EFFECTS OF TEACHING 2 AND 3 DIMENSIONAL SHAPES, USING COOPERATIVE LEARNING APPROACH

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Abstract
The role of mathematics in everyday-living can never be over-emphasized, there is a need to always teach it in a way learners will understand it very well. A very good knowledge of 2 and 3 dimensional shapes will definitely yield a very good performance in the study of geometry and mathematics at higher education level, hence sustenance in science, mathematics and technology education (STME). Cooperative learning strategy addresses both academic and social abilities in pupils. Cooperative learning strategy helps pupils to build new skills, since there is room for individual accountability in the strategy. Generally, a shape can be defined as the form something has. 2 and 3 dimensional shapes have 2 and 3 dimensions respectively. Despite the good records of cooperative learning strategy, mathematics teachers avoid the use of the method in the teaching of mathematics, hence an increasing poor performance of pupils in mathematics. It is as a result of this background that this paper tends to awaken mathematics teachers on this better way to teach 2 and 3 dimensional shapes. To improve on the results of achievement in teaching the concept of 2 and 3 dimensional shapes, this paper focused its objectives on using cooperative learning approach for effective teaching of the concept. Benefits of cooperative learning strategy in teaching 2 and 3 dimensional shapes were also highlighted in the paper.

Introduction

Mathematics has become a celebrated key to knowledge, servant and midwife to science (Abimbola *et al.*, 2014). Badmus (1989) asserted that there could be no real development in science and technology without a corresponding development in mathematics. The depressed state of mathematics education in Nigeria calls for concern of all the stakeholders. No nation can develop scientifically and technologically if it neglects mathematics (Tukur & Abimbola, 2013). Despite the role of mathematics in science, technology and national development, its study has not met the need of national development. Pupils' performance in both internal and external examinations has not been encouraging. Researchers have offered many reasons for the pupils' poor achievement in mathematics. Some of the reasons includes; pupils' lack of interest, negative attitude of the pupils towards the subject, lack of qualified mathematics teachers, wrong teaching methods and teaching without teaching aids. Galadima and Yusha'u (2007) highlighted that instructional materials are not used in teaching mathematics despite the establishment of the effectiveness of using it in teaching mathematics. Studies of Harbor-Peters (1991) and Ihejieto (1993) pointed at teaching approaches and strategies used in the classroom by the mathematics teachers as one of the root causes of the undesirable poor performance of the pupils in mathematics. Series of teaching approaches were discovered by researchers, yet a lot is still left

to be achieved. Teachers have failed to use these approaches due to lack of funds. This paper focus its objectives on cooperative learning approach for effective teaching the concept, however, the following are emphasized on:

1. Types of cooperative learning
2. Components of cooperative learning
3. Basic elements of Cooperative learning
4. Application of cooperative learning in teaching 2 and 3 dimensional shapes
5. Benefits of cooperative learning strategy

Types of Cooperative Learning

Formal Cooperative Learning

Formal cooperative learning consists of pupils working together, for one class period to several weeks, to achieve shared learning goals and complete jointly specific tasks and assignments (John & Johnson, 1986). In formal cooperative learning groups, the teachers' role includes:

