

## **The Influence of e-Content on Academic Performance and Retention Ability in Learning Mathematics among High School Students - Solomon Four Equivalent Group of Experimental Design**

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### **ABSTRACT**

The study aims to find out the more influence on the academic performance and the retention ability after receiving the subject concept through pedagogical methods such as conventional and modern methods of teaching. The investigator used the pre, the post and the retention tests for Solomon Four-Group Design of the experiment in this research. The convenient sampling technique which was adopted by selecting a sample of 20 students of the Ninth standard for each group was assigned to the conventional and modern method of teaching. The e-content development module and a standardized researcher's achievement test were developed by the researcher under the guidance of the research supervisor based on the Mathematics subject portion as set theory including skills of drawing the Venn diagram. Levene, ANOVA, Bonferroni,  $\omega^2$ ,  $r^2$ , Effect Size (d) and Gain Ratio tests are used for statistical analysis and interpretation of achievement and retention scores (data) and the results are discussed in this paper along with the findings and recommendations.

**Key Words:** e-Content Module of Learning, Chalk and Talk Method of Teaching, Solomon Four Group Design, Learning Mathematics, Academic Performance, Retention Ability, Levene Homogeneity of variances, Bonferroni.

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### **INTRODUCTION**

Set language is a language which is used in a vast area in mathematics such as Algebra, Topology, Functional Analysis, discrete mathematics, mathematical analysis and so on. Application of it may be solved some kinds of problems in the practical life. Examples: IPL schedule of cricket matches may be prepared by using the set language. The selection of batsmen, bowlers, fielders and players of all-rounder may be followed by the application of a set language easily. Teaching the reading comprehension by using the Venn diagram technique increased the students' achievement in descriptive text (Malasari, 2017 and Emi Agusriani Samosir, 2013).

### **SIGNIFICANCE OF THE STUDY**

Mathematics is a foundation of all subjects, especially sciences. Unless everyone discontinues due to stagnation and wastage, everyone must learn mathematics upto the tenth standard.

Learners learn the subject matter through interest, motivation and self-direction. Any teaching method is to be created to the student's interest, motivating him or her to learn continuously, having the concept depth and clarifying the doubts, providing rich experiences of the learners own thoughts. The e-content is a teaching-learning module in modern trends. E-content attracts students towards mathematics learning for the purpose of enrichment of subject content. It is an application of everyone's critical situation of the real life. Mathematics is not a very tough subject, but a suitable teaching method fulfills the need for abolishing the wrong notion of this world perception of Mathematics. The e-content deliveries facilitate students' learning with avoiding the rote memory without understanding the meaning.

## **OBJECTIVES**

1. To calculate the homogeneity and value of the equivalent groups.
2. To calculate the average academic performance and retention in learning mathematics between e-content module of learning and chalk and talk method of teaching among ninth standard students.
3. To calculate the effect size values and gain ratios between the e-Content Module of Learning and the Chalk and Talk Method of Teaching among ninth standard students.

## **REVIEWS OF THE RELATED LITERATURES**

The following reviews are referred to this research article writing: Abiola Lateef Olori and Adekunle Olusegun Igbosanu (2016), Adediran Adekunle Amosa, Fayemi John Adelanib and Adebajo, Y. Adebola (2015), Alice Latimier et al (2019), Allan Ayithey, Amutha, S. (2016 & 2011), Emmanuel Arthur-Nyarko and Francis Onuman (2019), Andi field (2016), Anna Laszlo (2017), Ball, AK. (2016), Bruce Jerome Carter (2017), Cyril, M. U. (2016), Devendiran, G., Vakkil, M. (2017), Dolník, V (2018), Govindaraj, S. (2017), Hilal Almara'beh, Ehab F. Amer, Amjad Sulieman (2015), Iqbal Shah, Muhammad Khan (2015), Ilknur Gulsen Turgut and Sedat Turgut (2018), Ismail, D. (2017), Jebaraj and Mohanasundaram (2015), Jennifer L. Seymour (2016), Joseph, Manju (2015), Joyline Mugeru Muchiri (2018), Kumar, Raman and Kaur, Jagpreet (2018), Koopman, L. (2017), Kutiriko et al (2019), Manikandan (2017), Mamun Ali Naji Qasem (2015), Meliha zeinilagic-Hajric, Nizama Beganovic and Ines Nuic (2016), Muhammad Shamim (2018), Munni Kumari (2017), Lei, Y. (2016), Murali Vipul and Jaise Jaya (2016), Muruganantham (2015), Muthukumari, J and Ramakrishnan, M. (2017), Muthulakshmi, P. (2016), Nair Sobhana Nandakumar (2015), Najeh Rajeh Alsalhi, Mohd. Elmagzoub Eltahir, and Sami Sulieman Al-Qatawneh (2019), Nwanze, A.C. (2018), Rajkumar, R. and Hema, G. (2018), Sajna Jaleel (2015), Salah Zogheib et al (2015), Sautiere, P.E., Blervacq, A.S. and Vizioli, J. (2019), Sakiyo John, Aishatu Ahmad Musa and Kawu Waziri (2018), Sathya, T. (2016), Sengamalaselvi, J. (2016), SenthamaraiKannan. B et al (2015), Sorzano, C.O.S. and Parkinson, M. (2019), Sudha Kumari, N. (2017), Suresh Prabu, P. (2016), Swati Shukla and Daljeet Kaur (2019), Syamsuddin and Andi Azis Jimi (2019), Thair Hamtini (2017), Tekin, Ahmet and Polat, Ebru (2016), Umar, B. K., Ossom, M. O and Egbita, A. U (2020), Warner, SK. (2015), Zare, M. (2016).

