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EFFECT OF THE COGNITIVE APPRENTICESHIP APPROACH ON ACADEMIC ACHIEVEMENT OF STUDENTS IN MATHEMATICS AT THE SECONDARY LEVEL

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ABSTRACT:

This study sought to determine the effect of the Cognitive Apprenticeship Approach on academic achievement of students in mathematics at the secondary level. Sample size consisted of 60 students who were equally divided into an experimental group and a control group on the basis of pre-test. After the treatment, post-test was used to see the effects of the treatment. A two-tailed t-test was used to analyze the data, which revealed that both the experimental and control groups were almost equal in mathematics base at the beginning of the experiment. The experimental group outscored the control group significantly on the post-test.

Keywords: Cognitive Apprenticeship Approach, mathematics and achievements

1. Introduction:

According to Hargeaves and Molyes (1998), education, in its true sense, entails activities that are intrinsically important. The acts of teaching, which aim to provide useful knowledge, skills, and understanding, are acts of education. Malik (1992) describes secondary education, as it generally serves a dual purpose, as a terminal stage for a large number of students and as a preparatory stage for higher education for those who wish to continue their education.

Education cannot be made more effective without effective teaching. There are so many devices for effective teaching and an effective technique can ensure effective learning. It is being felt

that there should be new techniques of teaching and learning (Iqbal, 2004). We, like other developing counties, still use lecturing as a major teaching method which, however, needs blending with other methods and approaches. This has been suggested by Grobbelaar (1998) when he reported on the teaching of higher education in South Africa.

2. Review related literature:

1) Yusepa, Kusumah, & Kartasasmita (2018) conducted a research on "Promoting middle school students' abstract-thinking ability through Cognitive Apprenticeship instruction in mathematics learning" The aim of this study was to get an in-depth understanding of students' abstract-thinking ability in mathematics learning. The subjects of this study were eighth-grade students from two junior high schools in Bandung. The experimental group was exposed to Cognitive Apprenticeship Instruction (CAI) treatment, whereas the control group was exposed to conventional learning. The results showed that abstract-thinking ability of students in experimental group was better than that of those in control group in which it could be observed from the overall and school level. The conclusion of the study was CAI could be a good alternative learning model to enhance students' abstract thinking ability.
2) Jayakumary (2017) conducted a study on "The effectiveness of the Cognitive Apprenticeship model on scientific inquiry skills and achievement in Physics among the students of standard nine". The results revealed that Cognitive Apprenticeship model is effective in improving inquiry skills and achievement in Physics.
3) Solitro, Zorzi, , Pasini, & Brondino (2016) conducted a research on "A light application of extreme apprenticeship(XA) in teaching programming to students of mathematics". The outcomes showed a tangible improvement of learning outcomes in students trained with XA compared with the traditional teaching method.
4) Cooper (2015) investigated the "Effects of Cognitive Apprenticeship Based Instructional Coaching on Science Teaching Efficacy Beliefs (STEB)". The results showed that there was significant increase in STEB in the quantitative standards.
5) Saadati , Ahmad Tarmizi , Mohd Ayub , Abu Bakar (2015) conducted the research on "Effect of internet-based Cognitive Apprenticeship model (i-CAM) on statistics learning among postgraduate students". In the study, the investigators utilized an internet- based Cognitive Apprenticeship model in three phases. The results of the study revealed that, the i-CAM was significantly effective in promoting problem solving performance among postgraduate students when compared to conventional mathematics learning model.

3. Objectives:

To find out the effectiveness of the cognitive apprenticeship approach on academic achievement of students in mathematics at the secondary

4. Hypothesis:

1) $H_0$1:There is no significant difference between Pre-Test mean achievement scores of the experimental and control groups
2) $H_0$2:There is no significant difference between Post-Test mean achievement scores of the experimental and control groups

5. Methodology:

All the secondary school students constituted the population of this study. 60 students in 9th grade of the High School of Davangere city consisted of the sample for this study. The pre-test and post-test research instruments were used for this study. These instruments were used for accessing students' performance which would reflect their level of knowledge in mathematics before and after the experiment. The pre-test and post-test equivalent group design was considered to be the most useful for this study. The content validity of tests was insured by preparing chart of specification. The content validity was also checked by correlation coefficients which were found to be 0.5. Reliability of the achievement test was measured by the K-R-20 formula, and each item's scores of achievement tests correlated significantly with total scores, either at 0.01 or 0.05 levels. Test reliability was also calculated by Cronback alpha which was 0.8 for total items.

