Original Research Article

BEYOND THE CLASSROOM WALLS: ACTIVITY BASED LEARNING FOR A REAL-WORLD MATH EXPERIENCE

ABSTRACT

Students and educators have reported that mathematics education in schools is in a poor state. Because of this, pupils' academic performance suffers, both in class and on standardised tests. Teachers' pedagogy is a significant impact on pupils' mathematical achievement. For the most part, educators in today's schools continue to use time-tested practises. Evidence from studies shows that this approach fails to get the desired results. So, we need to move away from the lecture-based model of education and toward more active forms of learning like project-based learning. However, many educators struggle to develop and implement efficient methods of activity-based learning for mathematical concepts. This study is belonging to activity-based learning in mathematics classrooms for students with constructivist approach. Methods such as guided exploration, hands-on activities, instructional technology, collaborative study in small groups, and classroom debate all figure prominently. The authors argue that mathematics education should shift from a focus on conventional approaches to one that emphasises activity-based learning.

Keywords:Activity-Based Learning (ABL); Mathematics Education; Hands-On Learning; Curriculum Enhancement; Real-World Applications; Student Engagement;

INTRODUCTION

Many elementary and secondary school pupils struggle with some mathematical concepts. Teachers have just as much trouble becoming good educators as do students when it comes to teaching mathematics. This has made things difficult for everyone involved in the school system: parents, students, instructors, and educationists. The onus is now on educators to provide lessons that help students succeed on standardised tests and in classroom activities.

Teachers' efficacy, as assessed by their acquisition and application of strong teaching skills and methods, seems to play a pivotal role among the elements that impact the

accomplishment of students in school mathematics (Max, 1988). A teacher's approach is crucial since it determines whether or not their pupils will take an interest in the material they're being taught. This is supported by a study by Mstem in Emaikwu (2012), which states that the style in which a teacher presents information to pupils has a significant impact on whether or not the students respond positively to the material being presented in class.

The lecture approach, in which lecturers speak and pupils sit quietly and take notes, is still widely used in today's classrooms. The problem is especially severe in elementary schools, when a teacher is required to cover a broad range of subjects with his students. The lack of properly trained math educators has resulted in many elementary school instructors being forced to teach subjects outside of their expertise. More than 90% of primary school educators still rely on the tried-and-true lecture technique. The majority of educators aren't qualified to teach mathematics, which is a big contributor to the problem. Another problem is that the instructors were taught in school by inept professors who largely used the lecture method of teaching, and so the teachers of today just reproduce the way they were taught. The instructors even admitted to these. Johnson, D.W.at el (1998) showed that the lecture Method was the predominant mode of contact between instructors and students in schools, lending credence to these claims.

According to Tseng, K.-H., Chang, C.-C., Lou, S.-J., & Chen, W.-P. (2013) lecturing pupils is ineffective due to their young age and the inherently passive character of scientific inquiry. The strategy has been recognised as unsuccessful by scholars and educationists worldwide. This suggests that pupils may not achieve successful learning in mathematics until instructors begin using activity-based learning strategies. Then schools would continue to groan in the shadow of our children's poor performance. Teachers around the country are now receiving rigorous training in the use of Activity-Based Learning methodologies. However, many educators are still working through the challenges of implementing this new approach to education. Therefore, it is important for K-12 mathematics educators to be familiar with the methods of activity-based learning.

There is mounting evidence that the lecture approach to mathematics education is no longer productive. Students are not allowed to think critically or participate to class discussions. Wong, N. Y. (2004) claims that the degree of understanding needed of students in a standard pedagogy course is so low that it just involves the students' ear and their writing hand, and not their brains at all. The goal of the activity-based learning philosophy is to encourage students to take an active role in their education and growth. This inefficient conventional approach of teaching comes to focus via the pupils' outcomes in exams. There is a pressing

need to emphasise active learning in mathematics classrooms rather than lecture-based instruction. The conventional method begins with a review of the lessons covered the day before, followed by a presentation of the day's content via teacher-led explanations and little student participation. Author's findings using this approach include:

1) This style of teaching places the majority of the onus for learning on the instructor, while students take a more receptive role.
2) Students strive to listen and copy from the instructor when they are told mathematical formulas and ideas.
3) There is no improvement in pupils' ability to remember and apply learned material. As a result, within a few days, pupils have already forgotten what they learned.

The following questions should be answered by the instructor via the lesson plan in order to effectively teach any subject in mathematics.

- What are we talking about?
- How do you arrive at that answer?
- How did they come up with the formula, or why is it computed that way?

