



## The Effectiveness of PowerPoint Mediated Early Elementary Science Modules for Independent Learning

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Habiba Azhar\*

Afifa Khanam†

Uzma Quraishi‡

### Abstract

*PowerPoint is one of the programs that has made classrooms more colorful and attractive with its multimedia incorporation. The present research has examined the effectiveness of early elementary science modules prepared with attributes of PowerPoint show for students' independent and autonomous learning. The modules were prepared for the subject of sixth-grade science, employing programmed learning principles. This experimental study has compared two groups of sixth grade; each group having N=30, at public and private schools parallelly, with a pretest, posttest control group design by introducing PowerPoint mediated modules for four weeks for one hour daily. The pre and post-test achievements were compared through the t-test. Both study groups at public and private sector schools increased their conceptual ability and performed better than the control group participants on a fifteen-item multiple choice objective type test. The study holds implications for the effectiveness of PowerPoint modules for bridging individual differences, adding learner autonomy and pace and place free independent learning, specifically, for underprivileged students.*

**Key Words:** PowerPoint Mediated Modules, Elementary Students, Independent Learning, Learner Autonomy

### Introduction

The signatories of UNDP Sustainable Goals (2015) are making consistent efforts to meet the set targets for poverty, health, gender equity, employment and other grey areas (Kumar, Kumar & Vivekadhish, 2016; Wetheridge, 2016). However, none of the states have successfully obtained the desirable figures after lapsing one and a half-decade. Therefore, these goals are still the biggest unachieved slogan of the world despite several efforts that have been made individually and collaboratively to meet the targets (Cernev & Fenner, 2020). Pakistan is also one of the countries whose targets for education and gender equity are far behind the other nations (Ali, 2018). Therefore, it is need of the hour to find ways to address the educational problems of those who have limited resources, reside in remote areas or have personal or social barriers of accessibility and also mitigate gender differences by opening resources for all men and women in the nation (Shah, Ahmad & Khan, 2019).

### Role of Technology in Reaching the Unreached

Luckily, technology has emerged as a cost-effective source for bridging the digital divide among developed and developing countries (Estacio, Whittle & Protheroe, 2019). Researches like Bebbington & Unerman (2018) Tjoa & Tjoa (2016) have suggested that SDG Goal 4<sup>th</sup>, "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" and Goal 5<sup>th</sup> "Gender equality" may be realized by increasing the accessibility of education and educational material. The technology-based independent learning instructional material can increase the accessibility for those in remote areas, the underprivileged groups; girls and women, students with difficulties and disabilities to cope with their individual needs (Godwin-Jones, 2019).

\* PhD Scholar, Department of Research & Evaluation, Institute of Education, Lahore College for Women University, Lahore, Punjab, Pakistan.

† Assistant Professor, Department of Research & Evaluation, Institute of Education, Lahore College for Women University, Lahore, Punjab, Pakistan. Email: [dr.khanam.wattoo@gmail.com](mailto:dr.khanam.wattoo@gmail.com)

‡ Professor, Women University, Multan, Punjab, Pakistan.

## **Penetration of Technology in the Teaching-Learning Process**

Technology has made drastic changes in the instructional culture by engaging students within and out of the classroom (South, 2017). Breaking the boundaries of institutional walls through virtual settings, technology has enabled the learners from all corners of the world to avail of knowledge of their own choice (Ally, 2019). Moreover, by providing the opportunity for independent and autonomous learning, it develops self-esteem, learning assertiveness, self-direction, motivation and interest in learners (Tondeur, et al. 2019).

## **PowerPoint Emerging as the Most Acceptable Multimedia**

Among the most popular multimedia technology, PowerPoint is broadly used within and out of class making the content more attractive, colorful, thrilling and lively with the incorporation of text, pictures, audio, video, animations, transitions and graphics (Cummings & Saunders, 2019). PowerPoint is a very interesting program with multiple attributes to be used for illustrations, mind-maps, flow charts and tables (Mason, 1998). It simplifies complex ideas with supportive images, graphics, videos to engage the human mind; encoding, analysis and synthesis etc. (Moore, 1996; Paivio, 1986). It is supportive of the concept of flipped classrooms to save time and enhance the understanding of students (Bognar, Sablić, & Škugor, 2019; Al-Sudais, 2019).

