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Comparative effectiveness of two it-enabled learning packages on achievement in mathematics of high school students

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***Abstract*---**There are numerous commercially developed IT-enabled learning packages available for students which have become an indispensable part of school education after the outbreak of Covid-19 pandemic. Oftentimes, due to the inadequacies of online learning where interaction between students and teachers are limited, dependence on these learning packages has become inevitable as they are professionally prepared packages and suitable for self-learning. But are these commercially available IT-enabled learning packages superior in enhancing the achievement of all types of learners? This investigation is an attempt to find out answer to this question. The study compared the effectiveness of the an IT-enabled learning package prepared by the investigator with a commercially available IT-enabled learning package in enhancing the achievement in mathematics of high school students. The results revealed that the IT-enabled learning package prepared by the investigator is more effective in enhancing the achievement in mathematics of high schools when compared to the commercially available learning package. The study thus proved that the incorporation of the suggestions of end users, especially teachers, is crucial in effectively designing and implementing an IT-enabled learning package for students.

***Keywords*---**IT-enabled learning package, commercially available, learning package, achievement test in mathematics.

Introduction

The perception that mathematics learning is an arduous task is one of the foremost hurdles in mathematics achievement. Unfortunately in the prevailing educational system, no systematic efforts were made to burst this myth. This coupled with the teaching-learning methodology which is still dependent on rote memorisation, fails to instil the right kind of interest in students while learning mathematics and as a result several of them start to develop mathematics anxiety and show some kind of uneasiness while learning mathematics. These students

often fail to get a strong foundation of the basic mathematical concepts and will never realise the excitement in learning mathematics and end up as poor achievers and may get labelled as slow learners or learning disabled. In fact, majority of them may become excellent mathematics wizards if the right kind of intervention is given at the right time.

Realising the importance of mathematics in the overall personality development of students and in selection of right kind of career choice, the information technology industry has forayed into educational content development. The exponential rate of growth of the IT industry with the advancement in multimedia capabilities also fuelled their entry into educational software development. This created a situation in which the educational content market getting flooded with numerous IT-enabled learning packages the quality of which are not always good. A benchmarking system needs to put place with the involvement of policymakers, teachers, educationists and all those who are directly involved in education, especially secondary education.

Significance of the study

Mathematics is a subject which has great influence on all facets of life. It aids us in building mental discipline through the development of logical reasoning, creative and critical thinking and problem solving ability. Proficiency in mathematics enables us to solve real life problems effectively. In the words of Sakunthala Devi, "Without mathematics, there's nothing you can do. Everything around us is mathematics". In the present information technology era, mathematics proficiency is an essential prerequisite to acquire a rewarding career. But acquisition of mathematics proficiency is a daunting task for majority of the school students as it takes patience and persistence and requires a firm foundation.

The advent of information and communication technology has paved way for the development of ICT-enabled learning packages as the multimedia-rich content creates interest in learners and acts as a catalyst in removing the negative attitude of students towards mathematics. The outbreak of Covid-19 pandemic has forced our schools to remain shut and all educational activities have become completely online. This situation resulted in the proliferation of several big and small educational content creators and all of them vied to achieve a good market share. This led to a situation where students find it difficult to select the right learning package from among the numerous commercial IT-enabled learning packages available and teachers also find it difficult to recommend a particular learning package as all of them had their advantages and disadvantages. Charp (2000) observed that thoughtful and appropriate selection of how and where technology should be integrated is essential while developing instructional materials.

The propagation of the commercial IT-enabled learning packages have attracted the interest of the investigator in delving deep into studying their effect on the mathematics achievement of students. Incidentally, the investigator conducted a validation study of an IT-enabled learning package prepared by her and found out that the learning package prepared by her was more effective in enhancing the

achievement in mathematics of high school students when compared to the traditional method of teaching (Brinda Nair, 2016).

While preparing the instructional package, the investigator interacted with several high school mathematics teachers to find out the inadequacies of the existing commercially available learning packages and the major shortfalls pinpointed by them are absence of enrichment sections, inappropriateness for enhancing mathematics skills and inadequacy to create interest and motivation among all types of learners. The IT-enabled instructional package was prepared by rectifying these shortfalls. Thus, the investigator felt that the prepared IT-enabled instructional package is very suitable for conducting a comparative effectiveness study with a commercially available IT-enabled instructional package. The investigator selected a popular commercially available IT-enabled instructional package in mathematics (name not disclosed as it will infringe commercial interest and privacy) and tested its comparative effectiveness with the IT-enabled instructional package prepared by the investigator.

Research question

Which among the two IT-enabled learning packages – the investigator prepared and commercially available – is more effective in enhancing the achievement in mathematics of high school students?

Objective of the study

To test the comparative effectiveness of two IT-enabled learning packages – one prepared by the investigator and the other commercially available - in enhancing the achievement in mathematics of high school students.

Hypothesis

There is no significant difference between high school students who were taught using the IT-enabled learning package prepared by the investigator and the commercially available IT-enabled learning package in their achievement in mathematics.

Method

Experimental method was used for the study. The non-equivalent group pre-test – post-test design was adopted. Based on convenience sampling technique, standard IX students from two intact classrooms were selected for the study. A sample of 45 students each (total 90 students) was used for conducting the experiment. The tools used for the study were the IT-enabled learning package prepared by the investigator, a commercially available IT-enabled learning package and an achievement test in mathematics prepared by the investigator. The comparative effectiveness of the IT-enabled learning package prepared by the investigator and the commercial IT-enabled learning package were found out using Analysis of Covariance. The students who were taught using the IT-enabled learning package were treated as the experimental group and the students who

were taught using the commercially available IT-enabled learning package were treated as the control group. The details of the analysis are given below.