1. Making pre-instructional decisions. Teachers (a) formulate both academic and social skills objectives, (b) decide on the size of groups, (c) choose a method for assigning pupils to groups, (d) decide which roles to assign group members, (e) arrange the room, and (f) arrange the materials pupils need to complete the assignment. In these pre-instructional decisions, the social skills objectives specify the interpersonal and small group skills pupils are to learn. By assigning pupils roles, role interdependence is established. The way in which materials are distributed can create resource interdependence. The arrangement of the room can create environmental interdepen-dence and provide the teacher with easy access to observe each group, which increases individual accountability and provides data for group processing.
2. Explaining the instructional task and cooperative structure. Teachers (a) explain the academic assignment to pupils, (b) explain the criteria for success, (c) structure positive interdependence, (d) structure individual accountability, (e) explain the behaviors (i.e., social skills) pupils are expected to use, and (f) emphasize intergroup cooperation (this eliminates the possibility of competition among pupils and extends positive goal interdependence to the class as a whole). Teachers may also teach the concepts and strategies required to complete the assignment. By explaining the social skills emphasized in the lesson, teachers operationalize (a) the social skill objectives of the lesson and (b) the interaction patterns (such as oral rehearsal and jointly building conceptual frameworks) teachers wish to create.
3. Monitoring pupils' learning and intervening to provide assistance. Teachers help in (a) completing the task successfully or (b) using the targeted interpersonal and group skills effectively. While conducting the lesson, teachers monitor each learning group and intervene when needed to improve task work and teamwork. Monitoring the learning groups creates individual accountability; whenever a teacher observes a group, members tend to feel accountable to be constructive members. In addition, teachers collect specific data on promotive interaction, the use of targeted social skills, and the engagement in the desired interaction patterns. This data is used to intervene in groups and to guide group processing.
4. Assessing pupils' learning and helping pupils process how well their groups functions. Teachers (a) bring closure to the lesson, (b) assess and evaluate the quality and quantity of pupils' achievement, (c) ensure pupils carefully discuss how effectively they worked

together (i.e., process the effectiveness of their learning groups), (d) have pupils make a plan for improvement, and (e) have pupils celebrate the hard work of group members. The assessment of pupil achievement highlights individual and group accountability (i.e., how well each pupil performed) and indicates whether the group achieved its goals (i.e., focusing on positive goal interdependence). The group celebration is a form of reward interdependence. The feedback received during group processing is aimed at improving the use of social skills and is a form of individual accountability. Discussing the processes the group used to function, furthermore, emphasizes the continuous improvement of promotive interaction and the patterns of interaction needed to maximize pupils' learning and retention.

Informal Cooperative Learning

Informal cooperative learning consists of having pupils work together to achieve a joint learning goal in temporary, ad-hoc groups that last from a few minutes to one class period (Aburime, 2007). During a lecture, demonstration, or film, informal cooperative learning can be used to focus pupils' attention on the material to be learned, set a mood conducive to learning, help set expectations as to what will be covered in a class session, ensure that pupils cognitively process and rehearse the material being taught, summarize what was learnt, and provide closure to an instructional session. The teacher's role for using informal cooperative learning to keep pupils more actively engaged intellectually entails having focused discussions before and after the lesson (i.e., bookends) and interspersing pair discussions throughout the lesson. Two important aspects of using informal cooperative learning groups are to (a) make the task and the instructions explicit and precise and (b) require the groups to produce a specific product (such as a written answer). The procedure is as follows.

1. Introductory Focused Discussion: Teachers assign pupils to pairs or triads and explain (a) the task of answering the questions in a four to five minute time period and (b) the positive goal interdependence of reaching consensus. The discussion task is aimed at promoting advance organization of what the pupils know about the topic to be presented and establishing expectations about what the lecture will cover. Individual accountability is ensured by the small size of the group. A basic interaction pattern of eliciting oral rehearsal, higher-level reasoning, and consensus building is required.
2. Intermittent Focused Discussions: Teachers divide the lecture into 10 to 15 minute segments. This is about the length of time a motivated adult can concentrate on information being presented. After each segment, pupils are asked to turn to the person next to them and work cooperatively in answering a question (specific enough so that pupils can answer it in about three minutes) that requires pupils to cognitively process the material just presented. The procedure is:
    a. Each pupil formulates his or her answer.
    b. Pupils share their answer with their partner.
    c. Pupils listen carefully to their partner's answer.
    d. The pairs create a new answer that is superior to each member's initial formulation by integrating the two answers, building on each other's thoughts, and synthesizing.

    The question may require pupils to:
    a. Summarize the material just presented.
    b. Give a reaction to the theory, concepts, or information presented.

c. Predict what is going to be presented next; hypothesize.
d. Solve a problem.
e. Relate material to past learning and integrate it into conceptual frameworks.
f. Resolve conceptual conflict created by presentation.

Teachers should ensure that pupils are seeking to reach an agreement on the answers to the questions (i.e., ensure positive goal interdependence is established), not just share their ideas with each other. Randomly choose two or three pupils to give 30 second summaries of their discussions. Such individual accountability ensures that the pairs take the tasks seriously and check each other to ensure that both are prepared to answer. Periodically, the teacher should structure a discussion of how effectively the pairs are working together (i.e., group processing). Group celebrations add reward interdependence to the pairs.