## **PowerPoint and Programmed Learning**

PowerPoint, however, has not been fully exploited for its independent and adaptive learning features (Liu, Relan, & Napolitano, 2020; Mavroudi, et al. 2016; Walkington, 2013). It could be an innovation to design independent learning PowerPoint mediated modules incorporating assessment elements using the programmed learning principles. Programmed learning is a pedagogical approach envisaged by Skinner (1959) who prepared 'learning machines' which were used to provide the learner with conceptual frames in the form of text (Kumari, 2020). The concept was divided into smaller units to be mastered at a time (Rouhani, 2019). The learner answered the subsequent question about the content and then the machine helped him to take the next frame or concept (Liu, Wei, Wang, Yang & Li, 2017). The idea was devised for quick feedback (Kay, 2019) which supposed to motivate the learner to explore the next concept at an increased pace (Ross et al. 2018). In other words, like today's gaming environment (Sung & Hwang, 2013; Westlin, Day & Hughes, 2019), it has multiple levels to draw learner's attention and motivation. The PowerPoint modules work similarly to Skinner's machine and engage the learner by providing the next level of content when he is able to provide the correct response.

## **Independent and Adaptive Learning**

Independent and adaptive learning programs (He, Zhang, 2019) are managed by complex high capacity servers by high-tech organizations storing macro data, whereas, in Pakistan, independent, self-sufficient and economically accessible management systems are not sufficiently available to educational institutions (Sharif, Afshan & Qureshi, 2019).

Therefore, instead of using complex technology, the researchers have endeavored to use an accessible, usable and affordable program; PowerPoint Show (Uzun & Kilis, 2019) to whom most of the teachers are well familiar and used to. Thus, PowerPoint was preferred for preparing independent modules for its multiple teaching-related attributes (Gordani & Khajavi, 2020).

## **Learning through Games**

Another engaging factor of technology is a gaming environment for learners (Tang & Hare, 2019). As claimed by Kankaanranta, Koivula, Laakso, & Mustola (2017), games are very important for children's physical and mental development. A vast range of well-designed educational games stimulate students' interest and enhance learning speed (Hung, Sun & Liu, 2019). Games provide a self-competition, self-motivation (Ryan & Rigby, 2020; Eyupoglu & Nietfeld, 2019) emotional, mental and physical engagement resulting in deep and immersed learning with greater attention span that reduce stress and threats of learning (Chen, Lu & Lien, 2019; Johnson, 2019; Wang, Sætre, Rydland & Dahl, 2019). The researchers, therefore, intended to incorporate the gaming environment within slides by interrelating concept levels with the assessment.

## **Using PowerPoint for Personalized Learning**

According to Budhram (Bouffard, 2019), “personalizing learning is the approach in which students have a choice over their learning based on interests and needs, flexible pacing, and/or access to differentiated content based on learning needs” (p.31). Thus, independent or personalized learning provides a learner an opportunity to work with her own pace, capability and learning style. The learner becomes self-directed, self-motivated and has control over her learning and consequently, it reduces learning time and enhances learning quality (Schmid & Petko, 2019). Where many researches explored the effectiveness of PowerPoint for the whole class ( Uzun & Kilis, 2019; Worku, 2019; Herting, Pros & Tarrida, 2019; Rohr, 2019) for science, arts, business and pre-service teachers, only one study (Cummings, & Saunders, 2019) was found which used PowerPoint for personalized instruction and it was used for autistic students. Ülger, & Irving (2019) emphasized that elementary students, having different capabilities, require need-oriented modules. Thus, the current study intended to personalize content and assessment-based progress of students in a gaming environment. The modules were envisaged for independent and adaptive learning for a wider clientele.

## **Statement of the Problem**

In order to bridge individual differences, provide an opportunity for independent learning for underprivileged children and encouraging students with a slow pace, the present research endeavored to ‘examine the effectiveness of PowerPoint mediated Science modules for sixth grade’ which had embedded assessment for developing an independent gaming environment.