Analysis of data

Comparative Effectiveness of the IT-enabled Learning Package prepared by the Investigator and the Commercial IT-enabled Learning Package in Enhancing the Achievement in Mathematics of High School Students

The pre-test and post-test scores in achievement in mathematics of high school students in the experimental group taught using the IT-enabled learning package prepared by the investigator and the control group taught using the commercial IT-enabled learning package were analysed using Analysis of Covariance to determine the comparative effectiveness of the two IT-enabled learning packages in enhancing the achievement in mathematics of high school students. This was done in order to determine which of the two IT-enabled learning packages was more effective in enhancing the achievement. Calculations were made to determine the sum of squares, mean square variances, and F-ratios for the pre-test and post-test scores of high school students who were assigned to either the experimental group or the control group. The results of these calculations may be found in Table 1.

Table 1
Summary of ANOVA of Pre-test and Post-test Scores of High School Students in the Experimental and Control Groups

Source of Variation	df	SSx	SSy	MSx	Msy
Between Means	1	0.18	134.44	0.18	134.44
Within Groups	88	271.11	511.78	3.08	5.82
Total	89	271.29	646.22		

Fx = 0.06 *From table F for df 1/88*
Fy = 23.12 *F at 0.05 level = 3.96*
F at 0.01 level = 6.96

The obtained value of Fx is 1.55, which means that the probability level is more than 0.05 (Fx = 1.55; p > 0.05). According to the results of the analysis of the variance of the 'x' means, the pre-test scores of the experimental group and the control group are not significantly different from one another. The value of Fy, which was obtained, is significant at the level of 0.01 (Fy = 23.12; p 0.01). The results of the analysis of variance on the means of the variable y suggest that there is a statistically significant difference in the post-test scores of the high school students who were in the experimental group vs those who were in the control group. The adjusted sum of squares and adjusted mean square variances for post test scores were computed, and the F ratio was calculated and reported in Table 2 to correct the final y-scores for the difference in the pre-test scores. Table 2 also contains the results of these calculations.

Table 2
Summary of ANCOVA of Pre-test and Post-test Scores of High School Students in the Experimental and Control Groups

Source of Variation	**df**	**SSx**	**SSy**	**SSxy**	**SSyx**	**MSyx**	**SDyx**
Between means	1	0.18	134.44	-4.89	140.57	140.57	2.16
Within groups	87	271.11	511.78	170.44	404.62	4.65	
Total	80	271.29	646.22	165.66	545.19		

Fy.x = 30.22 *From Table F for df 1/87*
F at 0.05 level =3.96 *F at 0.01 level = 6.96*

The Fy.x ratio that was determined to have been attained is statistically significant (Fy.x = 30.22; p 0.01). After taking into account the initial variations in pre-test scores, this finding demonstrates that the final means, which are dependent upon the experimental variables and the control variables, are considerably distinct from one another. It was decided to compute the adjusted means of the post test scores of the students in both the experimental group and the control group. It was determined whether or not there was a significant difference in the adjusted y-means. Table 3 presents the findings of the adjusted means for post test scores obtained by high school students who participated in either the experiment or the control group.

Table 3
Adjusted Means of Post-test Scores of High School Students in the Experimental and Control Groups

Groups	N	Mx	My	My.x (adjusted)
Experimental	45	11.27	22.67	22.69
Control	45	11.36	20.22	20.19
General Means		11.31	21.44	21.44

t = 5.50 *From the table df = 87*
t at 0.05 level = 1.99 *t at 0.01 level = 2.64*

It was determined whether or not there was a significant relationship between the obtained adjusted means for the post-test scores and df 87. The value of t that was discovered was 5.50, and it was significant at the 0.01 level. A large t-value indicates that there is a substantial disparity between the two means. This indicates that the mean adjusted scores of the experimental group and the control group are significantly different from one another. Because the mean adjusted score for the experimental group was greater than that of the control group, it is reasonable to draw the conclusion that the experimental group performed significantly better than the control group. This demonstrates that the IT-enabled learning package that was developed by the investigator is more effective than the learning package that is available for purchase commercially in terms of elevating the level of mathematical achievement among high school pupils. Therefore, the hypothesis that was formulated in this context, which stated that there is no significant difference between the achievement of high school students who were

taught using the IT-enabled learning package prepared by the investigator and the IT-enabled learning package that is commercially available, is not accepted.

Conclusion

The significant difference in the adjusted mean scores of the students in both the groups (the group taught using the IT-enabled learning package prepared by the investigator and the group taught using the commercially available IT-enabled learning package) revealed that the IT-enabled learning package prepared by the investigator is superior to the commercially available IT-enabled learning package.

Implications

The superiority of the IT-enabled learning package prepared by the investigator when compared to the commercially available IT-enabled learning package may be due to the fact that the investigator prepared the learning package after rectifying the shortfalls in the existing commercially available learning packages. The superior performance of students who were taught using the IT-enabled learning package prepared by the investigator shows that the inadequacies highlighted by high schools teachers about the commercially available IT-enabled learning packages are genuine. The preparation and testing of the learning package prepared by the investigator could be viewed as a humble attempt to make learning through IT-enabled packages more learner-friendly and engaging to all. It is recommended that involvement of the end users (teachers and students) from the initial stage of development itself has to be ensured while preparing IT-enabled learning materials. Teacher preparation programmes could provide training to student teachers in the use of information and communication technology in educational content development. Sensitizing the software industry on the importance of including prominent educationists and teachers of the concerned subjects while developing educational content is also needed. Only through these efforts, the IT-enabled instructional packages will become more inclusive and may cater to students of all learning styles and intelligence level.

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