	<p style="text-align: center;">PEDAGOGY OF LEARNING International Refereed/ Peer Reviewed Journal of Education Vol. 7 (4) October 2021, 21-29, E-ISSN: 2395-7344, P-ISSN: 2320-9526 <i>Abstracted and indexed in:</i> Google Scholar, Research Bib, International Scientific Indexing (ISI), Scientific Indexing Services (SIS), WorldCat, Cite Factor, Impact Factor: 0.787(GIF) Website: http://pedagogyoflearning.com</p>
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Recommended citation for this Article:

Beura, M.K., Barik, P.K. and Nayak, S.K. (2021). Effectiveness of constructivist approach in teaching mensuration at secondary school level- a quasi experimental study. *Pedagogy of Learning*, 7 (4), 21-29. Available at: <http://pedagogyoflearning.com>. DOI: 10.46704/pol.2021.v07i04.003

Effectiveness of Constructivist Approach in Teaching Mensuration at Secondary School Level- A Quasi Experimental Study

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Article DOI: [10.46704/pol.2021.v07i04.003](https://doi.org/10.46704/pol.2021.v07i04.003)

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Article Publication Date: 30 October 2021

ABSTRACT

Constructivist learning is comprised of learner's active involvement in problem solving and critically analyzing the learning activity. This study has been carried out through 5Es model by adoption of quasi experimental design and intended to determine the effectiveness of constructivist approach through Mensuration Achievement Test (MAT). The results showed that teaching through constructivist approach affect positively the achievement of learners and they showed greater interest and motivation during the experiment. It is evident that constructivist approach is more effective and appropriate method of teaching learning and it also increases intelligence and creativity ability among the students.

Keywords: Constructivist Approach, Mensuration Achievement Test (MAT), 5E's Model.

BACKGROUND OF THE STUDY

Constructivist approach is based on constructivism; it means, "to construct" where the learner constructs their own knowledge rather than simply cramming the concept. In this approach various models of constructivism are effectively used in the field of education such as 5Es, 7Es, ICON Model, Cooperative and Collaborative approach, Self-study and Peer study, problem solving and activity based approach etc. that effectively explores the cognitive operations of the learner. The most recognized contributors within this field are Piaget, Ausubel, Vygotsky and Bruner etc. It is broadly

two types: cognitive constructivism (coined by Jean Piaget) and social constructivism (coined by Lev Vygotsky). Learning is easier in assimilation than accommodation which is the key psychological principle behind the constructivism approach (Jean Piaget, 1973) and Lev Vygotsky strongly believed that social interactions have an active role in shaping individual's development and learning. Through constructivist approach the learner constructs or modifies their existing knowledge so the learner retains it for a longer time in a concrete manner. During this kind learning learners active involvement and participation make more interest and enjoyable the concept. Knowledge is more permanent in practice than precept (Chowdhury, 2016). In the traditional classroom the students' role is passive one and they have a limited scope to explore their cognitive abilities whereas in a constructive classroom environment learner has more freedom to think analytically, critically and work collaboratively. Constructivism approach is an innovative instructional design focusing to develop the cognitive processing and creative aspect of the learner for maximum teaching learning output. National Curriculum Framework (2005) also given emphasis on implementation and adoption of constructivist approach which stresses upon own knowledge construction, structuring and restructuring the raw ideas into a meaningful learning experience. This involves active participation, real time engagement, joyful learning and social built up in a cooperative and collaborative way.

The subject Mensuration first time coined in Egypt. As like other allied subject of Mathematics such as Geometry, Arithmetic, Construction, Trigonometry, Mensuration is also another branch of Mathematics. Mensuration in its literal meaning is to measure which includes all geometrical shapes, their volumes, areas, and parameters. In mensuration the learners use different geometrical figures and derive their solutions through analysis of various physical quantities i.e. length, breadth, area, volume etc. Generally, mensuration has two sections,

- 1) Plane Mensuration- It includes sides, perimeters and areas of plane, shape of different figures e.g. Triangles, Pentagon, Rectangle etc.
- 2) Solid Mensuration- It is highly used in the field of Engineering & Architecture. It includes the areas & volume of solid objects (cube, sphere, cone, cylinder etc.)

