

# A Study of the Effectiveness of the Self-instructional Material of the Foundation Course in Mathematics

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## ABSTRACT

The present study results reveal that, the developed course content reached the target learners those who do not have mathematics at their formal education and those admissions made through Eligibility Test. Over all out of five criterion tests, the reference group showed better performance on three tests, and the experimental group showed better performance on two tests. It reveals that, the developed course content has the internal validity. Thus it shows that the self-Instructional Course Material in Mathematics is equally effective with that of the Course Material studied by Intermediate students with Mathematics. The performance of the experimental group [post-test scores] in the achievement test in Mathematics was better when compared with pre-test scores of the distance learners taught through Self- Instructional Course Material. Further, the results show that the self-Instructional Course Material in Mathematics is equally effective when the performance of experimental group was compared with that of the reference group i.e. Intermediate students with Mathematics. The study revealed that, the analysis of the data during the course development reveal that, there is no significant difference on the scores of comprehensive and that of combined criterion tests. It shows that the course content as a whole is effective and students' comprehensive level.

**Keywords:** Effectiveness; Self-instructional material; Foundation Course; Mathematics; Distance learner; Open University; Open Distance Learning

## INTRODUCTION:

The formal system of education remained inadequate to meet the increased demand of higher education in the country. Moreover, it invited criticism, that, large amount of money is being spent for higher education and primary education is being neglected. It was also noticed, that, the formal system of university education could not serve the rural India as effectively as it did for urban. In addition to this, a large section of people could not enter the fold of formal education due to its non availability in the locality (rural areas), rigid procedures of time, place, attendance etc. People in job cannot meet formal requirements of the universities. In order meet the requirements of such a clientele, a more flexible channel of education was needed. Initially, though the correspondence Education was introduced in 1962, the distance education emerged as a novel system of education to supplement the formal system

(Kothari 1963). It appeared to be feasible with the advancement of science and technology. It provided big support to the learners who were trying to obtain university degrees privately.

The concept of Open University has emerged to meet the rapidly changing needs of the society. The availability of new technologies has triggered a revolution of knowledge and communication, which hold promise of bridging the gap between distances and deference's. The Open University occupies a unique position in Distance Education because of its autonomous characteristics. The Open University opens door for many who have the capacity to do a particular course, but, do not have the required qualification for admission essential in formal universities and correspondence course. The flexibility provided by the Open University in the selection of courses and in the system of admission has helped many learners to acquire knowledge and skill in the courses of one's own requirements, interest and aptitude (Srivastava 2002).

The idea for the establishment of Open University in India was mooted in 1970. The Ministry of Education and Social Welfare in collaboration with the Ministry of Information and Broadcasting and the U.G.C., New Delhi organized a seminar in December 1970. In the seminar Prof.V.K.R.V. Rao, the then Education Minister said that, "The new interesting programme of instruction, based on modern science oriented educational technology for students of higher education in the Open University should be made available to this much larger body of population which remain outside the so-called university system." Many other participants expressed similar views and the seminar suggested the establishment of Open University. As a result of the suggestions, the Government of India appointed a working group under the chairmanship of Mr.G.Parthasarthy, the then Vice-Chancellor of Jawaharlal Nehru University, Delhi, in 1974, to examine the feasibility of establishing an Open University in India. For the first time in India, the Andhra Pradesh Open University (APOU), which is now known as Dr.B.R.Ambedkar Open University, was established under the state legislature act 25th August 1982 (Kumar 2015).