6. Procedure:

A self-prepared pre-test was administered to sample 60 students. On the basis of achievement scores in the pre-test, the students were assigned to either the experimental group or control group through paired random sampling. Each group consisted of 30 students. Two teachers were selected - one for the experimental group and one for the control group. The control group was taught by Traditional Method while the experimental group was taught by the Cognitive Apprenticeship approach. The experimental group was taught using a series of lesson plans, which include heuristic steps of the Cognitive Apprenticeship approach. This experiment was completed for six consecutive weeks. Immediately after the treatment ended, a self -developed post-test was administered to both the experimental and control groups. Scores obtained by pre-test and post-test were presented in tabular form for the purpose of interpretation. The data analyzed by means, standard deviation and difference of means were computed for each group. Significance of difference between the mean scores of both groups on variable pre-test and post-test scores were tested at 0.05 levels by applying a t-test on the variable of the pre-test achievement in mathematics.

7. Analysis and results:

In order to confirm whether both groups were essentially equal on previous knowledge in mathematics, the statistical technique of t-test was applied, as shown in the following table:

Table 1: Significance of Difference between Pre-Test Mean Achievement Scores of Experimental and Control Groups

Group	N	Mean	S.D	t-value	P
Experiment	30	20.54	8.254	1.154	>0.22 Not significant
Control	30	21.50	9.241		

Table value of t at 0.005 = 2.069 (df=58)

Table-1 shows that the difference between mean achievement scores of the experimental and control groups was found to be statistically non-significant at the 0.05 level. The null hypotheses -1 was therefore to be accepted. Hence, both the groups were found to be equal in pre-test achievement scores.

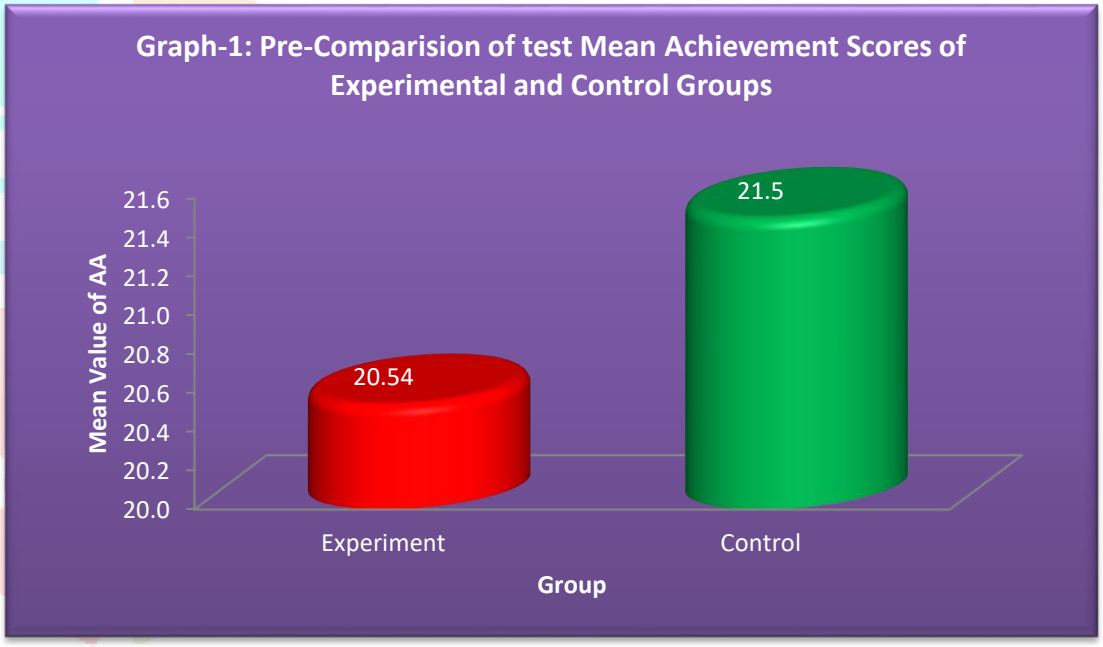
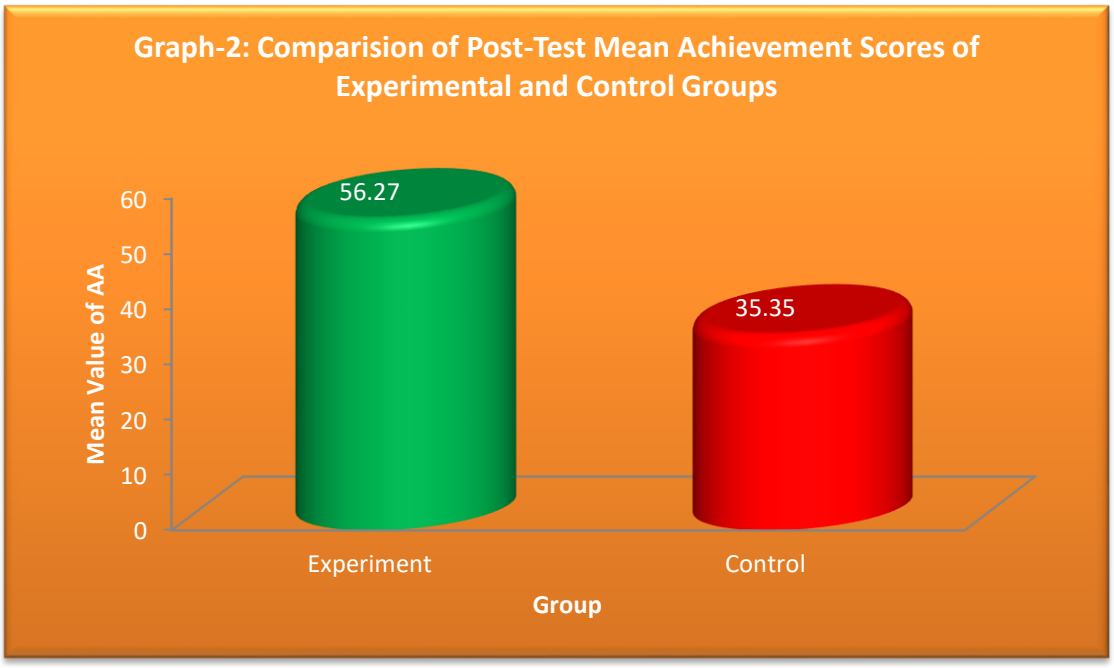


