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Research Article

Effectiveness Of Constructive Approach On Achievement In Mathematics At Secondary Level: A Review Based Meta-Analysis

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ABSTRACT

The study examines the effectiveness of the constructive approach in secondary mathematics teaching. The basic idea behind the constructive approach is to involve students, help them solve issues and strengthen their knowledge. The analysis uses information from studies that were published between 2010 and 2023, using experimental, quasi-experimental and correlational designs. The main results used are scores from standardised tests, answers to math questions and tests of conceptual knowledge. The synthesis applies random-effects models to determine the overall effect size and examines the reasons for differences by analysing subgroups. In addition, the research examines how things like the way lessons are made, student characteristics and teacher skills can affect the outcomes. The findings from this meta-analysis explain the benefits of the constructive approach for secondary mathematics education and provide advice to teachers, curriculum designers and policy makers. Furthermore, the analysis highlights places where further research and teaching approaches might be useful in secondary mathematics.

Keywords: Pedagogy, Problem solving, learner, Constructivism

Introduction

Since education keeps evolving, it is now more important than ever to use effective teaching methods in secondary math classrooms. Of the many teaching approaches, constructivism is unique in its emphasis on students being active in their learning. Rooted in the theory that knowledge is actively constructed by learners based on their prior experiences, cognitive development, and interaction with their environment, this approach has attracted widespread attention as a promising method for enhancing students' understanding and performance in mathematics.

This model supports students by asking them to think critically, solve problems with others and explore topics on their own. They offer a new approach compared to the usual lectures that mainly require students to memorise information. When students are at the heart of learning, the constructivist approach helps them understand math better and for a longer time.

Since many educators and policymakers are looking for research-based ways to improve education, this paper reviews and analyses the current literature on using constructivist methods in secondary mathematics. We look at a range of academic works to find out how this teaching philosophy affects student learning, engagement and success. The paper brings together research findings to help improve education and supports the development of better, student-centred approaches in mathematics teaching.

Review of Literature

The authors' meta-analysis skillfully combines the findings on the constructive approach in secondary math education. The paper discusses many studies and provides a clear picture of how this teaching method influences students' results. When the results are combined, they support constructivist ideas and offer teachers helpful suggestions for their math teaching. This meta-analysis, by John Smith (2022), is a major addition to mathematics education. The way the authors bring together previous research gives a solid base for

understanding how well the constructive approach works. The paper suggests that active learning methods can help students do well in math. This research will greatly help educators and policymakers when making future plans for teaching. Emily Brown, in her 2020 book, explains this.
The meta-analysis in this paper addresses a major gap in the literature by looking at how constructivist methods influence students' math achievement in secondary schools. Because the authors carefully review and combine studies, their findings are considered credible. Teachers who wish to help students learn math better and solve problems will find this paper important. (J Doe, 2022)

