Development of an Adaptive Learning Module Using Attributes of PowerPoint Show

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ABSTRACT--*The present research is a type of research and development where researchers have prepared an adaptive learning module for subject of science, consisting 12 chapters, for 6th grade students in Pakistan using attributes of PowerPoint show. The module uses principles of adaptive content and adaptive assessment for personalized instruction. Taking all 6th grade students of District Lahore as the population of the study, the researchers selected three experimental and three control groups who were intact groups with, N =30 each, from three different schools of district Lahore. Total 180 students participated in the study. The module was assessed through a quasi-experimental, pre-test post-test experimental and control group design on three diverse groups of 6th grade science students; in the beginning, during and at the end of 6th grade year. The experimental groups showed a significantly higher gain score as compared to their competitive control groups. The module was refined in the light of findings and feedback of students during adaptive learning session. The study has implications for using such modules for reducing time span of learning, keeping students engaged and active, coping students' individual pace and mastery of learning.*

Keywords-- *Adaptive learning, programmed learning, module, Science subject*

I.   INTRODUCTION

The use of computers and Information Technology (IT) for learning has been in practice since 1950. The machines designed at that time for programmed learning are considered antiquated and old now. Improvements in IT, accessibility to the internet, and increasing trend of utilizing web technologies in the learning process have enabled even a layman to use computers and IT for varied purposes. Despite continuous soft-ware research and creation of web applications, technology has not been fully exploited in the field of education (UNESCO, 2011). It is imperative to modify and adapt learning materials according to developments in educational approaches which may vary as per individual competencies of the students and their learning styles. Before we proceed to highly refined Intelligent Tutoring Systems (ITS), exploiting the simple technology can make education more accessible, easy and productive. The present research is an endeavor to provide students an adaptive learning module based on PowerPoint attributes for off line and online use through a user-friendly web application.

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II.   LITERATURE REVIEW

According to Brusilovsky (2005), education is the key factor in development of a country. The huge difference in developed and developing countries is the quality of education and perhaps the digital divide (Hawkins, 2002). There are little opportunities for attending school, especially in the rural areas and low financial zones of under developed and developing countries. Although in article 26 of the 1948 UN, Universal Declaration of human right (Human Rights, 1948) raised the importance of free education for all as the basic human right yet the world could not achieve this target and the slogan, 'education for all' remained still one of the agenda of SDGs, Sustainable Development Goals (2015). It was confessed by UN assessment of the MDGs (2015) that "The assessment of progress towards the MDGs has repeatedly shown that the poorest and those disadvantaged because of gender, age, disability or ethnicity are often bypassed."

Where other measurements are taken to reach to these deprived and underprivileged groups, technology is one of the tools to increase the accessibility of educational content and delivery through several distance and remote learning management systems. The concept of free, flexible and adaptive learning is more suitable to reach the targets of extendable educational inclusion. Creating an educational environment of independent learning is helpful for those who have no access to educational institutions. Furthermore, the concept of adaptive learning is equally useful for coping individual differences within the class. The students who lag behind the class and need more time to learn the concept can be helped by providing them the control of their own learning through adaptive learning environment.

III.   ADAPTIVE LEARNING

Adaptive learning is an educational method in which computers are used as interactive teaching devices, and these are organized according to the provision of human resources and requirements of the learners. Computers present the educational material according to the learning needs of the students, as their responses, experiences and tasks indicate. Modern technology covers all fields of study i.e. primitive to advance. Adaptive learning is used for many kinds of educational methods such as computerized adaptive testing, adaptive hypermedia and computerized adaptive testing. Adaptive learning system can be divided into different models (Sufian, 2011). i.e.

1) Expert model   --- In this model, information is taught
2) Student model --- Indicates the student learning track
3) Instructional model --- Information is conveyed
4) Instructional environment --- Users line of interaction with the system

Technologically supported learning environment

When hard and soft technologies are incorporated into a single platform or environment, to attain specific goals for increasing the students learning process, it is called adaptive learning environment. There are specific types of adaptive learning environments, as follows:

Adaptive Hypermedia environment

According to (Brusilovsky, 1996), Adaptive Hypermedia system or environment starts from an intelligent teaching system and it combines with the instructional system. For this purpose, two types of adaptive hypermedia systems are used (1) adaptive content presentation (using different media formats), and (2) Learning path (by direct guidelines, hiding, recording, or by interpreting the links etc. (Kinshuk & Lin, 2004).