## PREVIOUS STUDIES:

Research on distance education has been subject to harsh and consistent critique (*Berge and Mrozowski 2001*); (*Bernard et al., 1989*); (*Perraton 2000*); (*Saba 2000*); (*Moore and Thompson 1990*) stated that there is "a massive volume of amateur, unsystematic, and badly designed research producing information of very little value" (p. 36). (*Panda 1992*) analyzed the Indian distance education literature and concluded that "most of the studies are either descriptive status surveys or experimental studies with poor methodological footing". (*Saba 2000*) criticizes the lack of theoretical underpinnings: "Research questions are rarely posed within a theoretical framework or based on its fundamental concepts and constructs". In systematic reviews of distance education and online education conducted over the past three decades, (*Tallent-Runnels et al. 2006*) reviewed research studies from 1993 to 2004 and discovered course environments and learner outcomes, while (*Berge and Mrozowski 2001*) reviewed research studies from 1990 to 1999. (*Zawacki-Richter et al. 2009*) reviewed research studies from 2000 to 2008. Learner traits, engagement, and interaction were determined to be the most researched themes by (*Martin et al. 2020*), which is in line with the conclusions of earlier reviews by (*Berge and Mrozowski 2001*) and (*Zawacki-Richter et al 2009*).

**RESEARCH GAP:**

Much of the research was conducted on instructional material for regular students, design of the studies are programmed text, linear and branching styles, content presented in between horizontal lines. Some studies are on modular approach, some are on teaching machines. Majority of the studies are very similar to Skinner type programmed instruction model. It has been observed that less number of studies were conducted in the development of foundation course in general, and particularly no study was found in mathematics for distance learner of Open University. This was the major research gap, and hence, this problem of developing a foundation course in mathematics to fill this gap.

**SIGNIFICANCE OF THE STUDY:**

The investigator worked as academic consultant in the department of education of BRAOU (Dr. B. R. Ambedkar Open University) and during his tenure he had observed the existing curriculum of the first Open University in India. Foundation course in mathematics was not included in the existing curriculum at first year undergraduate programme of university. May be because of this, students are not getting chance to pursue management and computer science degrees after their graduation. This is the reason for the present study was undertaken. The significance of the present study, the procedure for the development of the course material, and to see its effectiveness.

**STATEMENT OF THE PROBLEM:**

A study of the effectiveness of the self-instructional material of the Foundation Course in Mathematics for distance learners of open university

**OPERATIONAL DEFINITIONS:**

**Effectiveness:** The self-Instructional Course Material in Mathematics is equally effective with that of the Course Material studied by Intermediate students with Mathematics.

**Self-instructional material:** The self-instructional material is the course material developed by the investigator in self-instructional format similar to the format being used in BRAOU.

**Foundation course:** The investigator developed and used foundation course in mathematics to develop the mathematical skills among the students in the first year of undergraduate programme of Dr. B.R. Ambedkar Open University as fifth additional subject along with the existing four foundation courses.

**Distance learner:** The distance learner is the student of first year undergraduate programme who enrolled in undergraduate programme offered by Dr. B.R. Ambedkar Open University either through direct admission (Students with Intermediate qualification with and without mathematics) or admission through Eligible Test (Students with educational qualifications ranging from below SSC, SSC and upto Intermediate failed).

**Open University:** In the present study, the investigator used Open University as the Dr. B. R. Ambedkar Open University.

**OBJECTIVES OF THE STUDY:**

1. To design and develop the self-instructional course material for the foundation course in mathematics for distance learners of Open University.
2. To study the effectiveness in terms of the performance of the distance learners on criterion tests.
3. To prepare final form of the course material based on the results of the validation.
4. To find out the effectiveness of the self-instructional material of the Foundation Course in Mathematics in terms of the performance of the distance learners of Open University on the achievement test in mathematics.

**HYPOTHESES:*****Hypothesis for first and second objectives:***

With reference to the first and second objectives it is expected that the developed course material is at the level of the students.

***Hypotheses for the third and the fourth objectives:***

The following Null hypotheses are formulated on the third and the fourth objectives

1. There is no significant difference between the mean scores of comprehensive test and that of combined criterion tests.
2. There is no significant difference between pre-test and post-test mean scores of students, from both Non-formal stream (below SSC, SSC, Intermediate failed) and formal stream (Intermediate qualified but without Mathematics) taught through Self-Instructional Course Material.
3. There is no significant difference between mean scores of Experimental Group [Students of Non-formal stream (below SSC, SSC, Inter failed), and students of Formal Stream (Intermediate qualified without Mathematics)] and Reference Group [Students of formal stream having Intermediate qualification with Mathematics] in the achievement test in Mathematics.

