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RESEARCH PAPER

Effect of Online-Live-Teaching on Students Achievement in Mathematics: An Experiment Study in Balochistan, Pakistan

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ABSTRACT

For the study a true experimental design, pre-test/post-test control group approach was used. The purpose was to find out the effect of online-live-teaching on 7th graders achievement in mathematics. A government high school was selected in a rural setting having 104 students in 7th grade. Three groups were formed and the participants were assigned to each group through simple random sampling using SPSS. The groups A & B were the experimental groups while group C was the control group. The teacher used the prescribed 7th grade Balochistan Textbook Board mathematics book. The 7th graders of group A, B and C were pretested. The duration of experiment was 4 months. One-way ANOVA and ANCOVA were applied to find the difference in three study groups on mathematics pre-test mean scores and mathematics post-test mean scores. The study concluded that the online-live-teaching is as effective as the traditional face-to-face teaching is.

Introduction

Learning is natural to all living organisms whether human or animal. This process of learning continues throughout one's life. Albert Einstein (1879-1955) in one of his quotes said that *"Once you stop learning you start dying".*

Learning is according to Barron, A. B et al. (2015) there is variation in definitions of learning like other concepts of "gene" and "fitness. But no single definition may be best. By reconciling most of the definitions of learning, it may be brought to a mutual framework that learning is a process that is structured appraising fresh information.

Like the learning definition, defining the term of online learning has a long history of debate. Online learning is defined by U.S. Department of Education, 2010 as, "learning that takes place partially or entirely over the Internet".

Anderson (2011) explains online learning more comprehensively as, "online learning as a subset of distance education has always been concerned with provision of access to educational experience that is, at least more flexible in time and in space as campus-based education". (P. 53)

It is evident that the needs of learners vary from student to student, place to place and time to time. Simply we can say that learning needs are so diverse that may not be fulfilled by the traditional face to face instruction only. According to Chaney (2010) need of

online education is the consequent of a drive "to provide quality education to all students, regardless of location and time"

This study was carried out in the province of Baluchistan. Geographically, Baluchistan is 347,190 km^2 which is the 44% of the total land area of Pakistan, whereas, demographically it holds only 5% in the total Pakistan's population. The density in population of Baluchistan is 36 persons per square kilometer (Baluchistan Census Report, 2017), the population in Baluchistan is vastly spread having pitiable networks of communications (UNICEF, 2017). Baluchistan with poor indicators of development, low rate in literacy and high level of poverty contrasts it with other provinces. As a result low quality of education and inaccessibility to education are the key problems of Baluchistan.

Due to scattered population, home-school distance poses a serious problem as far as approachability is concerned. The average distance between two nearest schools is reported to be 344 km^2, whereas, this distance stands at 360 kilometers in the case of high schools. UN Sustainable Development (2017) the highest drop outs as compared to other provinces of Pakistan may be attributed to the home-school distances.

What should be done in this technologically developed world where the problems in every field of life are being solved on a single click or touch on screen? Where should we stand in getting the problems in the field of education in this era of science and technology? In the view of above mentioned scenario, online-live-teaching can be one of the solutions where there is a lack of qualified teachers and schools. Instead of recruiting and posting a large number of qualified competent teachers to improve the access and quality which is another long and costly procedure, online-live-teaching can be a good option for the province of Baluchistan in order to improve quality and access.

Siddiquei, N. L., & Khalid, R. (2020) concluded that online learning is becoming one of the leading and powerful means of education to substitute the traditional teaching in developing countries such as Pakistan. They pointed out that much improved results can be created by adopting online-learning by decreasing cost and refining performance. Moreover, this adoption as a paradigm shift will require restructuring of human and technical elements which are hindered by social-economic, political and cultural factors. By improving both human and technical frontiers, online learning has the potential to revolutionize the education sector in Pakistan with lesser long term cost and improved students'

In the light of above-mentioned scenario of Baluchistan regarding quality and access of education and the findings of the studies addressing the quality and access. An online-live-teaching was tried out through a true experimental design, pre-test/post-test control group approach. The purpose was to find out the effect of online-live-teaching on 7^{th} graders achievement in mathematics.