3. Closure Focused Discussion: Teachers give pupils an ending discussion task lasting four to five minutes. The task requires pupils to summarize what they have learned from the lecture and integrate it into existing conceptual frameworks. The task may also point pupils toward what the homework will cover or what will be presented in the next class session. This provides closure to the lecture.

Informal cooperative learning ensures pupils are actively involved in understanding what is being presented. It also provides time for teachers to move around the class listening to what pupils are saying. Listening to student discussions can give instructors direction and insight into how well pupils understand the concepts and material being as well as increase the individual accountability of participating in the discussions.

Cooperative Base Groups

Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership (Salman, 2006). Members' primary responsibilities are to (a) ensure all members are making good academic progress (i.e., positive goal interdependence) (b) hold each other accountable for striving to learn (i.e., individual accountability), and (c) provide each other with support, encouragement, and assistance in completing assignments (i.e., promotive interaction). In order to ensure the base groups function effectively, periodically teachers should teach needed social skills and have the groups process how effectively they are functioning. Typically, cooperative base groups are heterogeneous in membership (especially in terms of achievement motivation and task orientation), meet regularly (for example, daily or biweekly), and last for the duration of the class (a semester or year) or preferably for several years. The agenda of the base group can include academic support tasks (such as ensuring all members have completed their homework and understand it or editing each other's essays), personal support tasks (such as getting to know each other and helping each other solve nonacademic problems), routine tasks (such as taking attendance), and assessment tasks (such as checking each other's understanding of the answers to test questions when the test is first taken individually and then retaken in the base group).

The teacher's role in using cooperative base groups is to (a) form heterogeneous groups of four (or three), (b) schedule a time when they will regularly meet (such as beginning and end of each class session or the beginning and end of each week), (c) create specific agendas with concrete tasks that provide a routine for base groups to follow when they meet, (d) ensure the five basic elements of effective cooperative groups are implemented, and (e) have pupils periodically process the effectiveness of their base groups.

The longer a cooperative group exists, the more caring their relationships will tend to be, the greater the social support they will provide for each other, the more committed they will be to each other's success, and the more influence members will have over each other. Permanent cooperative base groups provide the arena in which caring and committed relationships can be created that provide the social support needed to improve attendance, personalize the educational experience, increase achievement, and improve the quality of school life.

Integrated Use Of All Three Types Of Cooperative Learning

These three types of cooperative learning may be used together (John, & Johnson, 1986). A typical class session may begin with a base group meeting, which is followed by a short lecture in which informal cooperative learning is used. The lecture is followed by a formal cooperative learning lesson. Near the end of the class session another short lecture may be delivered with the use of informal cooperative learning. The class ends with a base group meeting.

Components of Cooperative Learning Strategy

There are basically three major components of cooperative learning strategy. These include:

a. Lesson Preparation

The teacher needs to do the following during the preparation of the lesson:

1. Select the collaborative objectives to target for instruction and cooperative learning groups.
2. Plan the activity.
3. Identify ways to promote the element of cooperative learning.
4. Identify roles of individuals and groups.
5. Establish groups.

b. Lesson Instruction

This talks of the time in which cooperative learning occur. Pupils should engage in it after they have received instructions on the 2 and 3 dimensional shapes, collaborative skills and targeted objectives for the group activity. Lack of direct instructions will necessitate a lot of questions from the pupils. It will be good to note that lesson instruction consists of direct instruction and the cooperative learning activity.

c. Lesson Evaluation

The purpose of lesson evaluation in cooperative learning strategy is to assess pupils' mastery of the objectives of teaching 2 and 3 dimensional shapes and the group's ability to work collaboratively. Such evaluation can be conducted by the following:

1. Observing pupils during the cooperation learning activity.
2. Having pupils completing individual tasks, following cooperative learning activities.
3. Asking pupils to engage in group processing (self evaluation), that is called group processing.