## **RESEARCH DESIGN**

The researcher adopted the pre, post and retention tests of Solomon Four-Group Design for equivalent groups in this research. One control group and one experimental group with the pre-

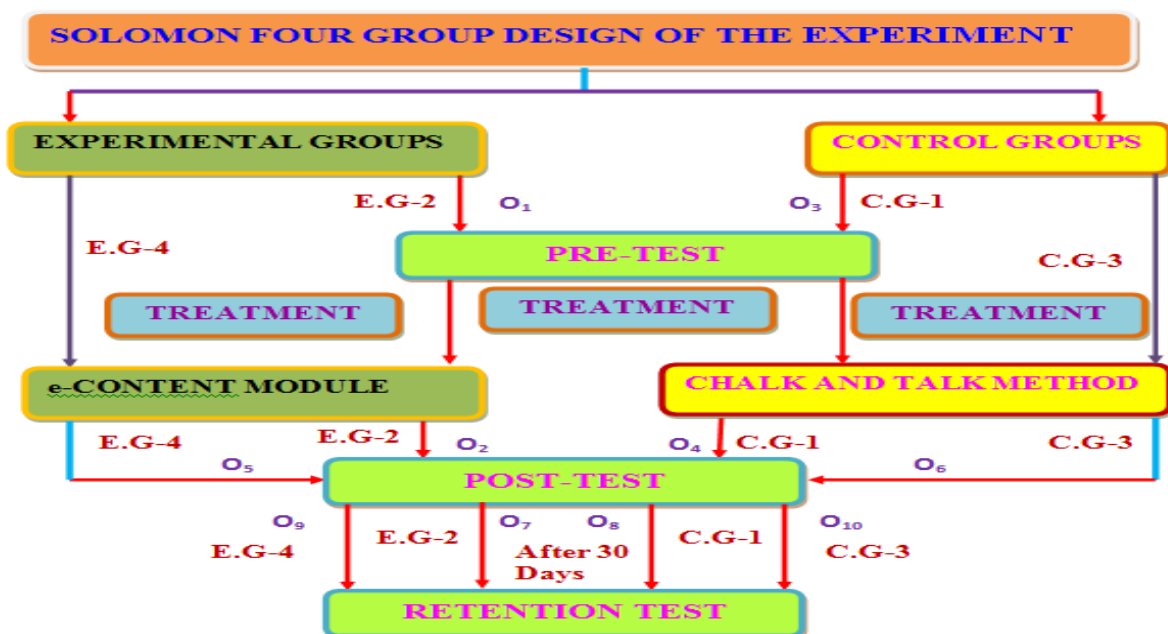
achievement tests, the post-achievement tests and the retention tests of achievement are administered before and after taught through the Chalk and Talk Method of Teaching and the e-Content Development Module of Learning respectively. And also, one control group and one experimental group with the post-achievement tests and the retention tests of achievement are administered after being taught through the Chalk and Talk Method of Teaching and the e-Content Development Module of Learning, respectively.