Literature Review

Theoretical Framework

For this study these theories were used (i) Uses Determinism (ii) Anderson Model of Online Learning

Uses Determinism

It is important to note that online-live-teaching as technology is used in learning process as a vehicle as advocated by "Uses Determinism". It is also significant to acknowledge that the theory of Uses Determinism fits well in online-live-teaching. As this position focuses on the uses of technology within teaching learning process. It emphasizes the technology as neutral tools which are used to extend teaching and learning capacities. This philosophy is supported by Fiske (1987), Welchman (1997), Stephen and Harison (1999) and Katz and Rice (2002).

In simplest way it can be asserted that online-live–teaching as a technology is the tool which is applied by teachers and students to achieve their objectives. There is need to clarify it is the role of teacher to plan, organize, design, implement and assess the content and the role of student is to receive the instruction of teacher not technology of online-live-teaching itself. Online-live-teaching is the mode or a tool through which the teaching and learning is facilitated.

Using uses determinism perspective, effectiveness of online-live-teaching will be experimented to gauge how the achievement level improves by comparing the results of pre and posttest scores and attitudes of students.

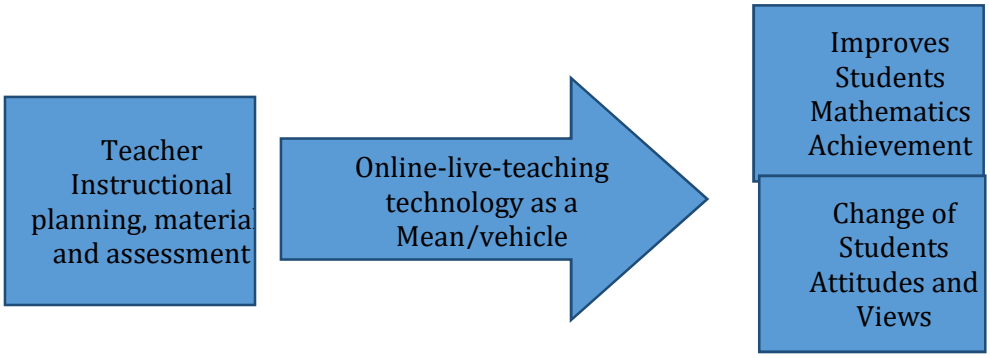

Figure 1: Uses Determinism

Anderson Model of Online Learning

The model of Anderson (2008) of online-learning is concerned to facilitate in access to learning experience free from the clutches of time i.e. more flexible and space i.e. anywhere not limited to traditional setting" (p. 53).

According to Anderson there are two key actors i.e. students as well as the teachers in learning online. In this process an interaction between students to students, between students and teacher as well both actors interact with the content. When the students interact with content, there are different formats, especially content on internet. However, it is more preferred by the learners to have their learning sequenced, guided, and evaluated with the support of teacher. Hence, in online learning this contact is taken place within a community of inquiry by utilizing a number of web-based activities that is not only synchronous but asynchronous also. Such rich environments are worthy to develop social abilities, learning the content with collaboration, and most importantly, the improvement

of associations among students. there is no doubt that the collaboration developed among students, binds them in time, making then to be regular in session sessions while in synchronous mode or encouraging at-least group learning. This online learning model illustrates the organized and planned learning procedure and tools are connected with more self-regulating learning. The tools and procedures that are common in online learning model comprise digital lessons, exercises or drills and digital simulations (Anderson, 2011). Anderson (2011) established that his model is good to know about the **complexities** of online learning in the context of education.