Various studies have been undertaken in the form of constructivist approach with various disciplines like mathematics, science etc. in this section the researchers critically analysed these studies in the form of their findings to know whether constructivism approach affect learners learning style, their cognitive abilities and their academic achievement. Turan & Matteson (2021) highlighted that the mathematics teacher's faces various challenges such as when they shift from teacher centered to student centered during teaching learning process So the middle school teachers are using 5E model of constructivist approach with greater devotion because it has been proved from various studies that teaching through constructivist approach (5E model) gives better results in comparison to traditional approach. This approach not only improves students' abilities but it also provides professional development of teachers in lesson construction. Rathod (2019) revealed that the adoption of constructivist approach of teaching results in development of understanding and application level of learners in mathematic. Students show high level interest during the constructivist way of teaching learning classroom. Vintere (2018) highlighted that the process of teaching mathematics in a adopting constructivist approach has been directly linking to the daily life of learners and enhancing their competency in solving the abstract knowledge of mathematics in a more creative way. Adak (2017) revealed that by adopting constructivist approach strategy the learner improved in mastery over the content. It acts as an effective tool having a great impact on scientific content knowledge construction at the higher order levels of cognition. In contrast to traditional method of instruction, learners perform better when they taught through constructivist method. Constructivist approach of teaching found to be very effective and useful in achieving high scores among all intelligence level of learners. Kameda (2017) explored that the introduction of constructivist pedagogy is a critical component in mathematical education. It fosters in promotes students cantered learning environment. It demonstrates the theoretical concepts in to a realistic manner. Constructivist approach develops a

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International Refereed/ Peer Reviewed Journal of Education

Vol. 7 (4), October 2021 (E-ISSN: 2395-7344, P-ISSN: 2320-9526), Impact Factor: 0.787(GIF)

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learning culture, which also influence students collaboration and cooperation activity in the classroom situations. Maheshwari & Thomas (2017) reported that students displayed high achievement and greater motivational level when they were treated with constructivist method of teaching in comparison to the traditional methods in business statistics. Chowdhury (2016) professed that both the male and female students who were taught through constructivist approach perform better as compared to the students who are taught traditional method mathematics subject. Constructivist ways of learning also improves the overall understanding and application skills of the learners. Galia (2016) identified that constructivist based approach is more effective than lecture method. And he suggested utilizing constructivist based approach in other mathematics related subject. According to Inan (2013) through constructivist learning approach the learner maintain the knowledge for long-term as compared to traditional approach and it helped to develop favorable attitude towards mathematics. Folasade and Akinyemi (2009) found that gender factor has no role in constructivist learning approach and both male and female learners achievement level increased by adoption of this type of learning approach in comparing to the traditional methods. After the critical analysis of several studies on constructivist approach the researchers supported the results that it positively affects learners' achievement, interest, motivation, creativity, intelligence and acquainting them to work collaboratively and cooperatively with their peer groups this results creating curious among the investigators to conduct experiment.

RATIONALE OF THE STUDY

Cognitive learning theory has been emerged with a paradigm shift from traditional behaviorism theory of learning, where the main aim is directly modifying the cognitive structure and functions of human mind (Anderson, 2005). The cognitive aspect of the learner is greatly influenced by the constructivist teaching approach and it also contribute in high scholastic achievement (Aydisheh & Gharibi, 2015). NCF (2005) recommended to shift paradigm from teacher centered to learner centered as learner's rote learning to learning by experience. Constructivist approaches are widely used in teaching learning system by adopting various models like 5E, 7E, cooperative & collaborative approaches etc. in various field such as Science, English, History, Commerce, Business statistics in various age or grade level with improving learners academic achievement and learners also show high level of interest during the constructivist way of teaching learning environment. 5E's model of teaching in mathematics is showing positive results or outcomes and it also strengthen learner's achievement in counterpart of traditional approach (Shashi & Jubilee, 2019; Turan & Matteson 2021). Likewise, the other field constructivist approach also adopted in the field of mathematics and its different allied subjects like algebra, geometry etc. Mensuration is also another branch of Mathematics which includes all geometrical shapes, their volumes, areas, and parameters. After the critical analysis of the various studies the researchers professed that there is no or less studies have been carried out in the field of mensuration at secondary school level. Secondary education stage is a very crucial stage in which the child finds themselves in the adolescence period of stress and strain. In this stage the child tries to perform maximum exercise of their cognitive operations to deal with the abstract problem. In this context the investigators influenced to conduct experiment on effectiveness of constructivist approach among the secondary school students to envisage whether the constructivist approach affect their achievement in mensuration.

