Alternative Learning Strategies for Mathematics Education

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Abstract

This study explores to identify alternative learning strategies of the mathematics achievement and enrollment in mathematics education. The COVID-19 pandemic has further highlighted the need for such strategies, with an increasing demand for innovative learning. This study also aims to investigate students' perceptions and practices of alternative learning strategies and provide valuable insights for educators and policymakers. The methodology involves a comprehensive literature review spanning from 1978 to 2021, with an attention on relevant books, articles, and research reports. The study investigated best practices and effective strategies in mathematics education including Inquiry-Based Learning (IBL), Technology-Based Learning (TBL), Edu-Lab model, Flipped Learning Model, Problem-Based Learning (PBL), Cooperative Learning (CL), and Collaborative Learning (CL). These strategies have shown hopeful results in motivating students, reducing anxiety, and improving mathematical knowledge. The study proposes a paradigm shift towards student-centered learning and the integration of innovative technologies for mathematics education in the 21st century.

Keywords: Alternative Learning Strategies, Effective Learning, Mathematics Education, Mathematics knowledge, Technology based learning.

Introduction

Learning strategies encourage students to empower the new creation and new knowledge for learning mathematics. Alternative learning strategies promote active learning, student-centered learning, and a myriad of critical and creative thinking techniques and activities (Bonk & Smith, 1998; Pangeni, 2016; Pelet, 2013). According to NCTM (2000), alternative instructional strategies can motivate students' anxiety increase achievement in mathematics learning, and foster different learning strategies such as active learning or teacher-student dialogue for real learning. It describes also how the integration of technology contributes to the creation of standards in the classroom and enhances increased student achievement in

mathematics. As a result, alternative learning strategies are necessary to students to understand mathematical concepts and improve their performance.

Alternative learning strategies are technique that prioritizes the needs of the students and necessitates a teacher's knowledge to guide instruction. An alternative instructional strategy is supported by the internet and provides access to instructional materials obtained from the objective as well as facilitates interaction among teachers and students (Moore, 2012). Researchers have found alternative strategies are motivating techniques that engage students in mathematics learning and help to fulfill the overall aim of education and the effectiveness of teaching and improving students learning.

UNESCO found that alternative instructional strategies should be put into practice by governments for students who were not at school due to the diverse situation in an emergency (Huang et al, 2020). The digital resources obtainable to students and educators must integrate digital resources in curriculum methods. The ministers of education follow development in various parts in alternative learning strategies to exchange information and to support personal development like; distance education, online learning and television outlets during the coronavirous COVID-19(UNESCO, 2020). The Ministry of Education (MOE) has started alterative learning ways for all pri mary,secondary and higher schools. An alternative educational strategies are to improve learning outcomes and to continue their education in pendamic.After Covid-19 crisis, an alternative teaching strategy is beneficial in mathematics education. In our experience, one method or approach does not successfully grasp all students in real world context for our student.

In Nepal, not enough researches have been conducted to explore the students' perceptions and practices of alternative learning strategies of mathematics. The above theoretical backgrounds and practical experiences have inspired me to investigate the preferred alternative learning strategies of mathematics students in Nepalease context. In this context, the goal of this study is to explore the practices of alternative learning strategies of mathematics education.

Statement of the Problem

Low achievement and low enrollment in mathematics is an ongoing issues in higher level. Many students are not motivated in mathematics in diverse situation. Mathematics teachers directly influence how students will approach problems and experiences in life. Lack of relevant guidance regarding how to address different

learning styles, engage students, integrate manipulative and differentiate instruction based on the many individualized learning needs that mathematics instructors.School Sector Reform Plan (SSRP) (2009-2015) recognized traditional modes, lecturing, teacher-centered pedagogy, and classroom-based education and harmonized them with alternative learning provisions. There are existing situations such as anxiety in mathematics and students having no interest in mathematics caused by curriculum issues, content issues, evaluation systems, classroom instruction, and lack of learning strategies (Acharya et al., 2021)

The most effective teaching methods are manipulative, real-world application, differentiated instruction, and the use of technology in mathematics strategies (Moore, 2012). These methods must address the issues of low mathematics achievement and motivation of students and teachers. Without understanding the student's alternative strategies and their problems improvement in mathematics education is difficult. In my long experience of teaching–learning, there are lack of clear visualization of the education system and many students are not motivated by the traditional method of mathematics learning. Learning Strategies are the approach to enhancing access and quality teaching that helps students to be more engaged in a continuous mathematics learning pace. A mathematics teacher needs to address the issues related to each of the students' cultures so that the students feel his/her importance and freely contribute to classroom discussion. In this regard, this study focuses mainly on investigating perceptions and practices of students' learning in alternative strategies of mathematics education.