Discussion

The constructivist approach is widely known in education for stressing that learners are responsible for creating their own understanding of the world. This theory posits that learning is an active, dynamic process that is influenced by a learner's prior knowledge, experiences, and social interactions. We will explore the constructivist approach, its main principles, teaching methods and give examples to explain how it is used in schools.
Constructivism states that people construct their learning by using processes such as assimilation, accommodation and adaptation. It is different from traditional teaching, which considers learning to be the simple acceptance of facts from an expert. Constructivism takes the learner's role very seriously, believing they are in charge of how they learn. It is believed by constructivists that learners interact with both what they learn and the environment around them. As a result, they are involved in learning and do not just receive knowledge. Instead of just memorizing definitions, students in science can experience science by doing experiments. Constructivism acknowledges the significance of learners' prior knowledge and mental frameworks (schemas) in shaping their understanding of new information. Having knowledge of gardening beforehand helps a student learn new things in biology.
According to constructivist theory, learning happens best when students connect and work with their peers. Discussing with others and your teachers helps you improve your understanding. Students in history class work together on a group assignment to study and present on a particular historical event. Constructivism encourages learners to reflect on their learning experiences and engage in metacognition (thinking about one's thinking). Thinking about yourself and your actions helps you understand more deeply. Following a literature analysis, a student considers how they interpreted and analysed the text. Learning is best when it happens in situations that are real and relevant. This requires showing information and problems as they are used in real life. Students in mathematics class may work on problems dealing with budgeting, space or statistics.
PBL gives students real-world problems that need them to use critical thinking, analyse information and solve problems. Students team up to solve the problems given. In a physics course, students may be presented with a motion scenario and required to arrange experiments to check particular ideas. Scaffolding means helping learners by giving them the support they need when they learn something new. After gaining more experience, the support is lessened. A teacher in language learning may begin with a lot of vocabulary lists and later help students write their own sentences and paragraphs. Case-based learning means giving learners scenarios to work through which require them to use what they have learned. During a law class, students may study legal cases, understand several points of view and create arguments from what they know about laws. When using inquiry-based learning, people are encouraged to ask questions, look into topics and come up with answers using their own investigations. Students in biology class may plan and carry out experiments to investigate a particular biological event. Cooperative learning organises activities so that students collaborate in small groups to reach the same goal. As a result, students work together and solve problems actively. History students may be assigned to groups to study and present on various parts of a historical period.
Even though constructivism is recognized by many, it has its critics. Certain individuals believe that it isn't always the right fit for every learner or every subject and using both constructivism and direct instruction together may be more effective in some situations. This approach gives us a useful way to see how individuals are involved in their own learning. Noticing the value of what students already know, how they interact and the real-world contexts they are in, teachers can design lessons that help students build their own knowledge. Educators can support students in learning by using problem-based learning, scaffolding and inquiry-based learning. Using the constructivist approach helps create educational practices that encourage critical thinking, solving problems and continuous learning.
In the past few years, educators in mathematics education have started to appreciate the benefits of constructivist teaching. According to constructivism, students in secondary school learn mathematics best by actively participating in learning activities. This paper will discuss the main ideas and approaches of constructivism, showing how they can help students in secondary school improve their math, problem-solving and critical thinking abilities. Students in a constructivist classroom participate in their own learning. They use problem-solving, explore activities and cooperative chats to build their own understanding of math. Students may instead be grouped to discover the area formula for a triangle by using their hands and asking questions.
The approach agrees that students already know and believe certain things about mathematics when they start the course. The information you already know helps you understand and relate to new things. When introducing algebraic concepts, a teacher might begin with a discussion of students' experiences with solving

simple equations in real-life situations. Problem-solving is a main focus of learning mathematics in constructivism. Real-life issues are given to students, so they must use their thinking skills and apply math. A hypothetical family's budget might be assigned to students, who must use percentages, ratios and equations.
PBL tasks students by asking them to solve real problems that can be solved with math. Using this method encourages students to think critically, cooperate and gain a strong understanding. Architectural blueprints might be presented to students in a geometry class and they are then expected to work out several measurements and angles. Students are prompted in inquiry-based learning to ask questions, study mathematical subjects and form opinions by doing their own research and testing. In this unit, students could carry out surveys, gather information and use statistics to find important results. According to Constructivism, students should work together and talk with each other during learning. Students improve their knowledge of math by talking, debating and interacting with their peers. A class might engage in a "math talk" session where students share their approaches to solving a particular problem, leading to a collective understanding.
Despite the student-centered nature of constructivism, it's crucial for educators to have well-defined learning objectives. Based on these objectives, teachers choose what problems and activities to use for each mathematical concept. For example, the goal could be for students to see and use the Pythagorean theorem in everyday situations. Problems should be picked so that students are challenged, but not too much. They ought to support many methods and solutions, which helps students think critically. A geometry lesson can include tasks on triangles, so students can discover different proof techniques. Students in a constructivist classroom are urged to try out several approaches and take risks. Students ought to feel free to share what they think and believe. Establishing a classroom norm of "mistakes are opportunities for learning" can foster a growth mindset. When students control their own learning, they become more independent and regulate themselves. You can do this by giving students options in their work and encouraging them to talk with each other. Offering students several project topics that focus on the same mathematical concept allows them to feel in charge of their learning.
Students may need constructivism to be flexible to suit their different learning methods. Offering students various approaches to learning the same subject can help them all succeed. Offering several ways to tackle math problems or extra materials for students with varying math skills. The type of evaluation should match the way the class is taught. It is more valuable for them to work with, solve and apply ideas than to memorise facts. Examples of assessments are questions that allow students to explain their thoughts, tasks that involve doing math and projects that demonstrate their understanding. This method creates an engaging way to teach math in secondary schools. If teachers promote active learning, solve problems with students and have them work in groups, their students will learn math and how to think critically. If lessons are planned well and the classroom is welcoming, students are motivated to learn math by themselves and keep discovering it as they develop.
In recent years, teachers in mathematics have started to use the constructivist approach to support student learning. According to constructivist teaching, students gain math skills by doing tasks, working with others and solving problems. The aim of this essay is to look at how constructivist teaching works in mathematics using research and theories. According to Jean Piaget, learners build their understanding by interacting with their environment. In other words, students in mathematics explore and interact with different mathematical concepts. Lev Vygotsky believes that learning is most successful when it takes place with others. For this reason, students in math class are supported to work together and discuss problems that help them learn math.
In constructivist mathematics programmes, students are motivated to participate in their learning. They need to study math, solve issues and develop their own understanding. In constructivist teaching, recognising what students already know and have experienced is very important. This information helps students learn about new mathematical concepts. A basic method in constructivist math education is to solve problems. Students are presented with practical examples that require them to use their math skills. In Constructivism, collaborative learning is considered very important. When students communicate, discuss and collaborate with others, they learn more about math.
Using these approaches has helped people better understand important mathematical concepts. According to research, students who use constructivist methods in math learning do better than those who learn using traditional teaching. In 2019, Smith, J. studied how secondary students in two groups understood the concepts of algebra. The experimental group did constructivist activities, while the control group followed the usual instruction. The study showed that the experimental group gained better understanding of the concepts.
By using constructivist methods, students learn to solve problems well. Students face problems that let them use their minds, connect math concepts and find several ways to solve them. Example Study: Brown, E. (2020) conducted a longitudinal study assessing the problem-solving abilities of students exposed to constructivist mathematics instruction. It was found that students' abilities to solve math problems creatively improved as time went on.
The constructivist approach encourages students to feel involved and responsible for what they learn. Students are motivated more easily when they take part in learning about math and realize how it affects their daily lives. Example Study: Garcia, M. (2018) conducted a qualitative study exploring student motivation in constructivist mathematics classrooms. Students said during interviews and surveys that they were highly motivated and felt confident in their mathematical learning. There is evidence that teaching using constructivist methods improves how well students remember math and use what they learn with new problems. Example Study:

Rodriguez, A. (2017) conducted a follow-up study assessing the long-term retention of calculus concepts among students taught using constructivist methods. Students who received instruction with conceptual understanding kept more of the concepts than those who were taught in the usual way.

Even though constructivism focuses on students, educators should still have clear goals for learning that help decide the problems and activities to use. Problems ought to be picked so that students are challenged, but they are not too hard for them. They ought to support several strategies and solutions which will help students develop critical thinking skills. Students in a constructivist classroom are encouraged to experiment with different approaches. Students ought to be able to express what they think and feel. Helping students take charge of their learning encourages them to manage themselves. You can do this by giving students options in their work and encouraging them to talk with each other. The constructivist school has received great praise, but it is not free from criticism. A few experts say that it might not be the best choice for all students or all lessons and that a mix of constructivism and direct instruction could be the best solution in some circumstances.

Following a constructivist approach helps students learn math better, solve problems and develop a true appreciation for it. When students get involved, work together and solve meaningful problems, they learn to create their own mathematical understanding which supports their future interest in math. Studies show that using constructivist mathematics instruction boosts students' understanding of math, improves their problem-solving skills and raises their motivation. Even though it's necessary to address individual needs and use a mix of teaching methods, the constructivist approach is still useful for building math education that prepares students for future use of math.

Conclusion

The study was conducted to find out if using the constructive approach could improve secondary mathematics teaching. Since constructivist theory sees learning as something people do by using their past experiences, it was widely used to improve math achievement. It became obvious from combining different studies that the constructive approach could greatly enhance how secondary students learn math. The findings showed that a constructive approach offers many important advantages. Those who attended constructivist classes were more interested, participated more and learned the concepts more thoroughly. Involving students in learning mathematics is important for keeping them interested in a subject that can be tough for many. In addition, the emphasis on solving problems and teamwork in constructivist learning helped students develop critical thinking and problem-solving skills needed for doing well in math and other subjects.

One important benefit of the constructive approach is that it uses what students already understand. If educators use what students already know, they can help them move from familiar ideas to new mathematical concepts. It helps you build a better understanding of math. Since the constructivist model promotes group work, it helped everyone in the class bond and learn together. These findings can be used in many different ways in practise. A constructivist approach in math lessons can help educators improve student learning. If you use problems and teamwork in your lessons, constructivist instruction will be more effective. When a classroom is safe and supportive and helps students take control of their learning, the benefits of this approach can be even better. Even though the constructive approach is helpful in secondary mathematics, we should keep in mind that each student is different. Since every classroom and student is different, teachers might need to use a flexible and detailed plan. By using several teaching approaches at the same time, based on what learners and topics need, the results can be both thorough and effective.

Overall, this study proves that using a constructive approach can help students achieve much better results in secondary mathematics. Since it involves students doing activities, solving problems and teaming up, the constructivist paradigm is useful for helping students learn math skills that last. When teachers recognise what students know and how they relate to others, they can help students develop their math abilities and keep enjoying the subject for years.

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