Objectives of the Study

The objectives of the present study were

1. To find out the difference between experimental group and control group on their achievement in mensuration before intervention at secondary school level.
2. To find out the effectiveness of constructivist approach on the student's achievement in mensuration after intervention at secondary school level.

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- To find out the effectiveness of constructivist approach on the students' achievement in mensuration in relation to gender.

Hypotheses of the Study

The hypotheses developed for the present study were:

H₀₁ - There is no significant difference between experimental group and control group on their achievement before intervention in Mensuration at secondary school level.

H₀₂- The constructivist approach has a positive effect on the achievement of secondary school students in Mensuration.

H₀₃- There is no significant difference between boys and girls of secondary school students' achievement in Mensuration after teaching through constructive approach.

METHODOLOGY

Research Design

The present study carried out with non-equivalent pre-test and post-test design. At the beginning of the experiment both the groups undergo with pre-test on mensuration achievement to assess the achievement levels. The whole classroom was categorised into two groups i.e. experimental group and controlled group randomly in the light of adoption of quasi experimental design.

Category	Pre-test	Independent variables	Post-test
Experimental group	T ₁	5E Teaching Model	T ₂
Control group	T ₁	Traditional method of teaching	T ₂

Population and Sample

For the purpose of the study, the investigators had taken the Purposive sampling technique of Non-probability sampling method by choosing Ravenshaw Collegiate School, Cuttack. For the present study the population consisted of the Cuttack district, R.C. School, (affiliated to Board of Secondary Education (B.S.E), Odisha) a government Odia medium school students for the experiment. The total sample of the study was 58 from class IX, out of which 28 students' were in experimental group (E) and 30 students' in control group (C) in a random manner. Distribution of samples as follows;

Group	Total number of students (N)	Number of boys	Number of girls
Experimental group (E)	28	15	13
Control group (C)	30	16	14

Tools

For the present study, the researchers adopted two types of tools;

Instructional tools: It was the unit wise lesson plans based on the 5E's instructional model of teaching having five dimensions namely: engage, explore, explain, elaborate & evaluate. It also includes the TLMs (charts, models, blocks, etc.)

Measuring tool: It was the teacher made achievement test carrying MCQ type questions.

Procedure of Data Collection

The following procedure was adopted by the researcher. It consists of three phases i.e.

Pre-experimental phase

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Here the experimenter had selected the purposive sampling and selected the R.C. School, Cuttack. The researcher developed lesson plan on mensuration of class IX in two methods (5E's and Traditional).

Experimental phase

After the pretest the two groups were treated with different teaching approach. The control group subjected with traditional method and the experimental group exposed with the 5E's instructional model.

Post – Experimental phase

After the instruction, post-test was administered on both the group. A comparison was made to find out the effect of 5E's instructional model.

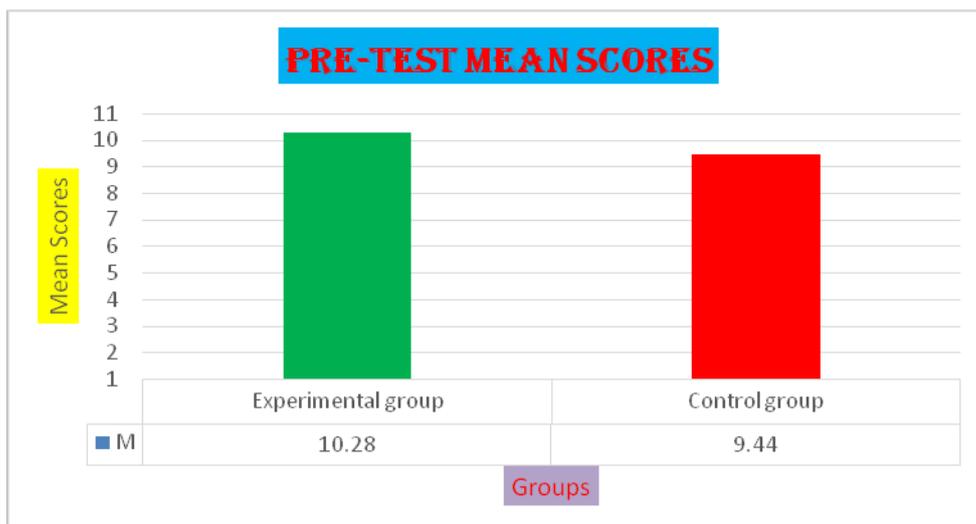
RESULTS AND DISCUSSION

To find out the entry level (pre-test) scores of experimental group and control group on students' achievement in mensuration before intervention.