Rationale of this Study

Many theorists and researchers have attempted to define learning styles and teaching strategies at the secondary level. However, they have not provided sufficient suggestions regarding what alternative strategies can be applied in learning mathematics. As a major concern, the researcher has not found an answer to the question of what kinds of students use the best alternative learning strategies in mathematics in the context of Nepal. It is difficult to improve mathematics education without comprehending the alternative learning strategies and issues of low student enrollment. Educators and policymakers may gain a better understanding of their role in improving students' achievement and enrollment in mathematics education and the significance of reflecting and modifying teachers' teaching methods by understanding how students adopt learning strategies. One method or approach does not successfully

grasp all students in real world context. The reason for many issues may be due to poor attitudes towards mathematics learning and teaching prepare for this problem of low achievement and low enrollment in mathematics, it is needed to be aware and implement the best alternative learning strategies.

This literature review provides insights into choosing more effective strategies that can improve students' understanding of mathematical concepts. Similarly, this study will help to determine learning strategies that increase student engagement, active participation in learning, and grapes comprehensive skills knowledge in mathematics education in the Nepalese context.

Objectives of the Study

i) To explore students' alternative learning strategies in mathematics education.
ii) To identify the most effective alternative learning strategies for better achievement in mathematics education.

Methodology

Researcher has carried out this study reviewing a variety of sources in the following methods and procedures. I examined a variety of sources, including books, review articles, and research reports.

Criteria for selection

The selection criteria are robust research applied quantitative, qualitative, or mixed method design, reports, articles, and books collected by scholastics, and literature published both nationally and internationally.

Search procedure

The Researcher used the search terms " different learning strategies", "mathematics strategies" "alternative learning," and "Innovative learning strategies," to search published academic and professional scholarship. The researcher conducted manual searches of relevant books, journals, and research reports. Searches are ProQuest Dissertations and Pubmed.com, scholar.google.com, science direct.com, Jstor.com, nepjol.info, eric.ed.gov, proquest.com, tucl.remotexs.com bases Search complete utilizing the Google search engine for internet searches. To verify and validate key concepts and information that were brought forward during the review of the literature and then, posted the first draft of this article in a Google doc. A total of twenty-eight article titles were found related to the keywords and findings are presented. Review, the systematic research, was restricted to articles published

between 1978 to 2021. This study depends on a literature review of alternative learning strategies in mathematics education. The researcher presents the results from different books, articles, and diseration included in the literature review by starting out with a discussion of the selected comparison studies of alternative learning strategies.

Results and Discussion

I presented an outline-result based on my objectives and research question of the most recent empirical research.I have categorized best effective learning strategies into seven ways. Among them four are best practices model of learning strategies and three are the most effective learning strategies for better achievement in mathematics from twenty- eight distinct literature.

Best practices learning model strategies are a group of strategies or procedures that have been demonstrated to create ideal outcomes or results in a specific field. These systems are typically founded on observational proof, research, and aggregated insight. Best practice models are usually utilized in different enterprises like medical services, schooling, and innovation such as the Inquiry-based learning model, Technology-based learning learning,, Edu-lab model, and flipped learning model. The objective of executing best practices is to guarantee that associations or people follow demonstrated approaches that have a high probability of progress.

Best practices strategies are wide rules that have been demonstrated powerful in clear-cut spaces, while effective learning strategies center around individual strategies and techniques to streamline the educational experience. Utilizing both accepted procedures and powerful learning techniques can prompt more effective results in different undertaking studies.

The Inquiry-Based Learning (IBL) Model is a best practice learning strategy

From the different literature reviews; the reviews' summary is shown the Table 1 below.