Table -2: Significance of Difference between Post-Test Mean Achievement Scores of Experimental and Control Groups

Group	N	Mean	S.D	t-value	P
Experiment	30	56.27	12.15	12.14	<0.001 Significant
Control	30	35.35	9.36		

Table value of t at 0.005 = 2.069 (df=58)



It appears from Table 2 and graphu-2 that the difference between the two means was found to be highly significant. Null hypothesis-2 is therefore to be rejected. Hence, both groups were found to be different in post-test achievement scores, the difference being highly in favor of the experimental group.

This means that the students taught by the Cognitive Apprenticeship approach showed much better achievement compared to the control group which was taught by the expository strategy. These results support the studies of Yusepa, Kusumah, & Kartasasmita (2018), Jayakumary (2017), Solitro, Zorzi, , Pasini, & Brondino (2016), Cooper (2015) and Saadati , Ahmad Tarmizi , Mohd Ayub , Abu Bakar (2015) that students showed good results if they were taught with the Cognitive Apprenticeship approach.

8. Discussion:

Methods play an important role in teaching. It is a planned and systematic effort of the teacher to establish a sequence in the various parts of teaching. Due to the importance of mathematics in our life, as well as improving the standard of learning mathematics, it is necessary to develop a program of teaching mathematics by Cognitive Apprenticeship approach. The study was aimed at comparing the effectiveness of the traditional method and Cognitive Apprenticeship approach of teaching mathematics at the secondary level.

The results indicate that the Cognitive Apprenticeship approach need not be more time consuming than the traditional method of instruction at this age level. The results of this study strongly suggest that the presentation of mathematical concepts to secondary level pupils through the Cognitive Apprenticeship approach sequence causes the learner to integrate the content conceptually in such a manner that the student can retain it more readily than if the concepts were presented to him in an expository sequence. It is also concluded that both methods of instruction were fairly presented and that no factors operated would tend to give either method a significant advantage.

During the experiment, the researcher noticed that the basic concepts of mathematics were not clear to the students. The foundational stone of cognitive growth and skills takes place in the early years of childhood. Students who are lacking in growth of capabilities and skills would definitely face problems in the next class, as they are not equipped with the base they need.

The teaching approach used with the experimental group was, as a matter of fact, a combination of the traditional method and Cognitive Apprenticeship approach due to the reason that facts, rules, and action sequences (terms, formulas and procedures) had to be explained through exposition before using the heuristics.

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