## **Purpose of the study**

The study followed the following objectives:

1. To prepare PowerPoint mediated independent learning Science modules for sixth-grade students.
2. To examine the effect of PowerPoint mediated independent learning Science modules on the students’ learning achievement.

## **Hypotheses**

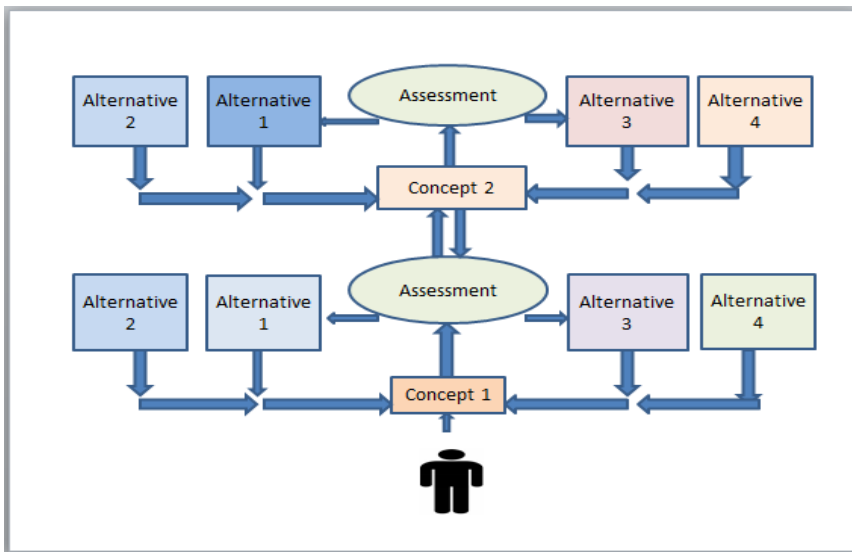
The study tested the following null hypothesis in order to establish the effect of teaching through PowerPoint mediated modules:

- H<sub>0</sub>.** There is no significant difference in the achievement of the intervention group taught through PowerPoint mediated modules and those having traditional chalk and talk method of teaching.
- H<sub>1</sub>.** The achievement of the intervention group taught through PowerPoint mediated modules was better than those having traditional chalk and talk method of teaching.

## **Material and Methods**

The researchers developed a PowerPoint mediated module following principles of programmed learning (Skinner, 1959), later proceeded to adaptive learning (Beldagli & Adiguzel, 2010; Goldberg, et al. 2012; Lee, & Park, 2008; Mödritscher, Garcia-Barrios & Gütl, 2004). A sum of 3425 slides containing 12 chapters of Punjab Curriculum and Text Book Board’s sixth grade General Science book were prepared to present conceptual units in the adaptive learning sequence. Each chapter was distributed in further sub-topics as a compact module for independent learning. These modules were prepared as PowerPoint presentations in the ‘.ppt’ show format, however, one of the sample modules was uploaded to Google through a web application prepared with Python 3.6 and Django 2.0 at (<http://elearningsamplemodule.info/>) for online access. These presentations were prepared in a branched framed sequence. There were introductory slides incorporating text, audio, video or mind map elaborating a single concept followed by an assessment slide having a multiple-choice item for testing the comprehension of the given content. If the learner clicks the correct answer, the slide shows the next concept and if he/she clicks the wrong answer, the slide takes the learner to an alternative explanation which is either relevant text, audio, video, concept map or flow chart to grasp the same concept with another angle. The learner proceeds in an independent and autonomous individual pace with this recursive process. Both slow learners and

faster students have command on their pace and this attribute helps mitigating individual differences. All students can learn at their own pace until they are able to answer all questions. If provided to a wider clientele, overall pace detection can be made to assess students' improvement. The following figure elaborates on the conceptual sequence of slides.