Model Anderson Online Learning

The perspective of Anderson model fits in this study. As the study will use synchronous (content delivery) and asynchronous (homework sharing by students and checking through email) interaction between student, teacher and content during online-live-teaching. It is a reduced model for this study. In this study the simulations, tutorials, games, e-books and other virtual materials use is not included. Because the study is not intended to assess the simulations, tutorials, games, e-books and other virtual materials use in online-live-teaching. It is therefore deemed appropriate for the present research to adapt and propose a modified version of the original Anderson Model of Online Learning (2008).

Effects of Online Learning on Improving Mathematical Performance

Summers, Waigandt, & Whittaker, 2005) studied how online learning is different from traditional learning. The differences were measured in the dimensions of students' scores in the final examination as well as the satisfaction of students with the taught course. The independent samples t-tests were used to conclude that there is no difference in the students' scores in the final examination by comparing both online learning from the traditional learning. However, the satisfaction level of students with the taught course was lesser in online learning than the traditional learning students based on different extents.

A substantial research is available that examined the effects of online tools on improving the students' performance in a range of subject areas. Among them is the contribution of Li and Ma's (2010) meta-analysis regarding online learning on improving the students' performance in Mathematics by covering the 46 primary research articles and collecting data from 37,000 students from primary and secondary schools. The teacher made and standardized tests were applied to measure the performance of students in Mathematics in these studies. Almost the entire studies used in this meta-analysis were well employed and controlled. This meta-analysis concluded

- A positive impact of online learning tools in improving the performance of students in Mathematics (mean effect size of 0.71) by comparing with those who were learning without online learning.
- The bigger effect was observed among younger students aged under 13 years as compared to the older students.
- Moreover, the learning was far better where child centered like inquiry, problem or discovery based discovery-based teaching was more focused than teacher centered.
- It was also asserted that the achievement level was higher where the online learning intervention is longer than shorter between six and 12 months at least. It was recommended to intervene online learning for a longer period

as long as the students get aware of the devices and tools of online learning it will increase achievement level in mathematics.

- It was also found no significant difference in mathematical achievement level by utilizing different devices and tools for teaching online whether using communication media or the tutorial devices.

- Similarly no difference was measured in the achievement level in mathematics among students on the basis of their characteristics like gender, social, economic grounds.

- It was discovered that the students who used the internet technology for one hour to accomplish their classwork and other activities had gained significantly higher scores. than the students who didn't practice the computer and internet at home

Another meta-analysis carried out by Higgins et. al. (2012). This meta-analysis summarized the findings of experimental and quasi-experimental researches. The purpose of this meta-analysis was to measure the impact of digital learning on school children performance aged between 5 to 18 years. It asserted a positive relationship between digital learning and academic performance of the students. Like the study of Harrison et al (2004) who came with the conclusion that there is a significant connection between the use of ICT and student achievement level in England in the subject areas of maths, English and Science.

Previously as discussed in the meta analysis of Liao et al (2007) and Higgins et al (2012), it revealed the positive effects on attainment of students in mathematics and other subject areas. The both meta- analysis of Li and Ma's (2010)and Higgins et al (2012) collected data from 48 qualitative and quantitative research articles. There were 48 studies which were utilized for both researches. It was found that 44 studies that is 92% out of 48 studies in total, had concluded in favour of online learning but the rest of 4 studies which is 8% of total studies concluded in support of traditional classroom learning. This higher attainment as suggested by the authors is due to the use of digital simulation in online learning by engaging the students with the activities that cannot be replicated by the traditional teaching activities in the formal classroom.

Jewitt et. al. (2011) asserted in his qualitative study and came with the following conclusions,

- Students spend more time actively while using online materials and resources in the classrooms.

- By providing digital resources and tools, the students remain active in learning outside the classroom. As the digital resources provided the students with self-directed pace and spaces, for example, online blogs, online games and chat forums etc.

- Moreover, the student can choose resources and learning opportunities online according to their own pace of learning.

- More importantly, the online resources can provide the student with harmless spaces for improving their learning by using and gaining access to formative assessment and productive in time feedback.