Basic elements of cooperative learning

Positive interdependence

This means the group has a clear task or goal so everyone knows they sink or swim together. The efforts of each person benefit not only the individual, but also everyone else in the group. The key to positive interdependence is committing to personal success as well as the success of every member of the group.

Ways to Ensure Positive Interdependence:
- The group has only one pencil, paper, book, or other resource.
- One paper is written by the group.
- A task is divided into jobs and can't be finished unless all help.
- Pass one paper around the group on which each member must write a section.
- Each person learns a topic and then teaches it to the group (Jigsaw method).
- Offer a reward (e.g. bonus points) if everyone in the group succeeds.

Individual and group accountability
The group is accountable for achieving its goals, and each member must be accountable for contributing a fair share of the work toward the group goal. No one can "hitchhike" on the work of others. The performance of each individual must be assessed and the results given back to the group.

Ways to Ensure Individual and Group Accountability:
- Pupils do the work before bringing it to the group.
- One pupil is chosen at random and questioned on the material the group has studied.
- Everyone writes a paper; the group certifies the accuracy of all their papers; the instructor chooses only one paper to grade.
- Pupils receive bonus points if all do well individually.
- Instructor observes pupils taking turns orally rehearsing information.

Interpersonal and small group skills.
Interpersonal and small group skills are required to function as part of a group. These are basic teamwork skills. Group members must know how to – and be motivated to – provide effective leadership, make decisions, build trust, communicate, and manage conflict.

Ways to Ensure Interpersonal and Small Group Skills:
- Be on time for group meetings and start them on time.
- Listen to others. Don't be so busy rehearsing what you are going to say that you miss other group members' points and ideas.
- Don't close the road to mutual learning by interrupting or using language that can be regarded as a personal attack.
- Make sure everyone has the opportunity to speak.
- Don't suppress conflict, but do control and discipline it.

Face-to-face promotive interaction
This means that pupils promote each other's success by sharing resources. They help, support, encourage, and praise each other's efforts to learn. Both academic and personal support are part of this mutual goal.

Ways to Ensure Face-to-Face Promotive Interaction
- A student orally explains how to solve a problem.

- One group member discusses a concept with others.
- A group member teaches classmates about a topic.
- Pupils help each other connect present and past learning.

Group processing

Group members need to feel free to communicate openly with each other to express concerns as well as to celebrate accomplishments. They should discuss how well they are achieving their goals and maintaining effective working relationships.

Ways to Ensure Group Processing:

- Group members describe each other's helpful and unhelpful behaviors and actions.
- As a group, make decisions about which behaviors to continue and which behaviors to change.

Application of Cooperative Learning Strategy in Teaching 2 and 3 Dimensional Shapes

What is a shape? According to Longman dictionary of contemporary English (2005), a shape is the form that something has. A Two – dimensional shape is a shape that has two dimensions; length and breadth. It is also called a plane shape. Examples of Two – dimensional shapes includes Triangle, Circle, Square, Rectangle etc. A Three –dimensional shape is a shape that has three dimensions; length, breadth and height. It is also called a solid shape. Examples of solid shapes include Cube, Cuboid, Sphere, Cylinder etc. A very good knowledge of 2 and 3 dimensional shapes will in no doubt help in the learning of geometry. Hence, there is a need for a very effective method in teaching the concept. In the teaching of this concept, using the aforementioned strategy, the researcher employed the informal learning strategy. The teacher is expected to divide the pupils into groups of 4 or 5 each. The pupils are provided with cardboard papers, scissors, ruler and cello tape. For 3 dimensional shapes, the teacher is expected to draw the net of each shape on the board so that the pupils can know what to cut. Each group is giving a task of making some 2 dimensional shapes and 3 dimensional shapes. The essence of the pupils making the shapes is for them to be very familiar with the shapes. Cutting out the nets and making the shapes will help the pupils in the retention of the shapes. Each member of the team is responsible for learning what is taught and helping teammates learn, thus creating an atmosphere of achievement. Results on record include improved academic achievement, improved behavior and attendance, increased self-confidence and motivation, and increased liking of school and classmates. Making of the 2 and 3 dimensional shapes by the pupils will help the pupils in the retention of the shapes and their properties. When there is retention, the pupils can remember how each shape looks like at any time and answer any question on any of the shapes anytime, anywhere. Teaching of 2 and 3 dimensions is not complete without talking of the properties. Here, the pupils can easily identify the properties of the shapes. The pupils have a better understanding of the perimeter of a shape, radius of a circle, diameter of a circle, total surface are of a shape, volume of a shape etc. Cooperative learning is also relatively easy to implement and is in-expensive.it is not enough to tell the pupils the properties of the shapes. It is also not enough to bring the shapes to the class and start showing the pupils the properties of the shapes. It makes a very good sense if the pupils work to the properties of the shape.