Table 1 Inquiry-Based Learning

Authors (year)	Results
(National Council of Mathematics Teachers, 2000)	students' mathematical reasoning problem problem-solving skills, and conceptual understanding
Ernst, Hodge, & Yoshinobu, 2017	Help to solve and understand a series of scaffolded math problems

From the above data, a total of 2 of 28 studies focused on inquiry-based learning. Inquiry-based learning (IBL) is a student-centered approach that emphasizes the use of inquiry to facilitate learning and investigate mathematical concepts and principles through guided inquiry computer technologies are used to provide investigation tools, knowledge resources, and record-keeping tools(National Council of Teachers of Mathematics, 2000; (Ernst et al., 2017)

Technology-Based Learning (TBL) Model

From the literature review; the review's summary is shown in Table 2;

Table 2: Technology-Based Learning

Authors(year)	Results
(Kozma et al., 1978)	A computer is an initial novelty used in the mathematics classroom to improve attitudes toward learning mathematics.
(Bakiya et al., 2020)	Incorporating technology for effective alternative classroom instruction will prepare the 21st-century learner
(Pelet, 2013)	Creating, sharing, communicating, collaborating, and potential for persuading modification of quality learning.
(Pangeni, 2016)	Emerging practices in education have been promoting online learning
(Rajkumar & Hema, 2019)	E-learning supports and promotes mathematical knowledge making reasoning, problem solving and communication
(Brown, 2017)	Better learning in the classroom as well as more enthusiasm about using technology in mathematics to learn and practice
(Huang et al., 2018)	Effective in improving students' mathematical skills, engagement, and motivation
(Estrellan et al., 2021)	New mode of learning as a more comfortable and convenient way

From the above data, a total of 8 of 28 studies focused on Technology-Based Learning(TBL). TBL is one most important of developing existing learning strategies(Kozma et al., 1978) to enhance the learning of mathematics and online programs are attractive ways for teachers and students to improve their mathematical skills because of the diverse functionality of emerging technologies and quick integration of various computer technologies into classrooms Bakiya, Shear, Toyama & Lasseter, 2012; Pelet, 2013; Pangeni, 2016; Rajkumar & Hema, 2016; Brown, 2017; Huang et al., 2018; Estrellan, et-al., 2021;).

Flipped Learning(FL) Model

From the literature review, the review's summary is shown in Table 3;

Table 3: Flipped Learning

Authors(year)	Results
(Bergmann & Sams, 2012)	FL is a way that strongly integrates technology
(Shafique & Irwin-Robinson, 2015)	FL helps to make effective use of the local expert and comprehend the concepts
(Oliveira & Pombo, 2017)	Effective for mathematical skills, engagement, and motivation

From Table 3, 3 out of 28 studies focus on Flipped learning. Flipped learning involves students watching videos or reading materials outside of class and then working on problems and activities in class(Bergmann & Sams, 2012; Shafique & Irwin-Robinson, 2015; Ozdamli & Asiksoy, 2016).

Edu-lab Model

From the literature review, the summary is shown in Table 4;

Table 4: Edu-lab Model

Authors(year)	Dimension
(Shafique & Irwin-Robinson, 2015)	Expository, teamwork, ac-tiomental maps, comparative charts and technology
(Oliveira & Pombo, 2017)	Technological resources and to promote a dynamic, effective teaching learning process
(Pombo et al., 2017)	open educational resources with integrated digital textbooks

From above Table 4, a total of 4 out of 28 studies focused on the EduLab model is a novel approach to education that combines technology with classrooms that are fully equipped with attractive and simple to use technological resources like computers, interactive whiteboards, and projectors (Oliveira & Pombo, 2017; Pombo et al., 2017; Shafique & Irwin-Robinson, 2015; Suyo Veg et.al.,2019).

Effective learning strategies are the methods involved with gaining information or abilities. These methodologies are outfitted towards advancing individual growth

opportunities and result in more proficiency, prompting better getting it and utilization of the material such as problem-based learning, collaboration, and cooperative strategies

Problem Based Learning(PBL)

Table 5: Problem-Based Learning

Authors(year)	Results
(Hmelo-Silver, 2004); (Strobel & Van Barneveld, 2009)	Effective in improving students' problem-solving skills, mathematical reasoning, and conceptual understanding
(Moore, 2012)	Best practices for effective students achievement in mathematics
(Weiss & Harris, 2001)	Help students to construct mathematical knowledge

Based on the literature review of alternative learning strategies, a total of 4 out of 28 studies focus on Problem-based learning (PBL). PBL is a student-centered approach that emphasizes the use of problems to facilitate learning and students work in small groups to solve real-world problems that require the application of mathematical concepts and principles (Harris & Johnson, 2001; Hmelo Silver, 2004; Strobel & Van Barneveld, 2009; Moore, 2012).