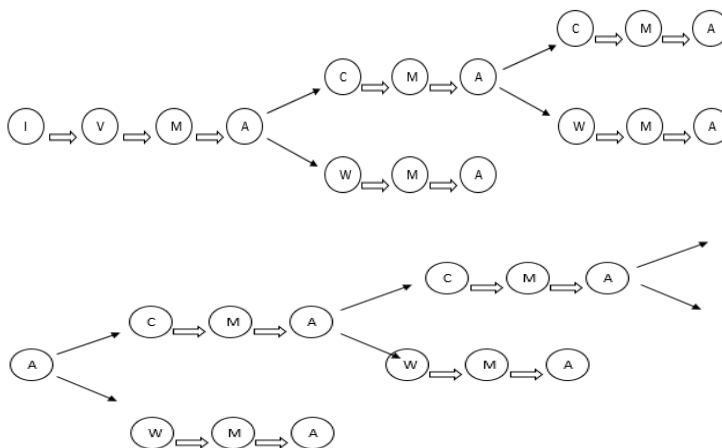


**Figure 1.** Slide sequence in the adaptive learning module

The slides used web material available on teaching and learning science web sites, YouTube and Punjab Curriculum & Text Book Board at [https://pctb.punjab.gov.pk/download\\_books](https://pctb.punjab.gov.pk/download_books) to deliver concepts related to sixth grade General Science book.

**Slide Sequence in a Unit**

Slides in a unit were arranged in the following sequence where 'I' depicts introductory material, 'A' shows assessment item, 'C' for correct feedback, 'M' for an alternative material, 'W' for wrong feedback and 'V' for video.



**Fig 2.** Arrangement of slides in a single topic

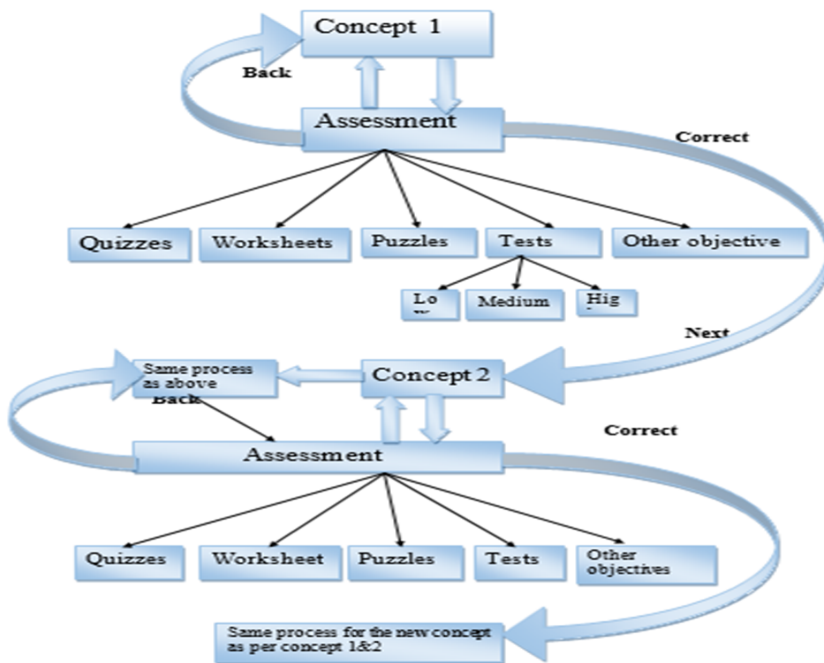


Figure 3. Sequential loop for one-unit slides

**Research Design**

As suggested by Elsendoom (1998) and Feng, Hochheiser, and Lazar (2010), evaluation of the e-learning course should be made both among groups and within-group to identify differences in their achievement. The present research, therefore, employed a pretest-posttest control group quasi-experimental design for comparing the effectiveness of PowerPoint mediated modules in sixth grade public and private sector students. Two intact experimental groups (female) each of N=30 were selected from urban public and private sector high schools. While two control groups; the parallel sections of the same schools, who were taught through traditional chalk and talk method at the same schools were engaged for pre and post-tests as per the following figure. A total of 120 participants in four groups of N=30 students participated in the study.