Adaptive Educational Hypermedia Environment

A specific kind of adaptive hypermedia system is called adaptive educational hypermedia environment. The hyperspace focuses on specific topics (Brusilovsky, 1996).

Collaborative Learning Environment

Crowder (1959) said that an alternative approach of individualized learning is called collaborative learning. According to this technique, students learn more and more when they work together; they negotiate with each other and share the meanings of relevant problems. Soller (2004), explains various techniques as probabilistic machine learning.

Simulation and Immersive Environment

Simulation and immersive environment maintain the learner model by (Rickel, 1997; Shute, 1989; Zeitoun, 2008) which is a simulated and immersive environment where the students can change their parameters as per their accord. The literature reveals four major approaches of adaptive learning, which are: macro-adaptive approach, the aptitude-treatment interaction approach, the micro-adaptive approach and the constructivist-collaborative approach. The first three approaches focus on the content learning process. All four approaches are discussed below:

Macro-adaptive approach

It was put forth in the early 1900s; it considers the following learning components: objectives, detail level and delivery system etc. (Shute, 1989). In this approach instructional methods are selected only for the student's achievement goals, their ability to learn and their level of progress in the curriculum.

(Como, 1986) presented a taxonomy for systematic guidance (e.g. developing of new skills or compensation of student's weaknesses), based on the student's aptitude, their intellectual abilities, their cognitive and learning styles and overall personality. Glaser (1986) presented a praxis-oriented model for the macro-adaptive learning system. It defines the learning content, developing the competencies of the students and providing different objectives according to their needs and abilities.

Aptitude-treatment interaction approach

This approach treats the student's specific characteristics in relation to instructional strategy. According to Cronbach (1987), e-learning environment provides a suitable environment to a wide range of students.

Micro-adaptive approach (Constructivist-collaborative approach)

This approach follows the modern rules for e-learning during the learning process. A very important element for this approach is that in this method, collaborative technologies are used (Lennon, 2003). Computer based learning mostly focuses on conceptual knowledge and technical skills(Andriessen, 1999). There are many criticisms of computer based learning systems; primarily, that they are limited in range, only rich people can access them easily and only experts can adopt them. In the end of nineteenth century, different researchers started examining these approaches.

In constructivist learning theory, the learner can play an important role and construct his own knowledge by experiences during the learning process. (Akhras, 2000) argue that it enables the learner by pointing out how knowledge is gained. For this purpose, a learner has to consider the context, learning activities and cognitive structure of the material etc. According to the (Wasson, 1990), during adaptive learning students' motivational factors combined with the instructional plans are further divided into two parts a) planning for the selection of new topic to teach, b) planning for the selection of teaching pattern for the new topic.

History of adaptive learning

Reiser (1987)gives the idea of some early projects such as Burke plan, Dalton plan and Winnetka plan, in which the learners were permitted to study as per their personal effort. Since at that time, macro adaptive instructions were regularly used in the class, most commonly it included information by asking different questions, to monitor students' reading and learning process, it also provided a complete feed back to the learners. During 1963, macro adaptive system was called Keller Plan (At Columbia University, in 1968, Keller and his associates developed a system called Keller Plan). In this plan, instructional method was personalized for every learner and was developed in Columbia University. In 1965, a comprehensive type of macro adaptive instructional system, called "Individually Guide Education (IGE), was also developed, in the University of Wisconsin.

Importance of adaptive learning and e learning

Adaptive learning is considered to be very important in this age of technology for the following reasons:

1. It provides flexibility of time, place and duration (Smedley, 2010).

2. It eliminates the barrier of shame and the fear of talking in front of others.

3. E- Learning motivates the student to interact with content as per his/her personal pace (Wagner, 2008).

4. It is cost effective because there is no need of travel for the student or the learner neither there is need of specific place or building.

5. It eliminates the individual learning differences. Some learners give specific preference to one part, some to the other and some would want to study the whole material (Zeitoun, 2008).

