplines. Bush and Cook (2019) argued that such integrated pedagogy is essential in which “content standards are intentionally integrated with value importantly given to meeting the goals of each of the five content areas in STEAM: science, technology, engineering, arts and mathematics” (p. 20). Also,

through integrated instruction, teachers can simultaneously address standards across content areas. Likewise, the socio-cultural approach of guiding pedagogy in mathematics class seems appropriate since it focuses to make learning more context based (Tan et al., 2017) and more learners-based according to their local and global world.

In the similar reasoning; Tan et al. (2017) give priority to introduce such pedagogical practice that fosters students to learn the requisites of “twenty-first century competencies” such as to be active designers of, and productive contributors to local and global futures from political, social, economic, and cultural perspectives. Anyway, it seems compulsory to revise the pedagogical approaches of used in our context according to the change of life standard.

Themes and Discussion

For the empowerment of the innovative mathematics learning pedagogies, I found that many authors have made remarkable contributions. According to their implications in local and global contexts, such pedagogies seem more fruitful in our context as well. From the reflective study and analysis of the related literatures for promoting engaged pedagogical approaches in mathematics classroom, I have generated the fact regarding such pedagogies. In addition, I have inspired by some pedagogical practices which focus on the students’ involvement in knowledge construction. Under this section, I have mentioned some effective pedagogical approaches with its effectiveness in classroom teaching and learning supporting to the ideas of many authors.

Integrated Pedagogy

Integrated pedagogy is an instruction approach that combines the principles and content of different subjects to make meaningful understanding. In other words, in this integrated pedagogy, the two or two disciplines are integrated conceptually to create interconnected learning experience for students. The disciplinary integration includes interdisciplinary, multidisciplinary, and transdisciplinary integration. In such pedagogical practices, the different perspectives on the same issue can be gathered and pulled together for reporting of the findings (Max-Neef, 2005). Such integration uses the knowledge, processes, and skills of one discipline within another. Likewise, it focuses on addressing specific ‘real world’ system problems and encourages students’ participation to create new knowledge across the disciplines to cross boundaries to create new knowledge (Stock & Burton, 2011). In addition, in such pedagogical approach, students bring ideas together from different disciplines to jointly frame (Hammer & Söderqvist, 2001) the solution of problem. From this perspective, it is obvious that learners become more engaged and active to learn.

In similar reasoning, transdisciplinary requires teachers to be able to integrate context and content (Wang et al., 2011) where, context integration focuses on the content of one discipline and uses contexts from a different discipline to make the content more relevant and to make the meaningful learning through empowering pedagogy. According to Petersen (2015), an integrated pedagogy progressively engages learners in learning and assessment, as opposed to the examination-oriented pedagogy, which is judgemental, undemocratic, teacher-centred and

“authority driven” (P. 75). Thus, an integrated pedagogical practice provides an enabling environment for a more fruitful teaching and learning process to take place in the classroom.

Furthermore, integrated pedagogical practices engage learners in learning and assessment, as opposed to the examination-driven pedagogy, which is judgemental, undemocratic, teacher-centred and “authority driven” (Petersen, 2015, p. 75). In general, integrated approach to teaching and learning has been described as democratic, learner-centred, encouraging life-long learning, and promoting work-related competencies (Raselimo & Mahao, 2015, p. 2). Thus, an integrated pedagogy provides an enabling environment for fruitful teaching and learning process to take place in mathematics classes as well.

STEAM Pedagogy

Wang and Wu (2016) argue that, STEAM education has many advantages in teaching and learning based on new technologies, and plays an important role in improving the level of science and technology. Indeed, STEAM education is a core link to change the organizational form of education, cultivate innovative talents and seize the high ground of talents, which requires the participation and cooperation of the learners to understand the world in an integrated way as well as to improve their problem-solving ability in order to transform the world with interdisciplinary knowledge. Likewise, students can also cultivate critical thinking in the process of communicating and sharing creative ideas with peers in this technique of teaching and learning. Weidong, Wei and Mimi (2019) argue that STEAM education supports the students to realize the world in a comprehensive way, to transform the world in an integrated and innovative way, and to develop their innovative ability to solve problems.

Furthermore, when students engage in activities that combine different STEAM disciplines, they experience guided inquiry in which they must ask thoughtful questions, discover answers, apply what they learn, and problem-solve creatively. Indeed, STEAM pedagogy empowers project-based learning (Thakuri, 2023), where the project draws on problem-based inquiry to improve students’ achievement and engagement in learning as well as to build a community of educators dedicated to STEAM teaching and learning (Bush & Cook, 2019). Moreover, STEAM projects involve teamwork and thoughtful dialogue in which students exchange ideas and discuss ways to problem-solving such that students learn how to divide up responsibilities, compromise, listen to and encourage each other, help each other and figure out how to use their different strengths and skill sets.