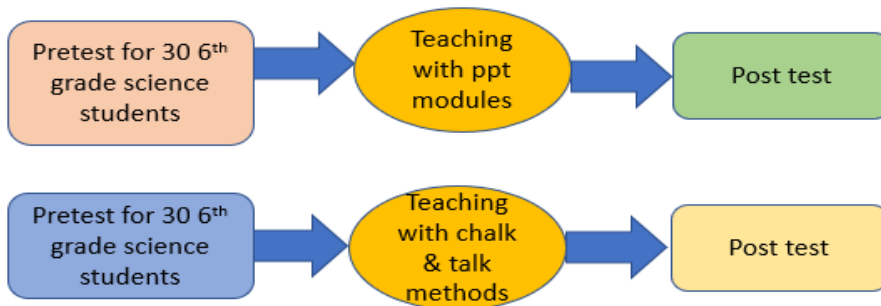


Figure 4. Quasi-Experimental Pretest Posttest Control Group Design was used in a Public and Private School Both intervention groups were taught with the help of PowerPoint mediated adaptive modules during the middle of their session at their computer labs. The researcher engaged experimental groups for a one-hour class daily for

one month excluding routine holidays where the control groups were taught with the routine chalk and talk method.

### Instrumentation

All 120 participants of the research were administered a fifteen item multiple-choice pretest before the intervention started. After completion of the one-month modular intervention, the same test was administered to all participants. The students were informed that the test was not going to influence their grades. The face validity of the test was examined by the school subject teachers and the test-retest reliability of the instruments was .824. The item difficulty for the test items ranged from .42 to .87. The content validity was ensured by adding approximately one item from each chapter.

### Analysis of Data

As suggested by Knapp & Schafer (2009) who stated, “Nothing is more straightforward than comparing the mean change from pretest to posttest for an experimental group with the mean change from pretest to posttest for a control group in order to get some evidence regarding the effect of an experimental treatment” (p.2), the research hypotheses were tested through comparing gain score (post-test minus pre-test score) of control and experimental groups in public and private school separately to measure increase in learning at significant level and then comparing gain score of public and private sector experimental groups to see whether the increase in learning (gain score) is same across sectors. An independent sample *t*-test was used for all pairwise comparisons.

### Results

**Table 1.** Gain Score Means of Experimental and Control Group at Public School

		Group Statistics			
	Groups name	N	Mean	Std. Deviation	Std. Error Mean
Gain score	Experimental group	30	4.03	2.18	.399
	Control group	30	1.06	1.20	.219

A descriptive analysis of gain score of control and experimental group at public school reveals that students of the experimental group exhibited a higher increase in their respective scores with  $M=4.03$  as compared to students of the control group with  $M=1.06$ .

**Table 2.** Gain Score comparison on t-test for Experimental and Control Group at Public School

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Gain score	Equal variances assumed	9.661	.003	6.507	58	.000
	Equal variances not assumed			6.507	45.020	.000

The independent sample *t*-test was run to compare the gain score of control and experimental groups at the public school. There was a significant difference in the increased achievement of control and experimental groups with  $t(58)=6.507$ ,  $p = .003 < .05$ . The findings rejected the hypothesis that ‘There is no significant difference in the achievement of students taught with PowerPoint mediated science modules as compared to students taught with chalk and talk method.’

**Table 3.** Gain Score Means of Experimental and Control Group At Private School

	<b>Control and experimental groups at private school</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Std. Error Mean</b>
Scores of control and experimental groups at private schools	control group	30	3.00	1.20	.21
	experimental group	30	6.66	1.95	.35

The mean score analysis of control and experimental groups at private school also revealed that students of the experimental group showed a higher increase in their learning with Mean = 6.66 in comparison with a control group whose cumulative learning increase was only M=3.00.