Table-01: Pre-test Scores of Experimental Group and Control Group

Group	Number of students(N)	M	SD	SE _D	df	T	Level of Significance
Experimental group	28	10.28	13.591	3.591	56	0.472	P< 2.01 Not-significant At 0.01 level.
Control group	30	9.44	13.757				

From the table no-01 it is clearly understood that the calculated “t” value (0.472) is less than the criterion “t” value (2.01) at 0.05 level of significance for df 56. The mean scores of achievement test in mensuration of the experimental group and control group were (10.28) and (9.44) respectively which expressed that the calculated t-value (0.472) is not significant at 0.01 level of significance with df 56 so, there is no significant difference between experimental group and control group on their achievement in Mensuration before intervention at secondary school level. It indicates that both the groups were having equal level of knowledge at the start of experiments.



(Figure 01: Pre-test mean scores of Experimental Group and Control Group)

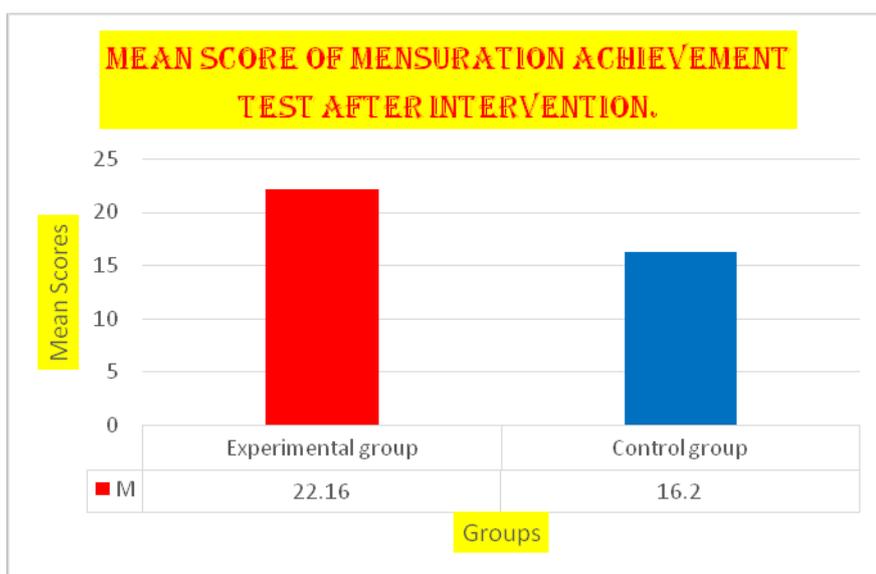
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To find out the constructive approaches' effect on students' achievement, the experimental data were evaluated keeping in view of the overall achievements scores of the learners in various dimensions (knowledge, understanding, application and skill) of Mensuration Achievement Test after intervention are given in Table-02.

Table -02: Post-test Scores of Experimental Group and Control Group

Group	Number of students(N)	M	SD	SE _D	df	t	Level of Significance
Experimental Group	28	22.16	10.303	2.48	56	2.4	P<2.66 Not-Significant At 0.01 level.
Control Group	30	16.2	08.431				

From the Table-02 it is evident that the means of Mensuration Achievement Test scores of the experimental group and control group were (22.16) and (16.2) respectively. It is evident that the acquired t-value (2.4) is bit less than the scheduled 't' value, which is not significant at 0.01 level of significance with df 56, so the hypothesis is retained and it concludes that the students showed better scores after teaching through constructivist approach (experimental group) in contrast to teaching through traditional approach of teaching (control group). The experimental group students displayed high level of interest and motivation during the activities.