**RESEARCH DESIGN:**

Research design for the present study would be discussed under two sections. First section deals with the development of course material, and the second section deals with the Experiment to find out the effectiveness of developed course material.

***SECTION – I: DEVELOPMENT OF COURSE MATERIAL***

After reviewing the course design models in open Distance Education at national and international scenario, the investigator adopted the course development procedure followed by IGNOU and BRAOU, because the present course was developed for the first year undergraduate students of BRAOU, The present study is similar to the Instructional Development Learning System (IDLS) and the personalized training model (Gandhi 2009). The course content is presented in linear and semi programmed text style. The investigator had worked in the Dr. B. R. Ambedkar Open University and acted as course coordinator and having experience in writing course material for distance learners. In developing and validation of the present course material, the investigator also kept in mind the other models,

characteristics, components, suggestions which have been practicing in the various Open Distance institutions (Gandhi 2002).

Since the research is mainly involved with the teachers working in Open Universities or Counselors working in study centers of Dr. B. R. Ambedkar Open University, it was thought that a study of their opinions would give an idea of the designing foundation course in mathematics. Hence, a pilot study was conducted as a preliminary to the construction of the Opinionnaire. The opinions of the teachers regarding the nature and scope of the syllabus to be included for the foundation course in mathematics for benefiting the non-formal stream and as well as formal stream students. This study was carried out by the Opinionnaire. Each respondent was asked to give a list of topics to be included for designing foundation course in mathematics. The nature and scope of foundation course in mathematics was collected from the teachers of high schools, Intermediate level, university level and the faculty of mathematics department of mathematics of Dr. B.R. Ambedkar Open University.

The developed course consists of 5 Blocks, in each block 4 units, and each unit have sections and further sections have sub sections. Content outlines of the course “Foundation Course in Mathematics for distance Learners of Open University” have been given below: BLOCK I: Number and Quantity: UNIT 1: Understanding of the Number System; UNIT 2: Playing with Numbers; UNIT 3: Profit and loss, discount; UNIT 4: Time and Distance. BLOCK II: Algebra: UNIT 5: Sets, Relations and Functions; UNIT 6: Expressions and Equations; UNIT 7: Equations and Inequalities; UNIT 8: Polynomials. BLOCK III: Geometry and Trigonometry: UNIT 9: Geometry; UNIT 10: Vector geometry; UNIT 11: Mensuration; UNIT 12: Trigonometry. BLOCK IV: Calculus: UNIT 13: Limits; UNIT 14: Continuity; UNIT 15: Differential Calculus; UNIT 16: Integral Calculus. BLOCK V: Statistics and Probability: UNIT 17: Data, Presentation of data; UNIT 18: Measures of Central tendency, Dispersion; UNIT 19: Permutations & Combinations; UNIT 20: Probability.

### **VALIDATION OF THE COURSE:**

Evaluation of developed learning material for establishing the effectiveness has been considered an integral part of the process of developing such material. Strategies of evaluation adopted in evaluating programmes can be distinguished as internal and external (Hartley 1972). Internal evaluation procedure include study of criterion test scores, analysis of errors on the course content and criterion test items etc. Internal evaluation through such procedures is carried out as a part of the developmental and field testing of the developed material. The main purpose of internal evaluation is to revise the course content and sequence and on the basis of empirical results with a view to improve the effectiveness of the developed learning material. Thus, internal evaluation procedure provide answer to the questions how well does the content teach, what it purports to teach, details of internal evaluation made with regard to the course content developed under the present study have already been discussed in the previous chapter.

External evaluation of developed learning material essentially refers to the validation of the course against an external criterion. The external criterion generally set would be in terms of learning effected by the course some other method of instruction. Thus external evaluation of a course involves experimental comparison of learning effected by presentation of some instruction material through content, and the learning effect by the presentation of the same material through one or more other methods of instruction.