Material and Methods

For this study a true experimental design, pre-test/post-test control group approach was used.

Sample and Sampling Technique

Multi-staged sampling was done. In the first stage, a high school in a rural setting was selected by purposive sampling. The purpose was to have electricity, internet connectivity or a computer lab. In this104 students in 7th grade participated.

Online-live-Teaching

Online-live-teaching was occur in two ways that were Synchronous and Asynchronous (Anderson, 2011). By using Synchronous, the students and teacher interacted at the same time by being online while asynchronous let the students and teacher interact at the different times for not being online. For this experiment, the instructions were Synchronous and home tasks was Asynchronous. For the synchronous mode, the app of "Zoom" used to teach and collaborate. Through this app the teacher would invite the students by sharing the link.

Mathematics Achievement Test

A test was used to measure the effect of online- live-teaching on 7th graders mathematics achievement. The test was made by the teacher. For the test development, the instructional objectives were seeing to frame the questions. The test followed the prescribed pattern of school for mathematics question paper. It consisted of

- 10 items on fill in the blanks
- 10 items on true and false statements
- 05 items on short answer questions
- 10 items on long questions (having choice of 02 questions)

Reliability and Validity of Tools

The test was made by the teacher. Therefore, the test followed the prescribed pattern of school for mathematics question paper. In order to maintain the content validity of the test, it covered all exercises that were taught in the quarter.

After the test development, the test items was shown to the five experts in the field of education, which included

- 01 university faculty member in mathematics education.
- 02 Secondary School teachers (SSTs Science) who are teaching mathematics in school. It is worth mentioning here that SST Science teach the subject of math in Balochistan
- 02 subject specialists (SS) of mathematics serving in Bureau of Curriculum (BoC) and Provincial Institute of Teacher Education (PITE).

The experts' feedback was noted and amendments were made in accordance to suggestions. The content as well as face validity of the test items was deliberated.

Analysis and Interpretation

The data was transferred to SPSS for analysis. ANOVA and ANCOVA was used to conclude the results

Results and Discussion

Table 1
Summary of One-way ANOVA: difference in groups A, B. C on pre-test scores

	Sum of Squares	df	Mean Square	F	p
Between Groups	470.379	2	235.190	4.867	.010
Within Groups	4832.436	100	48.324		
Total	5302.816	102			

Table 1 shows summary of One-way ANOVA. One-way ANOVA was conducted to find difference in experimental and conrol groups A, B. C on mathematics pre-test scores. Results reflect that there was statistically significant difference in mean scores of study groups on mathematics pre-test scores (p = 01). One-way ANOVA only reveals that one or more pairs are statistically significant.

To find which pair is statistically significant, Post Hoc test. (Tukey HSD) test was applied. Results of Tukey HSD are presented in Table 2

Table 2
Pairwise comparison of experimental and control groups using Tukey HSD

(I) Group	(J) Group	Mean Diff. (I-J)	Std. Error	Sig.
A	B	.540	1.67	.944
A	C	-4.25*	1.67	.033*
B	C	-4.79*	1.69	.015*

Note *p<.05

Table 2 shows Pairwise comparison of study groups using Tukey HSD. There was no statistically significant difference in mean scores of mathematics pre-test of study Group A and Group B (p=.944). There was statistically significant difference in mean scores of mathematics pre-test of study Group A and Group C (p=.033). The mean scores of Group C was higher than mean scores of Group A. There was statistically significant difference in mean scores of mathematics pre-test scores of study Group B and Group C (p=.015). The mean scores of Group C was higher than mean scores of Group B.

As the ANOVA mean score was not the same and the mean score of the control group was significantly higher than experimental groups A & B. Therefore, it was decided that the pre-test scores will be used as Covariance while comparing the mean score of control and experimental group. ANCOVA will be applied to find significant difference in Math Post-test mean Scores of Study groups by eliminating the effect of pre-test scores.