$$\begin{array}{l}
 \mathbf{R} \quad \mathbf{O}_1 \times \mathbf{O}_2 \quad \longrightarrow \quad \mathbf{O}_7 \\
 \mathbf{R} \quad \mathbf{O}_3 \mathbf{C} \mathbf{O}_4 \quad \longrightarrow \quad \mathbf{O}_8 \\
 \mathbf{R} \quad \quad \times \mathbf{O}_5 \quad \longrightarrow \quad \mathbf{O}_9 \\
 \mathbf{R} \quad \quad \mathbf{C} \mathbf{O}_6 \quad \longrightarrow \quad \mathbf{O}_{10}
 \end{array}$$

In this design

1. Subjects are purposively assigned to two groups
2. Two Experimental Groups Received the Treatment such as interactive e-content module of learning (×).
3. Two Control Group received the conventional method of teaching such as chalk and talk method of teaching (C)
4. Two groups is managed the pre- achievement tests (**O<sub>1</sub> and O<sub>3</sub>**)
5. Four groups receive the post-achievement tests (**O<sub>2</sub>, O<sub>4</sub>, O<sub>5</sub> and O<sub>6</sub>**)
6. Four groups receive the retention tests (**O<sub>7</sub>, O<sub>8</sub>, O<sub>9</sub> and O<sub>10</sub>**) after 30 days from conducting the post-tests.
7. All four groups are homogeneous and equivalent groups.

Figure-1: Solomon Four Design with the Pre, Post and the Retention Tests



Where C.G-1 refers Conventional Group-1, E.G-2 refers Experimental Group-2,

C.G-1 refers Conventional Group-3, E.G-2 refers Experimental Group-4, N=20 in each group.

## **POPULATION OF THE STUDY**

The population for the study was considered the Ninth standard students in the State Board of Tamil Nadu.

## **ACCESSIBLE POPULATION**

The accessible population for the study was considered the Tamil medium students of Ninth standard in the State Board of Pudukkottai District, Tamil Nadu.

## **SAMPLE**

Four groups contained 80 Tamil medium students of the Ninth standard for conducting the experiments. Each group contained 20 students. The Control Groups received the conventional teaching method such as the Chalk and Talk method of teaching which is provided through their class teachers and the Experimental Groups received the modern teaching method such as the interactive e-content development module of learning which is provided through the MP4 video lesson by using the LCD projector. Two schools are chosen for conducting the experiments. Four groups are assigned the equivalent and homogeneous groups which are formed by using their half-yearly examination marks of the students.

## **RESEARCH TEACHING-LEARNING MODULE**

The Interactive E-Content Module of Teaching is presented for the experimental groups and the Chalks and Talk Methods Teaching is taught by the class teacher.

## **RESEARCH TOOL**

The present study has used the following tool: Achievement Test in the Mathematics unit 'Set Language' is prepared and standardized by the investigator.

## **INTERPRETATION OF DATA**

### **Hypothesis-1**

Selected groups have homogeneous variances and equivalent groups to each other before participating in the experiments.

Table-1: Levene Test of Homogeneous Variances and ANOVA-Test of Equivalent Groups

Marks	Levene statistics	Sig.	Sum of squares	df	Means square	F	Sig.
Between groups	1.396	.251	274.2	3	91.4	0.564	0.64
Within groups			12306.6	76	161.929		
Total			12580.8	79			

The table shows that value of Levene (1.396) and F-value (0.564) is less than table value of F (4.0503) and also the significant value of Levene (.251) and the significant value of F (0.64) is greater than the selected significant level value  $\alpha$  (0.01). From these interpretations, the null hypothesis is not rejected. Therefore, selected groups have homogeneity of variances and equivalent groups to each other before participating in the experiments is proved.

**Hypothesis-2**

There is no significant difference among the Pre-test, the Post-test and the Retention test of the Academic Attainment in the Mathematics unit Set Language for the Conventional Group-1, the Experimental Group-2, the Conventional Group-3, and the Experimental Group-4 among ninth standard students.

Table-2: ANOVA Test among above Mentioned Four Groups

Source of Variance	Sum of Squares	df	Mean Square	Obtained F -value	Critical F-value	Significance At 0.01 level
Between groups	29392.820	9	3265.869	195.211**	2.5019	Significance
Within groups	3178.694	190	16.73			
Total	32571.514	199				

The table shows that the obtained F-value 195.211 is greater than the critical F-value 2.5019. It means there is a significant difference among the Pre-test, Post-test and Retention test of Achievement in Mathematics unit Set Language for the Conventional Group-1, the Conventional Group-3, the Experimental Group-2 and the Experimental Group-4 among ninth standard students. Therefore, a post hoc test, namely the Bonferroni test, can be applied to find the effectiveness of the conventional method of teaching such as the chalk and talk method and the interactive e-Content Development Module of Learning.