**Try-out :**

The edited course was of tried out on a group of first year under graduate students of Dr. B. R. Ambedkar Open University. These students were chosen randomly from the students admitted into the first year undergraduate program. This try-out would help the investigator for validating the course.

**FINAL FORM OF THE COURSE CONTENT:**

Item wise error analysis of students' performance on criterion tests will be carried out. Appropriate modifications would be made in the course content and content sequence based on the error analysis data.

A complete description of the final form of the course would be after item wise error analysis.

**Title:** Foundation Course in Mathematics for Distance Learners of an Open University.

**Target Population:** First year under graduate students of Dr. B. R. Ambedkar Open University.

**Content:** The course content covers the basic mathematics skills and daily life use of mathematics and connecting to pursue the higher level mathematics in the future career. The present course is for under graduate students of Dr. B.R. Ambedkar Open University. The course divided into five blocks. Further the each blocks divided into four units. The total course consists of five blocks and twenty units.

**SECTION – II: EXPERIMENT:**

The One-Group-Pretest-Posttest Design was followed for the experiment to find out the effectiveness of the developed Foundation Course in Mathematics for the first year undergraduate programme of BRAOU.

The Single-Group-Pretest-Posttest Design was used which involves three steps; (1) Administration of a pretest measuring the dependent variable (Performance of students on achievement test in mathematics); (2) Implementation of the experimental treatment (Independent Variable i.e. the instruction through developed course material); and (3) Administration of a posttest (The Achievement test) that measures the dependent variable again. The effects of the experimental treatment are determined by comparing pretest and posttest scores.

The Experimental group consists of both students of Non-formal stream (below SSC, SSC, Intermediate failed) and students of formal stream (Intermediate qualification but without Mathematics).

Besides the Experimental Group, a Reference Group was used as a basis of reference in order to compare and evaluate the performance of experimental group of students. The purpose of comparison was to determine whether the new foundation course in mathematics would improve the mathematical skills of the distance learners on par with the students having intermediate qualification with mathematics. As discussed in the rationale of study that for determining the quality and credibility of distance education system. It is generally compared with that of conventional system. For quality and credibility it is important not only the inputs such as course material but also the output, that the performance of the students, and hence the performance of intermediate passed students provides the benchmark needed for comparison with reference to the group of students who occupy the academic

level to which the national and state level bodies such as AICTE and APSCHE mentioned that to become eligible MBA/MCA programmes one should have mathematics at +2 level.

### ***VARIABLES OF THE STUDY:***

A variable is any measure characteristic or attribute that differs from different subjects. These variables can be classified as quantitative and qualitative or they can be independent and dependent or continuous and discrete. For this study, the investigator has chosen independent and dependent variables.

#### ***Independent Variable:***

A developed self-instructional material in mathematics at foundation level of first year undergraduate programme of Dr. B. R. Ambedkar Open University.

#### ***Dependent Variable:***

Performance of the students on criterion tests block wise and in achievement test in mathematics.

### **SAMPLE:**

#### ***Population of the Study:***

The first year under graduate students of Dr. B.R. Ambedkar Open University from non- formal and formal streams constitute the population of the study.

#### ***Sample and Sampling Technique:***

As the course material was developed in English medium the sample of students of English medium was chosen from the population at First Level. At the Second Level, all the English medium students of first year undergraduate programme were divided into two groups on the basis of educational qualifications. One Group consists of the students with educational qualifications (1) below SSC (2) SSC (3) Intermediate failed and (4) Intermediate without mathematics, while the Second Group consists of the students having intermediate qualification with mathematics.

Keeping in view the availability of English medium students, both from non-formal and formal streams, the students belonging to the study centres in twin cities (Hyderabad & Secunderbad) were selected at the Third Level.

For Experimental Group, a sample of 50 students was selected by using Systematic Random Sampling technique from the First Group which consists of the students with educational qualifications (1) below SSC (2) SSC (3) Intermediate failed and (4) Intermediate without mathematics.

For Reference Group, a sample of 50 students by using Systematic Random Sampling technique from the Second Group which consists of the students having inter- mediate qualification with mathematics.