6. The learner's activities are analyzed according to their preferences (Francois, 2011; Paramythis, 2004).

Shifting paradigm from programmed learning to adoptive learning

The adaptive learning is a variation of programmed learning, a renowned movement by Skinner during 1950s. There was an abrupt rise and fall in the popularity of programmed learning from 1950 to 1970 (McDonald, 2003).

The proponents of programmed learning (Crowder, 1959; Skinner, 1959) were of the view that it was the best technological way of learning through machines because it was initiated based on behavioral theory of operant conditioning (Casas, 1997). Later in 1970, it was considered, boring and rigid because it isolated students from a lively classroom environment(McDonald, 2003).

However, the salient features of programed learning; being self-paced, modular, automated and provision of immediate feedback were incorporated later in online learning programs and almost all e-learning instructional material(Daniels, 1999).

The e-learning technology also followed the concept of presenting content material bit by bit or in frames to guide the learner in a sequence of simple to complex and concrete to abstract. They further incorporated element of assessment and feedback to engage the leaner (Skinner, 1959).

Adaptive learning system is to provide the modified content to the students, specifically learning material (Aroyo, 2006). For example, Smedley (2010) proposed a well-planned learning system which was suitable for the learners and guided the students. (Tzu-Chi Yang, 2013) made an adaptive learning system for the subject of mathematics at secondary school level. They kept in mind their learning system and the difficulty level of the students. Several universities in the technologically advanced countries, have prepared and used adaptive learning programs for dissemination of their courses and to bridge the individual differences, however, the outcomes of such programs have been established in a limited way because the technologies have not been opted in developing countries at large.

Another important factor making hindrance in establishing effectiveness of these adaptive instructional programs is that usually researchers find smaller sample who have used it. Therefore, it is difficult to generalize or fully explore the outcomes of using and incorporating adaptive learning for common educational purposes(Verdu, 2008).

The adaptive learning programs can be managed through well-equipped high strength servers, with big organizations managing the macro data behind. While in Pakistan a self-sufficient, independent, economic and accessible management system is not available or accessible to masses.

Therefore, apart from complex adaptive technology, the researchers, keeping in mind the characteristics of a simple soft-ware which is accessible, affordable, usable and available to all using simple personal computers, have been used to develop a module congruent to the characteristics of adaptive learning. The PowerPoint is preferred due to its frequent use in instruction within and out of classroom-for online and offline learning purposes.

A successful technology aided program uses multiple resources because learning is considered to be a complex process (Adeyanju, 1997). These resources are defined by (Singh, 2005) as: "Any device which by sight and sound increases the individual's attention during learning is called a learning aid". Learning aids include pictures, charts, maps, videos etc. Visual aids strengthen the control and confidence of the student.

(Bryant, 2000) has stated that PowerPoint is capable of presenting complex interactions (Mason R., 1998) of learners with material of different colours, shapes, video, audio, maps, flowcharts, graphics, animations and any other aid used by computers in an effective way with long lasting effects. PowerPoint presentations incorporate graphics, animation, and color (imagery) supporting all human information processing theories; analysis, synthesis, encoding etc (Moore, 1996; Paivio, 1986).

Further, many features like, use of hyperlink, animations, transition, setting shows (automated or manual sequence of slides) makes it easy to create interesting and dramatic sequence of content to capture students' interest (Creed, 1997).

In Pakistan, several universities are offering online and blended programs such as Agha Khan University Karachi, virtual university, Lahore, Allama Iqbal Open University, Islamabad, but still e-learning is not taken up as an independent source of teaching students at school level. It is obvious that at schools, students face many problems in mastering the concepts for which several academies, tuition centers and very costly home tuitions are needed to bring students to the level. The government has provided almost all the secondary and higher secondary schools with functional computer labs but researches reveal that these labs are not fully used for content delivery. Only ICT courses are taught there or some computer related assignments are given to the students. There are no provisions available for individual learning to help and provide flexibility for those who have no access to schools.

This research focuses on preparing an adaptive learning module using the attributes of PowerPoint, and a web application which can help students with in and out of school and enable them to learn independently. The module has implications for all academic levels including intermediate and university education. Furthermore, the research has considered the cost effectiveness of the course material and accessibility to all low economic group of students.