Table 3
Summary of ANCOVA: Comparison of Math Post-test of Study groups while pre-test scores as Covariate

Tests of Between-Subjects Effects					
Dependent Variable: Math Post test Scores					
Source	SS	Df	Mean Square	F	P
Corrected Model	12107.88[a]	3	4035.96	34.37	<.000
Intercept	9865.05	1	9865.05	83.997	<.000
Math Pre-test	11352.85	1	11352.85	96.665	<.000
Group(A,B,C)	449.94	2	224.97	1.916	.153
Error	11627.04	99	117.45		
Total	98660.00	103			
Corrected Total	23734.91	102			
a. R Squared = .510 (Adjusted R Squared = .495)					

Table 3 shows summary of ANCOVA. Results shows that there was no statistically significant difference in Math Post-test mean Scores of Study groups after eliminating the effect of pre-test, F(2, 99)= 1.916, p=.153

Table 4
Summary of One-way ANOVA: difference in study groups A, B. C on Math Gain Scores

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	314.05	2.00	157.02	1.21	0.303
Within Groups	12998.55	100.00	129.99		
Total	13312.60	102.00			

Table 4 shows summary of One-way ANOVA. One-way ANOVA was conducted to find difference in study groups A, B. C on mathematics Gain test. Results reflect that there was no statistically significant difference in gain mean scores of experimental and control groups on mathematics (p=0.0303 and F= 1.21).

On the basis statistical analysis it is concluded that there is no significant difference in the mean scores of experimental and, the control groups performance in mathematics of 7th graders therefore, it is recommended to utilize online-live-teaching to teach mathematics in the province of Balochistan.

Findings

The findings of the study is based on results of data analysis of the study.

1. Results reflect that there was statistically significant difference in mean scores of study groups on mathematics pre-test scores (p<.05). The mean score of mathematics pre-test of study Group A is similar to mean scores of Group B (p=.944).
2. The mean scores of Group C was higher than mean scores of Group A. The mean scores of Group C was also higher than mean scores of Group B.
3. Results reflect that there was no statistically significant difference in mean scores of study groups on mathematics post-test scores (p>05).
4. The mean score of Mathematics pre-test (Mean=10.88, SD=10.34) was less than mean scores of post-test scores (Mean=29.65, SD=16.36) of Group C.
5. The results found difference in experimental and control groups on mathematics Gain test. Results reflect that there was no statistically significant difference in gain mean scores of experimental and control groups on mathematics (p=0.0303 and F= 1.21).

Discussion

The study results reflect that there was statistically significant difference of study groups on mathematics pre-test scores and post-tests score. The scores of students was increased in the post-test results of both experimental group A and B as well as group C. No difference of achievement score was observed among three groups. This result is supported by literature like (Neuhauser, C. 2002, Swan, K. 2003) found that there is no significant difference of test scores of students in face-to-face and online learning. Allen, E., & Seaman, J. (2010) reported online-live-teaching is as good as face-to-face teaching.

Conclusion

On the basis statistical analysis it is concluded that there is no significant difference in the mean scores of experimental and, the control groups' performance in mathematics of 7th graders. The scores of 7th graders were increased in the post-test results of both experimental group A and B as well as group C. No difference of achievement score was observed among three groups. Therefore, it is recommended to utilize online-live-teaching to teach mathematics in the province of Balochistan.

Recommendations

In the light of results as there is no difference of achievement score of students in mathematics between online-live-teaching and traditional teaching in pre-test and post-test therefore following recommendations are made as;

1. In schools where the infrastructure and facilities are available in schools of Balochistan there is need to activate the exiting mechanism to avail online-live-teaching without any cost.

2. The schools where no facilities are not available, the government of Baluchistan may invest a very little cost instead of recruiting new and qualified teachers which another lengthy and costly procedure.

3. Accessibility to education in Baluchistan in the far flung areas can be possible with online-live-teaching.

4. Quality of education can enhanced by connecting the schools where there is dearth of qualified teacher with the schools having more qualified teachers.

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