Before beginning to solve instances with students in class, a teacher organising a lesson on the area of a circle should include not only the subject, but also the formula as r2, and how the formula is achieved through practical exercises. Many educators today are only able to address the first two questions, leaving the third unanswered. The instructor just restates the formula and works through the instances with the pupils. The standard response to pupils' inquiries on the origins of the formula is "it is the rule in mathematics." Teachers' doing this to their pupils is a certain way to make them feel that mathematics is beyond their grasp. When a math teacher explains step-by-step how a formula is derived, they engage their students and make the material relevant to their lives.

ACTIVITY-BASED LEARNING

In activity-based learning, rather than "passively" taking in lectures, students actively participate in the learning process. The primary idea is that students learn better via active participation in a variety of activities and experiments than by passively absorbing information through lectures alone. Reading, writing, conversation, hands-on activities, problem-solving, analysis, synthesis, and assessment are all integral parts of activity-based learning. By extension, active learning is well-defined as any method "that includes students in doing things and thinking about the things they are doing" (Frenzel, A. C., Pekrun, R., & Goetz, T.,2007), (Bonwell&Eison, 1991). A child's learning is more enjoyable and effective

when they are given the freedom to discover new concepts on their own and are placed in an optimal learning environment.

The term "active learning" refers to a style of instruction in which students actively participate in all stages of the learning process and the role of the instructor is limited to that of a guide or facilitator. It is a method of education based on the belief that (i) students learn most effectively when they see the material as having direct application to their lives. (ii) Practical experience is a crucial component in acquiring many skills. (iii) The learner's accountable involvement in the instructional process is crucial to the success of the learning process. As for the most ubiquitous and long-lasting kind of education, I would argue that it is self-initiated learning that engages the full person, heart and mind (Okwudishu, 2011). In active learning, students are expected to take an active role in their own education. Active learning originates from two key principles. (1) learning is intrinsic to the human condition, and efforts to do so, (2) What Every Teacher Should Know About How Students Learn, that "different individuals learn in various ways" (Affandi, A., &Sukyadi, D.,2016).

Active learning, as described by Bowel and Eison (1991), involves the following characteristics: increased emphasis on students exploring their own attitudes and beliefs; increased emphasis on students engaging in higher-order thinking (analysis, synthesis, evolution); greater emphasis on students' engagement in activities (e.g. reading, writing,discussing); and more focus on students' involvement in action than listening.

Active learning has been shown to improve retention and comprehension among pupils. Activity-based learning, as outlined by Morable in Okwudishu(2011), has several advantages. Boosts students' motivation, confidence, and ability to work together, encourages innovative approaches to tackling problems, and fosters an atmosphere conducive to discovery learning. It also energises and invigorates participants, strengthens learner bonds, provides a variety that accommodates diverse learning styles, allows for practical application of course content, improves communication with diverse learners, provides an enjoyable and exciting learning environment, helps improve learner retention and motivation, provides an avenue for learner recognition and reward, and promotes fun.

The author contrasts Activity-Based Learning with the conventional method by noting its advantages:

(1) The teaching and learning processes include the participation of both the instructor and the student.

(2) With the teacher's direction, the pupils learn mathematical ideas and formulas on their own.

(3) The idea retention and recall are strengthened. Hence pupils educated using this manner barely forget the knowledge got from the activity.

Activity-based learning strategies have been shown to be effective in improving students' knowledge retention, according to studies. Students, according to a number of studies, would rather engage in more active learning methods than sit through standard lectures. In addition, Emaiku (2012) found that students who were taught using activity-based learning approaches outperformed their counterparts who were taught using lecture and discussion methods. Other studies assessing student performance have shown that many active learning practises are just as effective as lectures in helping students acquire the material, and often more so at developing their capacity for critical thinking and effective writing.

The phrase "active learning" is used to describe a variety of teaching strategies that put more of the onus of education on the students themselves. Kloosterman, P., Raymond, A. M., &Emenaker, C. (1996)argue that students do not learn much if they just sit in class, take notes, and regurgitate answers to predetermined questions. They need to share what they're learning, reflect on it in writing, draw connections to their own experiences, and use what they're learning in practical ways. They have to internalise the knowledge they get. Studies have shown that pupils who are more involved in their learning are better able to retain what they've learned (Sedova, K. et al, 2019).