Benefits of Cooperative Learning Strategy

1. Cooperative efforts result in members in a group gaining from each others' efforts thereby giving room for challenges. Those lacking communication skills tend to struggle to meet up with those gifted in oral communication.
2. Cooperative learning is a way of providing pupils with a well defined framework to learn from each other. It is a team work where the success of the group depends upon everyone making effort. Hence, your success benefits me and my success benefits you.
3. It is said that practice makes perfect, ability for pupils to carry out group assignment regularly gives room for regular revision and this helps the pupils' retention ability.
4. Cooperative learning helps the pupils in discovering new skills since there is room for individual accountability in this strategy.
5. Group members share various roles and are interdependence in achieving the group learning goals while the academic task is of primary importance. To be able to achieve this common goal, there is need for respect of individual views so as to achieve positive results.

Conclusion

Knowledge of 2 and 3 dimensional shapes can never be over-emphasized when talking of geometry. To simplify the teaching and learning of the concept of 2 and 3 dimensional shapes, cooperative learning approaches did it in a systematic and positive manner, supplementing textbooks instruction by providing the atmosphere for practicing mathematical skills and concepts, using mathematical language to discuss concepts, making connections with other skills and discipline and enabling the teacher to write lesson notes in this model. The pupils easily identifies the properties of the shapes. The pupils have a very good understanding of the area, perimeter, surface are, volume, and other geometries.

References

Abimbola, N. G. A & Halima, M. A. (2013). Examination malpractice: a factor militating against better performance of pupils in mathematics in Nigeria. *Fane-Fane International Multidisciplinary Journal,* 1(1): 77-84.

Abimbola, N. G. A, Ibrahim, M. A., Ali, A. & Usman, A. (2014). An investigation of the reliability of Senior Secondary School certificate examination (SSCE) results in Gombe metropolis, Gombe state, Nigeria. *Journal of Education and Practice*, 5(28), 145-151.

Aburime. F.E. (2007). Challenges of Universal Basic Education: A Quasi-Experimental study of the role of Manipulatives. Abacus. *The Journal Mathematical Association of Nigeria*, 32(1), 135.

Badmus, G. A. (1989). Trends in preparation of Mathematics Teachers for post primary Institutions in Nigeria; A Response-Evaluation. Abacus: *The Journal Mathematical Association of Nigeria,* 10 (1), 88-89.

Galadima, I. and Yusha'u, M. A. (2007). An investigation into Mathematics Performance of Senior Secondary School Students in Sokoto State. *Abacus: The Journal Mathematical Association of Nigeria*, 32 (1), 24-33.

Harbor-Peters, V. F. (1991). The Target Task and Formal Method of Presenting Some Secondary School Geometric Concept: Their Effects on Retentions, *Journal of Studies in Curriculum* 1(1), 93-97.

Ihejieto, D. O. (1993). Parallelism in Performance and the Multi factor Perspective to the Instructional Process. *Abacus: Journal of Mathematical Association of Nigeria*, 23(1), 28-36.

John, D. W. and Johnson, R. T. (1986). Main Streaming and Cooperative Learning Strategies. *Journal of Exceptional Children,* 52 (6), 553-561.

Salman, M.F. (2006). Teachers as a factor in the implementation of the Universal Basic Education Mathematical curricula. The proceeding of the 43rd Annual National Conference of the Mathematical Association of Nigeria, pp. 145-150.

Tukur, M. Y. & Abimbola, N. G. A. (2013). Factors influencing effective learning of Mathematics at senior secondary schools within Gombe metropolis, Gombe state. *Journal of Education and Practice*, 4 (25), 61-66.