**Table 4.** Gain Score comparison on t-test for Experimental and Control Group At Private School

		<b>Levene's Test for Equality of Variances</b>				
		<b>F</b>	<b>Sig.</b>	<b>t</b>	<b>df</b>	<b>Sig. (2-tailed)</b>
Scores of control and experimental groups at private schools	Equal variances assumed	6.052	.017	-8.753	58	.000
	Equal variances not assumed			-8.753	48.241	.000

The independent sample t-test was run to compare the gain score of control and experimental groups at the private school. A significant difference in the increased achievement of control and experimental groups was identified with  $t(58)=-8.75$ ,  $p = .017 < .05$ . These findings also rejected the hypothesis that ‘There is no significant difference in the achievement of students taught with PowerPoint mediated science modules as compared to students taught with chalk and talk method.’

**Table 5.** Gain Score Means Of Public And Private Experimental Groups

	<b>Public and private schools</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Std. Error Mean</b>
Gain scores of public and private schools	public school	30	6.100	2.040	.372
	private school	30	6.666	1.953	.356

**Table 6.** Gain Score comparison on t-test for Public And Private Experimental Groups

		<b>Levene's Test for Equality of Variances</b>				
		<b>F</b>	<b>Sig.</b>	<b>t</b>	<b>df</b>	<b>Sig. (2-tailed)</b>
Gain scores of public and private schools	Equal variances assumed	.079	.779	-1.09	58	.27
	Equal variances not assumed			-1.09	57.89	.27

Finally, the independent sample t-test was run to compare the gain score of experimental groups of both public and private schools whether they exhibited the same increase due to the intervention of PowerPoint mediated modules. The results declared with  $t(58) = -1.09$  and  $p = .779 > .05$ , that there was an insignificant difference in the learning increase (gain score) of both experimental groups proving that PowerPoint modules were equally effective for children of two sectors having different contexts.

## **Discussion and Conclusion**

The findings of this experimental study have multiple implications for the production of independent and adaptive learning PowerPoint mediated modules for all subjects and topics supporting Tang, et al. (2019). Apart from a significant increase in the learning achievement of early elementary students, these modules provided learners a pleasant gaming environment as suggested by (Kankaanranta, 2017; Wang, 2019; Westlin, et al. 2019) because students were pushed towards new concepts on the requisition of providing the correct answer to the presented questions. Due to the provision of quick feedback (Kay, 2019), students learned in the minimum time and were excited to run the PowerPoint show till the end of the topic with consistent motivation (Eyupoglu, et al. 2019). The modules possessed features of adaptive learning (Schmid, et al. 2019) because students were guided to weaker areas with alternative sources through; videos, flow charts, audios and pictorial illustrations when they clicked the wrong answer. The current study is not only in line with several types of research (Rohr, 2019; Worku, 2019; Uzun & Kilis, 2019) that explored the effectiveness of PowerPoint functions, but it has added a new dimension to the use of the program in a more productive and personalized way. It is important that the researchers have found scarce empirical experimental evidence previously about the use of PowerPoint for adaptive learning purposes. The study brings food for thought to explore further features of the program and especially more specific need-oriented modules (Ülger, et al. 2019) addressing students' deficient areas. The modules may be prepared with wider incorporation of other supporting media which could be incorporated in slides as suggested by (Gordani, et al. 2020; Cummings & Saunders, 2019). The study also highlights the need for pedagogical designing of content for a better sequence as per the principles of learning (Garton & Copland, 2019). As mentioned in this report, the modules could be used for LMS and online education (Sharif, et al. 2019). As given in the sample, prepared in Python 3.6 and Django 2.0, the modules could be uploaded to search engines for wider dissemination and open access for all those in need of personalized instruction (Tang, 2019; Bouffard, 2019). The study suggests the use of PowerPoint modules for blended learning for bridging individual gaps in the classroom and out of class for flipped classroom practices (Bognar, et al. 2019; Hung, et al. 2019). Modules could be provided in CDs for areas where internet is not available. Finally, being the most familiar and user-friendly program for teachers and greater in cost-effectiveness, the more these modules could be used, the wider the goals for quality education (Shah, et al. 2019) and gender equity (Wetheridge, 2016) could be achieved. Thus, producing the modules for the larger population; students of primary, elementary and tertiary education, vocational and entrepreneurship training, teachers' professional development, can help to achieve SDGs goals providing 'education for all'.



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