Co-operative Learning Approach (CL)

From the literature review, the review's summary is shown in Table 5:

Table 5: Co-operative Learning

Authors(year)	Dimension
(Davidson & Major, 2014)	Using computers to solve group problems in algebra, geometry, and trigonometry, as well as group interactions in calculus and algebra
(Kadry & El Hami, 2017)	Multiple-step exercises, research projects, presentations part of the mathematics lesson plans
(Herreid & Schiller, 2013)	Acquisition and transfer of knowledge information and skill in mathematics learning

Based on the literature review, a total of 4 out of 28 studies focus on the cooperative learning approach to increase student engagement, provide peer support, and raise passing rates(Davidson, 1990; Kadry & Safieddine, 2016; Herrada Valverde & Banos Navarro, 2018).

Collaborative Learning(CL)

From the different literature reviews, the review's summary is given in Table 6;

Table 6:Collaborative Learning

Authors(year)	Results
(Slavin, 1996); (Johnson & Johnson, 1999)	Improving students' mathematical skill engagement, and motivation
(Herreid & Schiller, 2013)	Acquisition and transfer of knowledge information and skill in mathematics learning

From the literature review, a total of 3 out of 20 studies focus on collaborative learning. CL is working together to understand the content or solve a problem is part of collaborative learning and is effective in improving students' mathematical skills, engagement, and motivation(Slavin, 1996); Johnson & Johnson, 1999; Herrada Valverde & Baños Navarro, 2018).

Best practices strategies are wide rules that have been demonstrated powerful in clear-cut spaces, while effective learning strategies center around individual strategies and techniques to streamline the educational experience. Utilizing both accepted procedures and powerful learning techniques can prompt more effective results in different undertakings, including training and expert turn of events. In the review of the papers, the researcher found almost all articles linked to constructivism theory.

Inquiry-based learning model, technology-based learning model,,Edu-lab model and flipped learning model are the best learning strategies model and problem-based learning, collaboration and co-operative are most effective learning strategies in the classroom. Learning strategies have been shown to improve students engagement and performance in mathematics.A high priority on the creation of motivational strategies that enable students to enhance their skills and competencies in the practical application of mathematics.

Conclusion

A diverse and wide body of many research suggests that alternative learning strategies positively impact students' ability to understand core concepts and procedures. Alternative learning strategies can be effective in improving students' understanding of mathematical concepts and principles. Important elements include scaffolding activities, formative feedback loops, and the adoption of powerful

technology strategies to guide the learning process. It is important to note that no single approach is best for all learners, and educators should choose the strategy that best suits their students' needs and learning styles. As a result, ALS is effective in improving student engagement, motivation, and understanding of mathematics a high priority on the creation of motivational strategies that enable students to enhance their skills and competencies in the practical application of mathematics. The flipped learning model and Edu-lab model must be incorporated in 21st-century skills for students as well as PBL, and cooperative and collaborative learning must be a priority in learning strategies in mathematics classrooms.

The researcher needs educators to create new policies of the latest learning strategies and implement new innovative teaching–learning strategies using the latest technologies and novel approaches in their teaching practices. In the 21st century, the teaching and learning in mathematics is to create autonomy and independence in the learning process.

Implication of this Study

The paradigm shift of education for the departure from the traditional teaching methods which are primarily teacher-centered into a student-centered learning environment.

The researcher needs educators to create new policies of existing learning strategies and implement new innovative teaching–learning ways using the latest technologies and novel approaches in their teaching practices. Technology is most applications used in the plate form to create, share, communicate, and collaborate making it easy for quality learning and potential for persuading modification in higher education (Pelet, 2013).This study assists in applying discourse of learning strategies such as, flipped learning, hybrid learning, and virtual learning in the mathematics classroom.

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