IV.   STATEMENT OF THE PROBLEM

The attributes of PowerPoint incorporating principles of adaptive learning were considered important for producing a compact learning module specifically for course design at lower elementary level and assessing its effectiveness. The researchers intended to develop an adaptive learning module for subject of science at six grade level.

Objective of the study

The study focuses on the following objectives:

1.   To develop an adaptive learning module for the subject of General Science at grade six using attributes of PowerPoint.

2.   To assess the adaptive learning module for Grade six General Science thorough experimental design and class observation.

3.   To refine the module in the light of findings.

Significance of the study

The study was categorized as research and development by purpose and by method it was an experimental research with pre test post test control group design.

1.   This study is useful to add technology to fill up individual gaps and accelerate the learning pace of children having outstanding potentials.

2.   The module is helpful for instructional technicians and teaching practitioners to develop further modules in different courses and at different levels.

3. The module helps to shift the paradigm of classroom teaching to flip classroom, online and on campus adaptive learning teaching.

4. The students are the main beneficiaries of the study who will be able to learn with the flexibility of time and space without the teachers help at any point.

5. The study may be replicated for higher levels to develop technology led courses.

Hypotheses

For determining the effectiveness of module, following hypothesis were tested during the study:

Ho1: There is no significant difference between the achievement gain score (General Science) of the control group and the experimental group at grade six in the beginning of the session.

Ho2: There is no significant difference between the achievement gain scores (General Science) of the control group and the experimental group at grade six during the session.

Ho3: There is no significant difference between the gain scores (General Science) of the control group and the experimental group at grade six at the end of the session.

Ho4: There is no significant difference in the gain score(General Science) of the three cohorts.

Delimitation of the study

The study was delimited to the 6th grade students of subject General Science in Lahore

V. METHODOLOGY/MATERIALS

The research in hand by purpose was 'research and development' and by method it was an experimental study. The research design draws upon three phases; the design phase (Allan Collins, 2004; Brown, 1992) experimental phase and developmental phase. The process research (Richey, 1996) includes all three phases of the study; design, evaluation and development.

Phase I

Through process research, a theoretical and technical background of the programmed adaptive learning module was constructed for use of online learning management system and off -line CD development using attributes of PowerPoint for those students who do not have any access to the learning management system. The researchers converted the text book related material of 6th grade General Science book into chapters, units and topics. The concepts were presented from simple to complex on a series of slides with the help of pictures, flow charts and videos for the learner. Then there was an assessment slide with a multiple-choice question related to the content learned. The correct answer led the learner to the next concept with an appreciation note. If the learner clicks a wrong answer, the slide shifts to an alternative of the content material; video, text, picture, flowchart, table or map etc. for further understanding. The learner is led back to the question slide with another chance to click the correct answer. Each slide is given a button or icon to be clicked for the next slide. Finally, the presentation is converted into a show so that the learner has to go through the sequence suggested by the presentation. Thus, based on

programmed learning modular style, the presentation provides an independent adaptive learning module for the learner to master the concept.

Phase II

In the second phase, the prepared module was applied (introduced) to the students of the experimental group (pre-test post-test design) after pretesting of both the experimental and the control group. The module was taught to three different intact groups at two different schools, one private and one public school, at the beginning of the session, after (one month), at the middle of the session (six months) and at the end of the session (9 months). The students completed the module from two to four weeks during the session. During the induction of module, periodical assessments were taken for monitoring the formative progress of the students and functioning of the module. The module design was improved as per requirement and the performance indicators of the students.

After the completion of experimental tenure, all students were post tested through cumulative achievement test. The design and experimental research procedure complemented each other for the modification of the module. The design provided the conditions for the experiment and the experiment lead to the refinement of the module.

Phase III

During the third phase, the module was refined and developed for future use in the schools for six grade students. The researcher presented different recommendations for the development of modules for other levels and subjects.

Population of the study

As the study was conducted in three phases, for the second phase of the experimental evaluation of the module, the population of the study included all the students of six grade in all the elementary and secondary public and private schools of Lahore, Pakistan.

Sampling

The quasi experimental study was conducted with six intact groups; three experimental and three control groups (N=30) each, selected from the public and private schools. The table below shows the number of students of control group and experimental group.