*Table 1: Table showing the Sample Distribution*

<i>Group</i>	<i>N</i>	<i>Percent</i>
<i>Experimental Group</i>	50	100
<i>Reference Group</i>	50	100
<i>Total</i>	100	100

**RESEARCH TOOLS:*****Opinionnaire:***

Opinionnaire was used with mathematics teachers at various levels starting from high school to college level to collect the areas in mathematics to design foundation course for distance learners of Open University.

***Achievement test:***

Achievement Test in Mathematics for entry level behaviour (pre-test)

*Table 2: Table showing the Sample Distribution; Educational qualification-wise*

Educational Qualification	Frequency	Percent
Below SSC (Non-formal)	23	23.0
SSC (Non-formal)	8	8.0
Intermediate failed (Non-formal)	8	8.0
Intermediate without Mathematics (Formal)	11	11.0
Intermediate with Mathematics (Formal)	50	50.0
Total	100	100.0

***Criterion Tests:***

Criterion test for five blocks for terminal behaviour (post-test)

***Comprehensive Test:***

A comprehensive test could be used to measure its effectiveness of the developed instructional material (post-test)

**RELIABILITY AND VALIDITY OF THE TEST:*****Reliability of the Test:***

In this study the investigator used the effectiveness of the course content is compared combined criterion test scores for the particular two groups which were compared in respect to their mean comprehensive test scores and the mean combined criterion tests. The reliability of the achievement test was tested by test-retest method and the obtained value was **0.8**.



***Validity of the Test:***

In this study the investigator utmost care was taken for content validity such as language, typo graphical errors and style, length, sequence, structure etc. Item wise error analysis was carried out by student performance on criterion tests. It revealed that Course Content has the internal validity.

**DATA COLLECTION:**

Before conducting experiment, the investigator conducted pre-tests i.e. an achievement test. After completion of experiment, the researcher again conducted the achievement test as post-test. The score of the students in the pre-test and post-test formed the vital data for the analysis. In addition to that, the scores of the five criterion tests, combined criterion test, comprehensive test were also furnished in it.

***DATA ANALYSIS:***

The purpose of the study was to develop the self-instructional material and to see its effectiveness on first year students of formal and non-formal stream of Dr. B.R. Ambedkar Open University. To find out if there was any significant difference between experimental and reference group, after collecting of pre-test and post-test scores, the mean and standard deviation of the data were calculated. “t” test was used to find out significant difference. Data was analyzed by using SPSS package.

**RESULTS & DISCUSSION:*****RESULTS:***

After receiving the nature and scope of the Foundation Course in Mathematics, the above discussed format was used in developing the course material.

Selection of the topic, Course Content and Task Analysis, Target Population, Entry Level Behaviour, Terminal Behaviour, Criterion based performance test on each block (Formative Evaluation, Comprehensive test (Summative Evaluation, Editing, Revision, Final form the course Material.

After completion of writing the course material, the entire course material which consists of blocks was given away to the students after they completed the each block. At the end of the each block the correspondence criterion test was administered.

It was made clear these beforehand that for the foundation course in mathematics, they should read only the developed learning material given to them but not any other text. Before, giving the course content, the students were oriented about the nature of learning material and procedure of using it. Students were to study the material during the contact-cum-counseling programme allotted for the particular course the course content was presented to the students block wise, the entire course material which consists of blocks was given away to the students after they completed the each block. The criterion tests for block wise try-out i.e. five criterion tests data was obtained. Difficulties encountered by the students regarding the language, content sequence like were noted. Errors committed by the students on the course content were analyzed. Error analysis was also done for each item of the criterion tests. The average scores obtained by the students on different criterion tests have been presented in **table 3**.