Moreover, the ultimate goal of STEAM pedagogy seems to empower creativity, critical thinking, collaboration, communication, socio-emotional and lifelong learning aptitudes in the learners (Tan et al., 2017). Since STEAM projects require students to systematically think through problems, applying the information they learn to figure out the best solutions, it increases the level of critical thinking in students. Likewise, STEAM pedagogy provides a chance to solve problem in unique ways because the students are forced to use a variety of methods to solve problems. In addition, it provides students a chance to engage in hands-on, experiential learning. Thus, STEAM pedagogy seems appropriate in the field of teaching and learning of mathematics as well.

Constructivist Pedagogy

It is a process whereby students construct their knowledge and understanding through active participation in classroom learning. According to Biggs (1995), constructivism is a family of theories rather than any one, in which students are assumed to learn cumulatively, actively interpreting and incorporating new material with what they already know. Thus, it is totally students-centred pedagogy. Moreover, the main motto of constructivism is regarded as: the construction of knowledge is an active process, not passive (Major & Mangope, 2012). It highlights that this pedagogy empowers engaged learning. Likewise, according to Bodner, Klobuchar and Geelan (2001), constructivism is based on three assumptions: knowledge is constructed, knowledge is viable and knowledge is adaptation. Therefore, in this pedagogical practice students are needed to be more active in learning process.

Likewise, the constructivism beliefs that knowledge is seldom transferred from the mind of the teacher to the mind of the student (Bodner et al., 2001). In this pedagogy, the role teachers look like as scaffolders. Constructivism believes in personal construction of meaning by the learner through experience, and that meaning is influenced by the interaction of prior knowledge and new events (Arends, 1998) in one hand. On the other hand, it is an approach to learning that holds the people actively to construct their own knowledge as well as to ensure that reality which is determined by the experiences of the learner (Elliott et al., 2000). Therefore, such pedagogical practices seem more effective in the development of engaged environment in the classroom teaching and learning even in mathematics.

Sociocultural Pedagogy

Sociocultural pedagogy focuses on the participation of learners in the social practices within a particular context (Danis & Gresalfi, 2018) i.e. sociocultural teaching and learning practice is grounded in context. It assumes that the origins of knowledge and the processes of engaging knowledge stem from the cultural and historical practices in which the individual is immersed. Likewise, it portrays the dynamic of a learner acquiring knowledge and skills from the society and then in turn shaping their environment (Miller, 2011). Moreover, sociocultural approaches focus on the social environment which supports and inhibits students' engagement with the discipline (Danis & Gresalfi, 2018). The main goal of applying sociocultural approach of teaching and learning is to understand the learning as continually mediated by the local activity system.

According to this pedagogy, knowledge creation is considered to be dynamic and locally produced within the sociocultural tradition (Danis & Gresalfi, 2018). Therefore, sociocultural pedagogy seems valuable in focusing the learning with social, cultural, and historical context. Indeed, the knowing and doing i.e., the content and context cannot be inseparable, if it happens there will be a problem in accounting for civilization. Thus, the sociocultural learning seems more helpful in empowering learning of mathematics towards cultural and contextual turns.

From the above discussion of some innovative engaged pedagogies, it is clear that such pedagogical practices obviously bring desired change in the students' engagement in learning and also in their achievement. As the many authors have mentioned in their works regarding such

pedagogies, students cannot be passive to learn in such pedagogical practices. These pedagogies are recognized for empowering their activeness rather than making them silent listeners. Moreover, they learn mathematics by such techniques connecting the mathematical concepts with other disciplines their own context as well as according to their interest and efforts.

Pedagogical Connection in Global-Local Context: Implication and Challenges

In our context, the implementation of these student-centred pedagogical approaches in mathematics classes is a bit challenging task from various perspectives. In particular, integrated pedagogy creates obviously some challenges from managerial perspective as well as conceptual perspective. From managerial perspective, it includes lack of staff training; lack of resources and facilities (Park, 2008); lack of understanding and accepting the process of change in curricular matters (Malik & Malik, 2011) i.e. lack of appropriate curriculum design; a possible mismatch between the curriculum taught and assessed (Shankar, 2014) etc. can be taken as the common challenges. Likewise, from conceptual perspective, the concept of integrated pedagogy includes basically three terminologies: multidisciplinary, interdisciplinary and transdisciplinary. The concepts of such terminologies explain integrated pedagogy at different levels of its process (Nhlapo, Moreeng & Malebese, 2019), where, multidisciplinary approaches are meant to enhance understanding of a topic or theme while maintaining disciplinary boundaries (Choi & Pak, 2006), interdisciplinary refers to common themes being identified, analysed and synthesized, to produce unified knowledge, in a manner that blurs subject boundaries (Daly et al., 2012) and transdisciplinary seeks that the learners can argue their positions from multiple perspectives (Daly et al. 2012: 2) i.e. transdisciplinary determines that learners can produce and apply knowledge gained from multiple disciplines to solve practical problems. Thus, the effective implementation depends on the understanding of an integrated pedagogy (Park, 2008). In the lack of the conceptual understanding, teachers think an integrated pedagogy is some kind of a teaching method (Nhlapo, et al., 2019) and then continue to teach in their own ways, rather than using the integrated pedagogy and examining its way of producing knowledge. In one hand, our daily classroom practices show that different disciplines are taught by different subject teachers as Nepali teacher, Maths's teacher, Science teacher and so on. In the other hand, the curriculum which is known as the frame work of the education process is structured in empowering the education process through different subjects including the contents of different natures without establishing any linkages. Thus, to bring such integrated pedagogy in practice, it is necessary to revise in our education structure such as curriculum designing from new perspective, conducting awareness programmes, developing effective implementation environment and so on.