Table 1: Sample distribution of participants

	Experimental Group	Control group	Total
Cohort I Beginning of the session)	30	30	60
Cohort II (Middle of the session)	30	30	60
Cohort I (At the end of the session)	30	30	60

Inclusive criteria

All six grade students having access to the technology (computer mediated programs) were included in the study.

Research Instrument

A set of chapter wise achievement tests; two chapters, six chapters and full course (twelve chapters) achievement tests consisting the concepts of content of module (General Science Text Book) were used for pre-test and post-test achievement of the 180 experimental and control group students. Each test contained fifteen multiple choice items related to the topics.

Procedure of data collection

After the identification of technology accessed six graders, the researcher selected 60 six graders from randomly selected public and private schools (30 from each school). The 30 students from the same school were also taken as the control group, i.e section 'A' was taken as experimental group and section 'B' was taken as control group.

The following concept map was used for preparing a programmed adaptive learning module, which was used for the intervention/treatment.
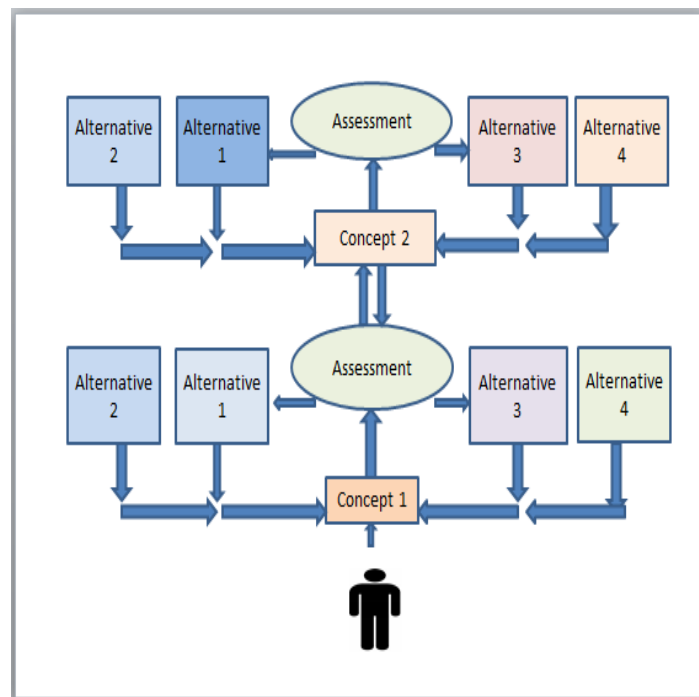

Figure 1: Concept map for Programmed adaptive learning module
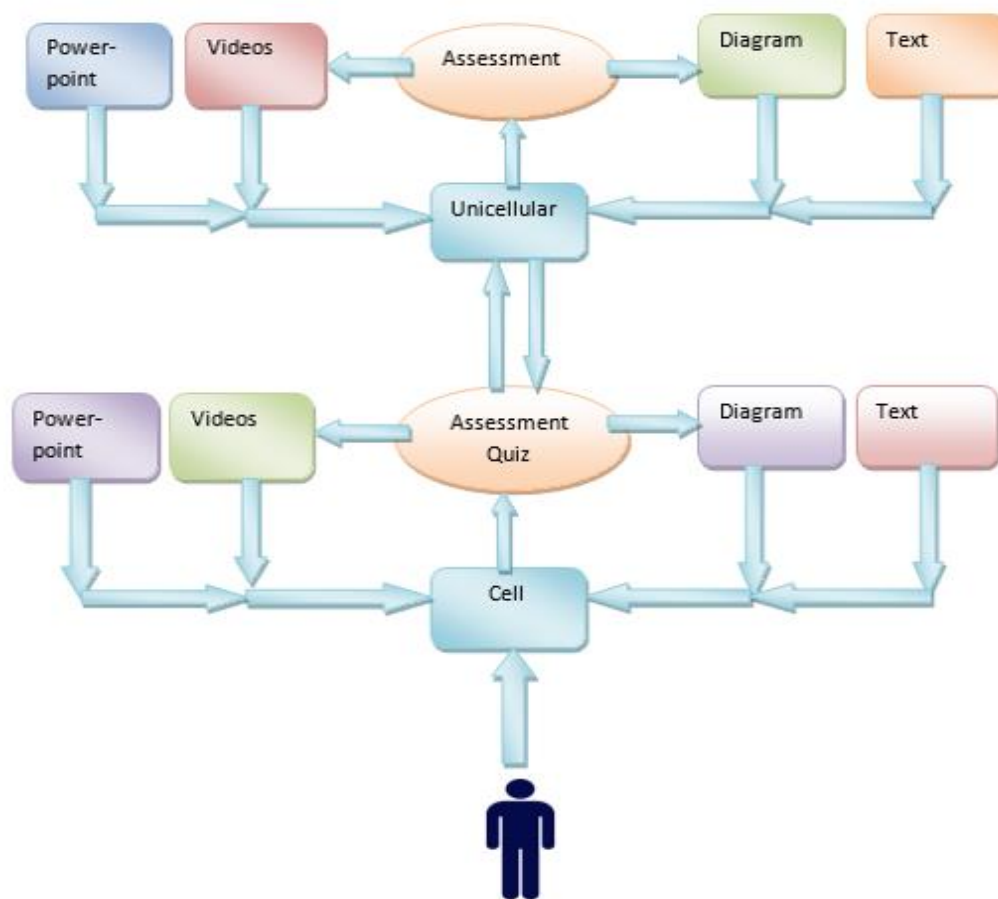
Example of one unit in module