METHODS FOR IMPLEMENTING AN ACTIVITY-BASED CURRICULUM IN MATHEMATICS CLASSES

Recent studies of successful mathematics education have concentrated on strategies that get pupils actively engaged in their learning. The new pedagogy in education calls for more hands-on, interactive lessons rather than dry lectures. Most instructors in the educational system frequently teach the mathematical sciences through the “telling method”. VanLehn, K.et al, 2021).This entails writing lesson notes, passing on the knowledge to the students, and finally assessing the pupils. The classroom dynamic shifts from "active" instructors to "passive" pupils. No long-term retention of material is achieved in this manner. The teachings are difficult for the students to grasp. Because of this, kids forget what they've been taught and do badly on tests. Students are more likely to retain information when they are able to use their senses of sight, hearing, smell, taste, touch, taste, hearing, reasoning, deduction, and inference as part of the educational process. In the mathematics classroom, this might be accomplished by means of the following:

THE DISCOVERY METHOD OF INSTRUCTION

The discovery approach is, as the name indicates, a way of teaching mathematics in which the instructor helps the student discover the material on his or her own via a series of well planned and executed tasks. In this method, the instructor gives the students the resources they need and then directs them through a series of exercises designed to help them learn something new. It would be possible for students to engage in such exploratory tasks alone or in small groups. Students are encouraged to take initiative in their education and make discoveries via this method. For instance, if a teacher wants pupils to learn that a triangle's total of its angle is 180 degrees, she should have them draw triangles, measure their angles, and then add those measurements. The class would figure out that the combined angle measure is 180 degrees. Students might also use the fact that the sum of all the angles on a straight line is 180 degrees to their advantage by drawing triangles on paper, cutting out the three angles, and arranging them to make a straight line. Math educators are urged to abandon the less effective "telling technique" in favour of the more engaging "discovery approach" that promotes students' active participation in the learning process. The proof that a quadrilateral's angle sum is 360 degrees is another example. The pupils have to design a quadrilateral, measure its four angles, and add them together to get the answer of 360 degrees. The idea here is that math instructors shouldn't only relay formulas but also provide examples to their pupils. Instead, educators should facilitate students' own investigations of mathematical ideas, theorems, and theorems.

PROPER HANDS-ON EXPERIENCE

Most pupils learn best through hands-on experience when it comes to mathematics and the sciences. When information is given to pupils as a jumble of isolated pieces, they are unable to make connections between the various pieces or draw parallels to their own experiences. As a consequence, they end up with warped ideas and a severe aversion to the topic later in life (Elliot, Thomas & Joan, 2000). The old adage, "What I hear I forget; what I see I remember; and what I do I comprehend," lends credence to this notion. This indicates that a youngster will not fully grasp an idea unless he or she puts it into practice or actively engages in the learning process.

Education is much more than just passing on knowledge. According to the old adage, "A bad teacher tells; an average teacher informs; a good teacher instructs; an exceptional teacher inspires," a good teacher should motivate their students to do great things (Sababha et al., 2016). To assess a teacher's effectiveness, one must consider how much their pupils have

been motivated to use their own imagination and originality in their own learning. The only way to do this is via the use of hands-on activities that encourage student participation in the classroom. As a result, educators must adopt a more hands-on strategy while instructing students in the mathematical sciences. For instance, while instructing students on how to calculate the area of a rectangle, the instructor should have them draw rectangles and insert unit squares. Volume, capacity, and nets of solids such as cylinders, cuboids, and cubes; graphs, probability, and construction, among other things should all be taught via hands-on experience. Putting together a stack of circles with identical radii would indicate visually the volume of a cylinder, for instance. Then, help the class realise that a cylinder is just a stack of circles and that the volume is r2h. Cut, measure, sort, and organise things before drawing conclusions. All of these will encourage students to take an active role in their education.

INSTRUCTOR'S GUIDE TO USING TEACHING AIDS

Mathematical ideas may be made more tangible and less mysterious with the use of pedagogical tools. "Things come before ideas and ideas come before words" is a guiding concept in mathematical education (Biasutti, M., & EL-Deghaidy, H., 2015). The usage of teaching aids has been shown to increase student achievement by piqueing and maintaining their curiosity in the subject being taught. For instance, SMcLeod& D. B. (1992) found that, compared to non-manipulative sessions, those that included the use of manipulative tools resulted in increased mathematics success among students. The use of both symbolic therapies and manipulative material is more successful than either therapy alone. Children from diverse socioeconomic backgrounds, skill levels, and educational attainment levels tend to benefit from using these items.