Likewise, STEAM pedagogy cannot be applied without in-depth plan, study, strategies and design of education process such that it enables students to create meaningful understanding of content and process (Herro, Quigley & Cian, 2019) in mathematics, which is a kind of big challenge in our context. Likewise, as Wang (2012) argues that a fundamental criticism of STEM is that there is no consensus on how to integrate the subjects effectively; same case may arise in STEAM until the education policies will not revise from local level as well as from national level

with sufficient guiding programs to the concerns. Moreover, if teachers will not be trained fully about the ideas of such pedagogy, there may occur next challenges including technology integration and issues related to assessment (Herro, Quigley & Cian, 2019) as well. In context of Nepal, the common understanding of the education process through STEAM seems as Isabelle and Valle (2015) state that the four disciplines that make up STEM are viewed as separate domains of knowledge, tied together mainly for the role they play in the job market of the 21st century global world. (p. 2); therefore, to make it in practice as the integrated approach combining the concepts of many multiple disciplines is another challenge in implementing STEAM pedagogy.

Furthermore, the effective implementation of constructivist pedagogy in mathematics classes also bears a kind of challenge because in most of the cases still our classroom practices seem guided by behaviourism and constructivism holds sharply opposite views about the nature of knowledge than behaviourism (Sharma, Pathak & Sinha, 2017) i.e. the assumption made in behaviourism about the way of creating knowledge is not acceptable in constructivism. Likewise, our education process seems guided by a structured process empowering behaviourist approach of teaching and learning where teachers have major role and students are taken as the knowledge receiver. But constructivist pedagogy does not assume such assumption. It priorities learners in education process. Therefore, to shift the concepts from one practice i.e. behaviourism to another practice i.e. constructivism, it is necessary to revise our educational policies and curriculum in one hand. On the other hand, the proper programmes of awareness such as training, workshops etc. are most to the teachers and implementors, which is also a kind of challenge in our context. Also, for the constructivist teachers, there exists another challenge of how to organize a course so that students are engaged and can progress in developing a deeper understanding of material, while simultaneously keeping a course moving and defining a teaching role (Hein, 2002). As our pedagogical practices focus the role of teachers with high priority rather than students' role; constructivism challenges a teacher's authority and place in the classroom for the teachers who are totally habituated by traditional classroom practices.

The implementation of sociocultural pedagogy in mathematics classes in our context is another challenging task. It is a collaborative venture in its essence, the role of teacher becomes very critical about what to teach and how to teach (Jabeen & Akhtar, 2013). If the teachers know how much scaffolds are necessary, only then they would be able to administrate "cognitively challenging learning tasks" (Gibbons, 2002, p. 10) in order to facilitate learning process. Thus, the proper management of the teachers' training about it is primary challenge. In our context, classroom activities are performed by teachers in teachers' dominated environment treating students as the passive listeners. Thus, next challenge of this innovative approach is that all the learners should participate in actively and vigorously in the completion of the learning activities (Jabeen & Akhtar, 2013), where learning is taken as a social enterprise and more learners work collaboratively. In addition, it seems that our education process is guided by a national level common curriculum prepared by a team of exports by the goal of producing same kind of

manpower. But sociocultural pedagogy empowers to localize and contextualize curriculum, which is another challenge of implementing sociocultural pedagogy in practice.

Conclusion

Finally, from the in-depth study and critical analysis of the concepts of enabling pedagogical approaches empowering students' engagement together with the remarkable efforts of various authors, I have summarized some major concepts regarding it. It is obvious that the use of active and enhanced pedagogical approaches helps students to gain exposure to any discipline even in mathematics in a stimulating and interactive environment, since it provides students opportunities to talk and listen to each other's responses, to questions, to interact, to collaborate, to share and to reflect (Wrenn & Wrenn, 2009). For such techniques of teaching and learning students are encouraged to pursue learning in a holistic way, without any subject-wise restrictions. Likewise, such approaches empower learners to engaged in project-based and designing approaches of learning mathematics. As the result, learners learn mathematical concepts in their own efforts making it contextual and practical based on their daily lives. The concepts learned from such activities become long lasting and supportive in solving their real-world problems.

Thus, there are many pedagogies empowering engaged learning in mathematics rather than treating students as the passive receiver. However, while implementing such pedagogies in our context, we need to shift from one practice to another. As the result, there arise some challenges in planning, in curriculum, in working with the plan as well as in manpower management.

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