Table-3: Bonferroni Tests for Solomon Four Groups

Between	B-value	Between	B-value	Between	B-value
1 and 2	7.0741**	2 and 9	14.9600**	5 and 6	4.5228**
1 and 3	3.7883**	2 and 10	19.9081**	5 and 7	6.3397**
1 and 4	0.4252	3 and 4	4.2136**	5 and 8	9.3162**
1 and 5	18.2072**	3 and 5	14.4189**	5 and 9	3.8270**
1 and 6	22.7300**	3 and 6	18.9417**	5 and 10	8.7750**
1 and 7	11.8675**	3 and 7	8.0792**	6 and 7	10.8625**
1 and 8	8.8910**	3 and 8	5.1027**	6 and 8	13.8390**
1 and 9	22.0342**	3 and 9	18.2458**	6 and 9	0.6958
1 and 10	26.9822**	3 and 10	23.1939**	6 and 10	4.2522**
2 and 3	3.2858	4 and 5	18.6324**	7 and 8	2.9765
2 and 4	7.4994**	4 and 6	23.1552**	7 and 9	10.1666**
2 and 5	11.1331**	4 and 7	12.2928**	7 and 10	15.1147**
2 and 6	15.6559**	4 and 8	9.3162**	8 and 9	13.1432**
2 and 7	4.7934**	4 and 9	22.4594**	8 and 10	18.0912**
2 and 8	1.8169	4 and 10	27.4074**	9 and 10	4.9480**

Where 1-refers the pre-test of the control group-1, 2- refers the post-test of the control group-1, 3-refers the retention test of the control group-1, 4-refers the pre-test of the experimental group-2, 5-refers the post-test of the experimental group-2, 6-refers the retention test of the experimental group-2, 7-refers the post-test of the control group-3, 8-refers the

retention test of the control group-3, 9-refers the post-test of the experimental group-4, 10-refers the retention test of the experimental group-4.

The table shows that all values are compared with the critical value of Bonferroni (3.7673) at 0.01 level. All values are significant except 1 and 4, 2 and 3, 2 and 8, 6 and 9 and 7 and 8 at 0.01 level.

From 1 and 4, the control group-1 and the experimental group-2 have more or less the same level of academic attainment.

From 2 and 3, no change in the academic attainment for the post test and the retention test of the control group-1.

From 2 and 3, no change in the academic attainment for the post test and the retention test of the control group-1.

From 2 and 8, no change in the academic attainment for the post test of the control group-1 and the retention test of the control group-3.

From 6 and 9, no change in the academic attainment for the retention test of the experimental group-2 and the post-test of the experimental group-4.

From 7 and 8, no change in the academic attainment for the post-test and the retention test of the control group-3.

Others interpret, the e-content module of learning as influencing the academic attainment and the retention ability in a positive way.

The chalk and talk method of teaching is influencing on academic attainment but not retention ability in a positive way.

### **Hypothesis-3**

There are no significant differences in the effect sizes and gain ratios between the control groups and the experimental groups.

Table-4: Effect Sizes and Gain Ratios of the Conventional and the Experimental Groups

Treatment of Teaching	Between	Effect size (d)	% of $\omega^2$	% of $r^2$	Gain Ratio
Chalk and Talk method	Pre-test-1 and Retentiontest-1	1.0302	33.58	11.22	0.1261
	Posttest-1 Retention-1	1.4071	49.11	58.37	-0.1431
	Posttest-3 Retention-3	0.8694	26.09	33.29	-0.1638
e-Content development module	Pre-test-2 and Retentiontest-2	10.2269	98.12	38.44	0.6117
	Posttest-2 Retention-2	2.1663	69.89	42.90	0.3824
	Posttest-4 Retention-4	1.7341	59.65	33.18	0.2340

The table shows that all the values of Effect Sizes and Gain Ratios in the Experimental Groups are greater than the Conventional Groups. Therefore, the Interactive e-Content Development Module of Learning is more effective than the Chalk and Talk Method of

Teaching. It is an authentication of the conformation of the effectiveness of the Interactive e-Content Development Module of Learning.