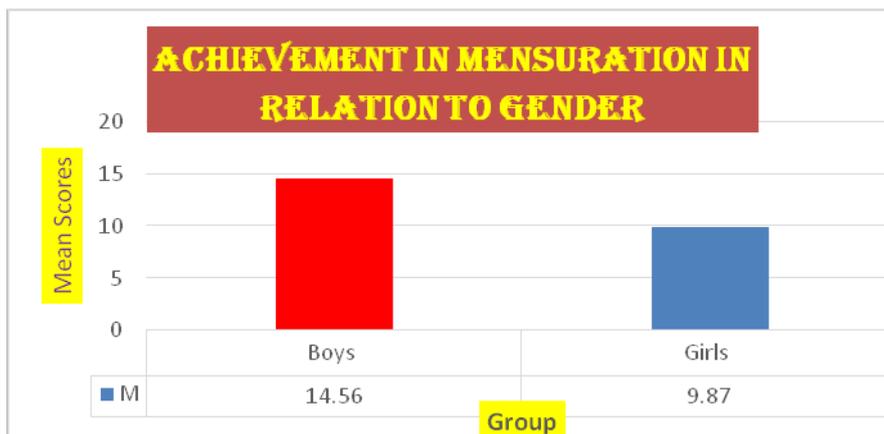
(Figure 02: post-test mean scores of Experimental Group and Control Group)

To find out the constructive approaches' effect on students' achievement in Mensuration in relation to gender, the experimental data were evaluated keeping in view of the overall achievements scores of the learners in various dimensions (knowledge, understanding, application and skill) of Mensuration Achievement Test are given in Table-03.

Table -03: Achievement in Mensuration in relation to gender

Group	Number of students(N)	M	SD	SE _D	Df	t	Level of Significance
Boys	15	14.56	08.96	2.946	26	1.59	P<2.78 Not-significant At 0.01 level.
Girls	13	09.87	06.85				

It is evident from the Table-03, which indicates that the mean difference is found between the boys (14.56) and girls (9.87). It is further indicated that the acquired t-value (1.59) is much less than the scheduled 't' value (2.78), which is not significant at 0.01 level of significance with df 26, so the hypothesis that reads "there is no significant difference between boys and girls of secondary school students achievement in mensuration after teaching through constructive approach" is accepted but from the mean scores comparison it was found that achievement scores of boys in mensuration (14.56) is bit higher than the mean scores of girl students (9.87). It is evident from the mean scores that boys are performed better in comparison to girl students. During the experiment it was observed that the boys are voluntarily participating in the activity with greater enthusiasm in comparison to girls.



(Figure 03: mean scores of Achievement in Mensuration in relation to gender)

MAJOR FINDINGS

From the above analysis and interpretation of the hypotheses, the findings can be comprehended as follows:

- Both the groups have no significant difference on their achievement before intervention in Mensuration at secondary level. It indicates that both the groups were having equal level of knowledge at the initial stage of experiments.
- The experimental group (teaching through constructivist method) showed better academic achievement (Scores obtained in MAT) in Mensuration as compared to control group (teaching through traditional method). Constructivist approach not only improved their academic achievement but also enhanced their creativity and intelligence abilities. The learners showed higher meta-cognition level in respect to their counterparts.
- The gender factor does not have any impact on teaching through constructivist approach. Both the boys and girls showed equal level of interest towards constructivist approach.

EDUCATIONAL IMPLICATIONS

The following educational implications are drawn on the basis of the findings of the present experiment;

- Constructivist approach should be applied for teaching in the classroom of secondary schools different subjects like Mensuration, Mathematics, Sciences and Social sciences for productive learning.
- For the development of mathematical and logical attitude among the learners, 5E or 7E models of constructivism are effective at Secondary School level.

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- c) To enable the secondary school learners as a discoverer, reflective thinker, active participant and to enhance their problem-solving attitude, every teacher should follow the constructivism approach based lesson plan in their classroom teaching.

CONCLUSION

From the above we conclude that constructivist approach is having spectacular insights than traditional approach of teaching. Constructivist approach of learning showed greater effect on cognitive abilities of all levels of learners. During the experiment observed that constructivist approaches not only improve academic achievement of learners but also positively affect their IQ level. The role of constructivist teacher is the facilitator of teaching-learning system. Besides this role the other roles are to encourage and appreciate the students ideas, effective use of cognitive terminology, focus on students- students and student- teachers interactions, nurture students' natural curiosity to elicit new knowledge.

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