Figure 2*: Example of one unit in module*

VI. RESULTS AND FINDINGS

Table 2: Table for independent sample t test for the gain score of experimental group and control group of

Cohort 1

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Gain score	Equal variances assumed	5.590	.021	-11.840	58	.000
	Equal variances not assumed			-11.840	44.828	.000

An independent sample t-test was run for finding the significant difference in the gain score of experimental and control group of Cohort 1. The t value was significant with t (58) =-11.84 and p = 0.021 < 0.05. It was found a significant difference between the values of control group and experimental group gain score at the beginning of the session. The first null hypothesis claiming that there is no significant difference in the gain score of experimental and control group of cohort 1 is rejected. The graph of mean score for pre test, post test and gain score for Cohort one is given below:
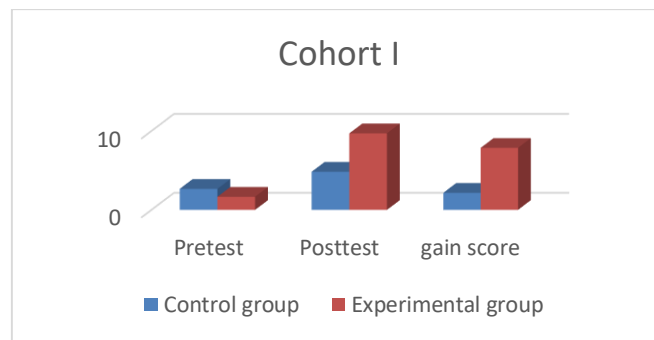

Figure 3: Graph showing scores of pre, post and gain score of Cohort 1

Table 3: Independent sample t test for the post-test of experimental group and control for Cohort II

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Gain Score	Equal variances assumed	7.53	.008	-10.127	58	.000
	Equal variances not assumed			-10.127	52.720	.000

The table above depicts that an independent t-test was conducted on the gain score of the students of control and experimental group. The t value with t (58) = -10.127 and p = 0.008 < 0.05 indicates that there is a significant difference between the gain score of control group and experimental group after intervention. The second null hypothesis is rejected that there is no significant difference in the gain score of experimental and control group rejected therefore.
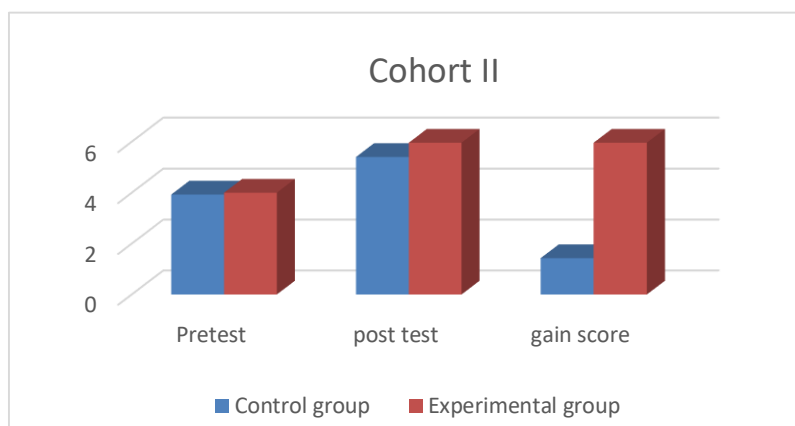
Figure 4: Graph for pretest, posttest and gain score for the running session of Cohort II