Table 3: Mean scores on criterion tests

<i>Block No.</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
<i>Mean percentage score</i>	21.69	22.37	14.20	8.77	17.26

Based on the analysis of errors on course units and criterion test items, and also considering the difficulties reported by the students, the course content were revised. Revision was effected regarding the language, the content sequence, structure of the certain units, and other related aspects. Wherever found necessary content were split into smaller one and also additional content were introduced. Item wise error analysis of students' performance on criterion tests was carried out. Appropriate modifications were made in the course content, and content sequence based on the error analysis data. A final form of the course was given treatment for the selected sample from the population to find out the effectiveness of the course content.

### ***DISCUSSION:***

Having the above mentioned group of sample, the data was tabulated to calculate the mean, standard deviation on each block for the different groups separately.

To know entry level behaviour, the achievement test scores (pre-test) were analyzed, to see the terminal behaviour (post-test) on two groups and the five criterion tests on five blocks were analyzed. The difference in the means of the two groups was tested for significance by applying the test. Effectiveness of the course content was compared block wise criterion test scores. The two groups mean difference were tested for significance by using 't' test.

### ***Testing of Hypotheses:***

With reference to the first and second objectives that the course material was designed and developed by following systematic procedures and formative evaluation procedures by assessing the performance of distance learners of on criterion test at every block level and accordingly revising the self-instructional material to ensure that the course material is at the level of students.

*Hypothesis 1: There is no significant difference between the mean scores of comprehensive test and that of combined criterion tests.*

For studying the effectiveness of the course content, as a whole two indices, viz. mean scores on the comprehensive test and mean combined scores representing the performance on the five criterion test were obtained. To obtain the combined criterion test score, for each student the actual score on each test was converted into percentages; mean of these percentages over the five criterion tests represents the combined criterion test score for the particulars for the two groups were compared in respect to their mean comprehensive scores and the mean combined criterion test scores.

In order to test the above hypothesis, t-test was used. The results are shown in the following **table 4**. From the **table 4**, it is observed that, the two means of combined criterion test (**71.47**) and

comprehensive test (**71.54**) almost same. The calculated ‘t’ value (**0.95**) is less than the table value (**2.53**). There is no significant difference on the scores of comprehensive and that of combined criterion tests with **99 degrees of freedom (df) at 0.05 level**. The null hypothesis accepted as there is no significant difference between the mean scores of comprehensive test and that of combined criterion tests. It shows that the course content as a whole is an effective.

With regard to the third and fourth objectives that the following Null hypotheses are formulated:

*Hypothesis 2:*

*There is no significant difference between pre-test and post-test mean scores of (Experimental Group) students of Non-formal stream (below SSC, SSC, Intermediate failed) and students of formal stream Intermediate qualification without Mathematics taught through Self-Instructional Course Material).*

**Table 4.2: t-test for the mean scores of comprehensive test and that of combined criterion tests ns- Not significant at 0.05 level**

Group	<i>(Pre-test)</i>		<i>(Post-test)</i>		t-value
	Mean	SD	Mean	SD	
<b>Experimental (N=50)</b>	<b>15.18</b>	<b>6.46</b>	<b>35.88</b>	<b>3.84</b>	<b>3.67*</b>

In order to test the above hypothesis, t-test was used. The results are shown in the following table 5.

**Table 5: t-test for students of Non-formal and formal stream (Experimental Group) with respect to achievement in mathematics on pre-test and post test scores.**

*\*Significant at 0.05 level*

Performance	<i>Combined Criterion Test</i>		<i>Comprehensive Test</i>		t-value
	Mean	SD	Mean	SD	
<b>Achievement test (N=100)</b>	<b>71.47</b>	<b>4.51</b>	<b>71.54</b>	<b>11.00</b>	<b>0.95<sup>ns</sup></b>

From the above **table 5**, it is clear that the mean of post-test scores is (**35.88**) with respect to achievement in mathematics is very high than the mean of pre-test scores (**15.18**). The calculated t-value is (**3.67**) is greater than the table value (**2.53**) at **0.05 level** with **degrees of freedom (df) 98**. Therefore, there is significant difference in pre-test and post-test scores with respect to achievement test in mathematics. Therefore, the null hypothesis is rejected and accepted an alternate hypothesis is that, there is significant difference between pre-test and post-test mean scores of (Experimental Group) students of Non-formal stream (below SSC, SSC, Intermediate failed) and students of formal stream Intermediate qualification without Mathematics taught through Self-Instructional Course Material.