## FINDINGS

1. The e-Content Module of Learning is raising the academic attainment and retention ability in learning Mathematics among ninth standard students.
2. The Chalk and Talk Method of Teaching is raising the academic attainment but not retention ability in learning Mathematics among ninth standard students.
3. The e-Content Module of Learning is more effective than the Chalk and Talk Method of Teaching in learning Mathematics among ninth-standard students.

## DISCUSSION OF THE FINDINGS

Findings-1, 2 and 3

The following studies are supported these findings.

Does pre-testing promote better retention than post-testing? By Alice Latimier et al (2019). Both post-testing ( $d = 0.74$ ) and pre-testing effects ( $d = 0.35$ ), with significantly better retention in the former condition.

Effects of Multimedia Instruction on Retention and Achievement of Basic Machining Skills in Mechanical Craft Practice by Cyril, M. U. (2016). The students in the experimental group performed better in mechanical craft practice and in retention test than those in the control group. Hence multimedia instructions have more effect on learning achievement and retention of skills in craft practice.

Effect of Computer Assisted Teaching Strategy on Students Achievement by Gender in Agricultural Education in Tharaka Nithi County, Kenya by Joyline Mugeru Muchiri (2018). CAT is an effective strategy in improving achievement in agriculture.

Application of Cognitive Theory of Multimedia Learning in Undergraduate Surgery Course by Muhammad Shamim (2018). The video-based operative sessions are effective mode of teaching general surgery operation in resource limited setting. It is effective in delivering knowledge irrespective of the prior operating exposure or overall satisfaction. Applying multimedia design principles during medical lectures improves both long-and short-term retention and transfer tests performances.

Teacher-Assisted Multimedia Instructional Package-An Inevitable Modus to Enhance Retention Capacity of Secondary School Students by Murali Vipul and Jaise Jaya (2016). The Teacher-Assisted Multimedia Instructional Package is highly effective in enhancing Retention Capacity of Process Skills in Physics as compared to the Activity Oriented Method of Instruction.

Effectiveness of E-Content on Achievement in History among IX Standard boys by Muthukumari, J, and Ramakrishnan, M. (2017). Solomon four group design of experimental study is adopted, use of E-Content way of teaching has significant impact on enhancing the achievement in history among the IX standard boys.

Effect of Multimedia Integrated Lessons on Students' Achievement and Retention in Chemistry by Nwanze, A.C. (2018). The multimedia integrated lesson greatly improved students' achievement and retention score in chemistry. Interactive Multimedia Method (IMM) was more effective for English teaching in comparison to Conventional Direct Method and the

retention is concerned multimedia method of learning is far better than conventional direct method.

Effectiveness of Multimedia Instruction in Better Acquisition of Concepts, Achievement and Retention in Biology among Senior Secondary Level Learners by Swati Shukla and Daljeet Kaur, (2019). Instruction through Multimedia, significantly increased achievement and retention scores in biology among boys and girls in the experimental group.

## **RECOMMENDATIONS**

The following recommendations are implemented on the basis of the findings.

1. The e-content will be created for all chapters in Ninth Mathematics.
2. The teachers feel free to use the e-content in the classroom.
3. The e-content will be created on the basis of psychological perspectives and steps of teaching models.
4. Teachers provide the e-module to students to teach and revise the studied concept of Mathematics in home studies.
5. Retention abilities enhance through the e-content module, so the module will be made to incorporate various formats such as PPT, video formats, animate pictures, and audio formats etc.

## **POLICY MAKING**

Students of Government schools are economically, socially and educationally backward. They cannot be unable to buy the mobile phone for learning purpose at the pandemic period and emergency declaration, so the Government will enact the policy making for providing the costless Edu-Phone with installing the learning software features for these students unlike other software features. Marketing Smart phones are not controlled by students while learning. Such advertisements and adult figures are distracting the students' attention and creating maladjustment behaviour against the society.

## **CONCLUSION**

Nowadays, it needs an alternative method of teaching to the Chalk and Talk Method of Teaching. The Chalk and Talk Method of Teaching can be replaced with the e-Content Module of Learning in these pandemic periods and emergency periods without failing the students' learning. The Chalk and Talk Method is provided in the classroom by the teacher, but e-Content Module of Learning in Mathematics is provided in both classrooms as well as home by the provider.

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