The majority of educators in our educational system do not make use of instructional materials, which makes it that much harder for students to understand and master mathematical concepts in school. Some institutions have created mathematics kits for use in elementary and secondary schools. Teachers all around the nation are being retrained using elementary mathematics kits. Teachers of younger students admitted during the seminars that they lacked the resources to actively engage their students in the lessons. Classroom participation is increased because of the instructional tools.

For instance, the circumference of a circle may be shown to students using circles of varying radii. Help your students calculate the value of pi. Simply calculate the circumference of the circle and divide it by its diameter to get this value. Students may use a tape measure and ruler to get accurate measurements. All students will get about 3.142 when they divide the

circumference by the diameter. The ancient Greeks used the sign to represent this constant, which they named Pi.

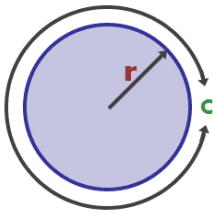
Thus,

$\frac{C}{D} = \pi$

C = π D

C = π x 2r, since D = 2r

C = 2πr



Teaching students to organise counters into groups based on different number bases is another way to illustrate the notion of number bases. To get students engaged in class and help them learn material, try some of these exercises. Total cube surface area, sphere surface area, circle area, cylinder volume, and so on are all useful tangible resources for teaching probability. When students are encouraged to participate in the learning process via the use of pedagogical tools, they are better able to grasp and remember mathematical ideas.

LEARNING IN PARTNERSHIPS OR IN SMALL GROUPS

One of the most effective ways to get students involved in what they're studying is via cooperative learning, often known as small-group learning. Students who haven't actively engaged in their individual studies are more likely to participate in a cooperative learning setting. Students learn more from one another when they work on a mathematics problem in small groups. Academic debates are sparked during group work, which is good for students. The result is learning that is more robust, interesting, meaningful, engaged, and fruitful.

Give a class a unique cylinder, cone, and sphere and have them figure out the volume correlations betweenthe three.

(1) Show them how to put water in the cylinder and then pour it into the cone. Does it fill the cone more than once?

(2) Let them use it to fill a cylinder, a cone, and a sphere. To what effect?

(3) Have the group pour water into the cone to make it spherical. It fills the sphere, but how many times?

When the crew investigates, they will find:

(i) The cylinder's water supply is sufficient to 3 times fill cone.

The volume of a cylinder = three times that of a cone.

So, the volume of a cone=$\frac{1}{3}$ x volume of a cylinder

=$\frac{1}{3}\pi r^2$h

(ii) A cylinder's volume is the same as that of a cone's and a sphere's combined. Thus, the volume of a cylinder is equal to the sum of the volumes of a cone and a sphere. Therefore, the volume of a sphere = the volume of a cylinder - the volume of a cone.

$$= \pi r^2 h - \frac{1}{3}\pi r^2 h$$

$$= \frac{2}{3}\pi r^2 h$$

$$= \frac{2}{3}\pi r^2 \times 2r, \text{ as } h=2r$$

$$= \frac{4}{3}\pi r^3$$

(iii) The formula for the volume of a cone is:

cone volume = $\frac{1}{2}$ x sphere volume.

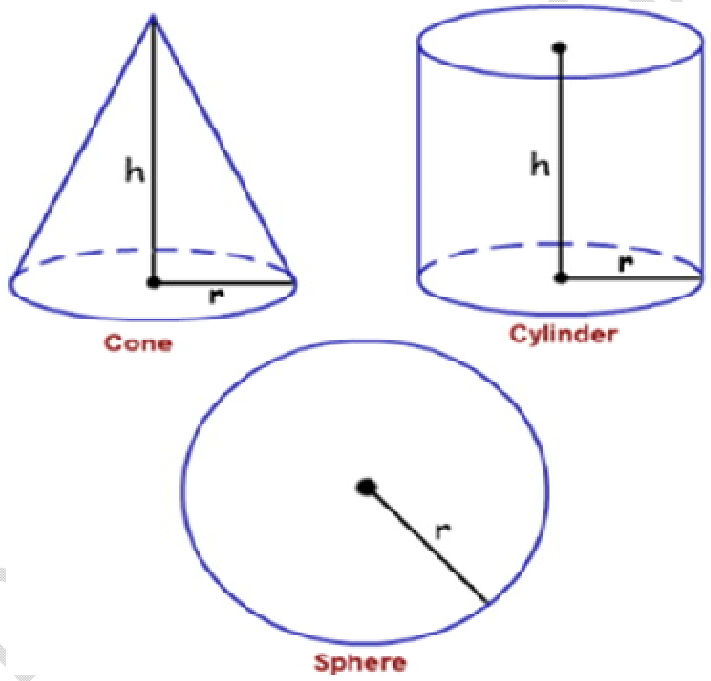


Fig.1. shape and structure of different object model

CLASSROOM DEBATE

One of the most popular ways to encourage active learning is via classroom discussion. Discussion is preferred over lecture because it "improves students' ability to retain material, encourages them to pursue more study, facilitates their ability to apply that information in novel contexts, and fosters the growth of their critical thinking abilities" (Bilgin et al., 2015). Instructors should promote student participation in class discussions. However, in order to accomplish the lesson's goals via discussion, the instructor must first set out the guided