From the result, in pre-test, the experimental group performance is low, because the reason could be the non-formal stream students do not familiar with simple concepts in mathematics. Formal stream Intermediate qualification without Mathematics students also contributed in this group. These students could not be interested in learning mathematics or they could be failed in learning mathematics at their school level. After the treatment the same group performed well. Therefore, the investigator declared that the developed course material reached to the target learners in understanding the mathematical concepts. As a result, the purpose and main objective of the study was realized

It shows that the performance of the experimental group's mean post-test score in the achievement test in Mathematics was better when compared with their pre-test scores. It supports the research findings of (Hatch 1959) who have found that a self- instructional device would promote learning. (Hosmer and Nolan 1962); (Smith 1962); (Uttal 1962); (Wendt and Rust 1962); studied to compare a traditional instruction to a programmed method of teaching spelling in the third grade, and found that the programmed group gained significantly better grade-equivalent scores than the control group by the end of the year. (Evans, Homme, and Glaser 1962), who have found that the group using smaller steps produced significantly fewer errors on both immediate and delayed tests. (Gropper et al. 1966) found that larger the step size, the more errors were committed during practice. This finding was significant for lower ability students.

### *Hypothesis 3:*

*There is no significant difference between mean scores of experimental [Students of Non-formal stream (below SSC, SSC, Inter failed, and Intermediate without Mathematics) and students of Formal Stream Intermediate qualification without Mathematics] and Reference [Students of formal stream Intermediate qualification with Mathematics] groups in the achievement test in Mathematics.*

Effectiveness of the course content was compared block wise criterion test scores. The two groups mean difference were tested for significance by using 't' test. Mean achievement scores for the groups on the five criterion tests are presented in **table 6**.

From the **table 6**, it is observed that on the tests for **block I, block II, block III, block IV** and the **block V**. The mean achievement scores do not differ significantly at **0.05 level except block II**. The mean achievement scores for the **block I do not differ significantly**. The performance of the two groups on criterion test for block I was done almost same. The means of experimental and reference group are (35.40) and (36.34) respectively. The calculated 't' value for block I is **0.17** which is less than the table value (2.53) with **98** degrees of freedom (df) at **0.05 level**.

For **block II** the mean scores differ significantly at **0.05 level** in favour of the experimental group which learnt through the course content. The means of experimental group for **block II is (38.40)** higher than that the means of reference group are (32.94). For **block III, IV and V the mean scores do not differ significantly at 0.05 level**. The means of reference group for **block III, IV and V are (33.86), (36.52) and (37.86)** and the means of experimental group are (38.60), (33.44) and (34.00) respectively. The experimental group had better performance for **block III**, while the reference group had better performance for **block IV and V**. The calculated 't' value for **block III, IV and V are (1.23), (1.64) and (1.11) respectively** are less than the table value (2.53) with **98 degrees of freedom (df) at 0.05**

**level.** Therefore, the null hypothesis was accepted as there is no significant difference between mean scores of experimental [Students of Non- formal stream (below SSC, SSC, Inter failed, and Intermediate without Mathematics) and students of Formal Stream Intermediate qualification without Mathematics] and Reference [Students of formal stream Intermediate qualification with Mathematics] groups in the achievement test in Mathematics.

It supports the research findings of **(Silberman 1962)**, who have found that there were no significant differences in learning from the use of programmed materials or conventional texts. **(McNeil and R 1962)**, **(Giese and Stockdale 1966)**, **(Alexander 1970)**, and **(Univin 1966)** also found that the there was no significance across method while comparing the two versions (programmed and conventional texts).