discussion. Active learning is promoted via guided classroom discussion. Students would be more engaged in their learning if they were given opportunities to contribute their own thoughts during class discussions.

A CONCRETE EXAMPLE OF THE TEACHING-CIRCLE-THEOREM INSPIRED FROM ACTIVITY-BASED LEARNING PROCESS

Before diving into the proof and examples, it's important to construct exercises that will help students understand and agree with the circle theorem (Azuka, 2001). It is up to the students to show this is the case via their work in class. In the example that follows, you can see how the activity-based approach is used to explain the circle theorem.

An arc of a circle subtends twice as large an angle in the center of the circle as it does at any other point on the circumference, according to a well-known theorem.

Step I. Participating in interactive activities with the students, such as questioning, reviewing arcs of circles, measuring angles with a protractor, creating circles with a set of compasses, etc.

Step II. Have each student draw a circle with a subtended angle in the center and around the perimeter, as illustrated in the examples below.

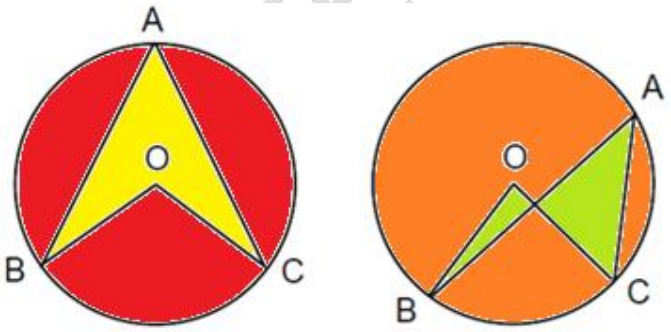


Fig. 2. Activity-Based Learning Process

Step III. Encourage your class to take turns measuring and reporting the angle formed by BOC and BAC. The class would respond with things like below

Table 1. Angle formed by BOC and BAC

S.N.	BOC	BAC
1.	120^0	60^0
2.	140^0	70^0

3.	130^0	65^0
4.	100^0	50^0

Step IV. Help them figure out how BOC is related to BAC. Inevitably, class participants will figure out that BOC = 2BAC.

The students may have contributed to the proof of the circle theorem using these. Students learn more and have more fun when they are given opportunities to explore topics on their own. "I trust that posterity will judge me favorably not only as to those things which I have described but also as to those things which I have purposefully withheld so as to allow others the joy of discovery," Rene-Descartes (1595-1650) said at the end of his book La geometric, as cited by Max (1988).

Limited class time; extensive preparation time; the possible difficulty of implementing active learning in big classes; a shortage of materials, types of equipment, or resources; and, perhaps most importantly, the possibility that students will not engage. However, these challenges may be conquered with forethought and organisation. Most of these issues will also diminish with time if the instructor employs the activity-based approach.

CONCLUSION

When students are involved in the class, they learn the material and remember it better. Instead of relying on the "telling technique," teachers can use tactics that encourage student participation. Students need to be actively engaged in the learning process, thus it's crucial to have their input as they construct mathematical ideas.

We must "move the focus from teaching to learning, from our world to the children's word," as Dienes, who was mentioned in Briggs (1968), put it. Primarily, we need to provide kids chances to use their own judgment so that they may approach learning as a dynamic and imaginative venture. Our primary goal in mathematics education should be to equip students with the ability to reason for themselves, an appreciation for the order and pattern that is fundamental to mathematics (and evident not just in the constructed but also in the natural world), and the necessary skills.

As a rule, educators have a responsibility to ensure that their pupils have access to state-of-the-art resources. Teachers in such an environment will be able to monitor and organise lessons based on students' experiences and discoveries. As a result, mathematics is no longer lifeless and abstract, but rather exciting and engaging. If we were to use more active learning

practises in our mathematics classrooms, our students' mathematical performance would rise, and the goals of mathematics education would be more likely to be met.

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