Table 6: Comparison of the criterion test scores of two groups

Block	Group	Mean	SD	t-Value
Block I	Experimental Group (N=50)	35.40	2.91	0.17
	Reference Group (N=50)	36.34	3.95	
Block II	Experimental Group (N=50)	38.40	3.54	3.61*
	Reference Group (N=50)	32.94	2.14	
Block III	Experimental Group (N=50)	38.60	3.16	1.23
	Reference Group (N=50)	33.86	2.27	
Block IV	Experimental Group (N=50)	33.44	1.95	1.64
	Reference Group (N=50)	36.52	3.98	
Block V	Experimental Group (N=50)	34.00	1.65	1.11
	Reference Group (N=50)	37.86	3.70	
Over all	Experimental Group (N=50)	179.84	9.22	1.03
	Reference Group (N=50)	177.52	13.03	

\* Significant at 0.05 level

It supports the research findings of **(Briggs and Bernard 1956)**, who have found that an experimental group using the Subject Matter Trainer (SMT), study guides, and oral and written exams outperformed the control group who used only the study guides and quizzes on a performance exam. **(Little 1934)**, compared results from groups either using a testing machine, a drill machine, or neither (control group). Both experimental groups scored significantly higher than the control group. The group using the drill machine moved further ahead than did the test machine group. It also supports the research findings of **(Freeman 1959)**, who have found that no significant effects related to achievement on learner performance in a class of students who received reinforcement for a portion of the class and no reinforcement for an- other portion of time. **(Holland 1959)**, found no significant differences as a result of practice techniques on college students studying psychology using machine instruction, required one group of students to space their practice versus another group of students who had to mass their practice. **(Csanyi A P and Reynolds 1962)**; **(Daniel and Mur- dock 1968)**; **(Goldbeck and Campbell 1962)**; **(Goldbeck and Llewellyn 1960)**; **(Hartman 1963)**; **(Kormondy 1962)**; **(Lambert 1962)**; **(Roe 1960)**;

(Stolurow and Walker 1962); (Tobais 1969a), (Tobais 1969b), (Tobais 1973); (Tobais and Weiner 1963); (Shimamune 1992) & (Vunovick 1995) found no significant difference between the effectiveness of programmed materials requiring overt responses and those using covert responses. (Smith and Moore 1962) found no significant difference was found on achievement related to step size, but the larger step program took less time in a study in which step size and Programmed Instruction cues were varied in a spelling program. (Burton and Goldbeck 1962); (Coulson and Silberman 1959); (Hough 1962); (Price 1963); (Roe 1960); (Williams 1963) compared constructed response and multiple choice responses but found no significant differences. (Dessart 1962), found that there was no significant difference between the conventional group and the linear group or between the linear and branching groups. (Holland 1965), (Lieth 1959), & (Anderson 1959), reported no significant difference in learning between linear and branching programs when compared, and indicated this was generally the case with older or intelligent learners, “younger children using linear programs were more likely to receive higher test scores. (Keisler and McNeil 1959), reported and found that using programmed materials, one showing a significant difference favouring the individual approach over the group approach. (Feldhusen and Brit 1962), found no significance between individual and group approach.

The results reveal that, the developed course content reached the target learners those who do not have mathematics at their formal education and those admissions made through Eligibility Test. Over all out of five criterion tests, the reference group showed better performance on three tests, and the experimental group showed better performance on two tests. It reveals that, the developed course content has the internal validity. Thus it shows that the self-Instructional Course Material in Mathematics is equally effective with that of the Course Material studied by Intermediate students with Mathematics.

## CONCLUSION:

The performance of the experimental group [post-test scores] in the achievement test in Mathematics was better when compared with pre-test scores of the distance learners taught through Self-Instructional Course Material. Further, the results show that the self-Instructional Course Material in Mathematics is equally effective when the performance of experimental group was compared with that of the reference group i.e. Intermediate students with Mathematics. The study revealed that, the analysis of the data during the course development reveal that, there is no significant difference on the scores of comprehensive and that of combined criterion tests. It shows that the course content as a whole is effective and students' comprehensive level. 10.

## Limitation of the Study

The study is limited to Dr. B. R. Ambedkar Open University. The present study was limited to the print material of the course. The study did not deals with the multi media. The course was developed in English Medium only.

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