Table 4: Independent sample t test for the mean score difference of experimental and control group of cohort III

		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 table above shows that an independent t-test was run for the gain score of the students of control and experimental group of the running session, Cohort II. The t value with t (58) = 6.50 and p = 0.003 < 0.05 indicates that there is a significant difference between the gain score of control group and experimental group after intervention during the session. The second null hypothesis is rejected therefore. The graph below shows the mean score comparison of pretest, post test and the gain score of Cohort II.
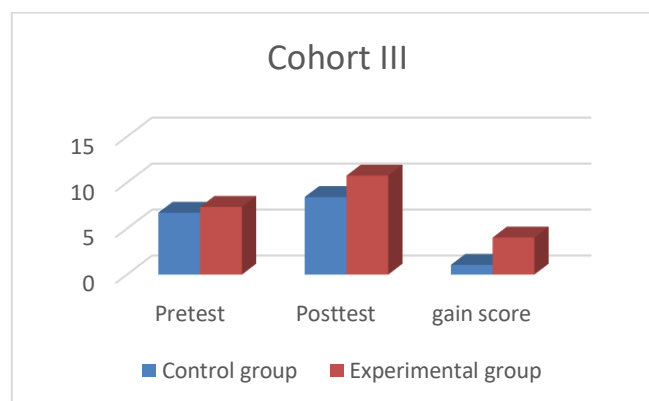

Figure 5: Graph for pretest, post test and gain score of Cohort III at the end
of the session

Table 5: Table for One Way ANOVA for the gain score of three cohorts

ANOVA					
Gain scores of Cohort I, Cohort II and Cohort III					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	272.689	2	136.344	27.858	.000
Within Groups	425.800	87	4.894		
Total	698.489	89			

A one-way *ANOVA* was applied to the gain score of experimental groups of three cohorts, the beginning session, running session and at the end of the session to find the significant difference among their mean scores. It was found that there was a statistically significant difference among the groups as determined by one-way *ANOVA* $(F_{(13, 76)} = 5.743$, p = .000<.05. The module was found differently effective at different stages of the session. The fourth null hypothesis is rejected.

VII. DISCUSSION

The findings of the study suggest that the PowerPoint module prepared by the researchers was exhibiting the features of adoptive learning; the learner's autonomy, flexibility of time and space, quick feedback, catering different learning styles, interest and engagement and focusing learner's weak areas. The study was inspired by programmed learning technological sequence of operant conditioning by Skinner (1959) and Crowder (1959). The movement later converted into complex adaptive learning modules using algorithm to develop a feedback mechanism to learners (Brusilovsky, 1996). It is interesting that using the simple attributes of PowerPoint, the same benefits; interest, engagement, adoption to learner's style of learning, mastery of learning, feedback and self-pacing can be achieved. The module is helpful for reducing the time of learning also. It can be used for bridging individual differences and for f(Tseng, 2011)lip classroom idea. The study supported the findings of Aroyo (2006), Karampiperis (2005), and Tzu-Chi Yang (2013) and Tseng (2011) who suggested that well planned and sequenced program can help accelerate learning in subjects like mathematics, science and languages. They further described that the program should consider the mental level of learners and their interests. The module is equally helpful for classroom teaching and the use for learning management systems. The students can interact with the module whenever they face difficulty within and out of the classroom. In response to the objection raised by (Andriessen, 1999) that, 'There are many criticisms of computer based learning systems; primarily, that they are limited in range, per se rich people can access them easily and only experts can adopt them." The present study suggests use of simple technology which is accessible for all practioners and teachers.

VIII. CONCLUSION

The study intended to develop a PowerPoint module having characteristics of adaptive learning for the Subject of Science for 6th graders. The researchers exploited the attributes of PowerPoint for incorporating multimedia included, pictures, flow charts, maps, audio, video and other illustrations in a sequenced way to provide the learner

a path from simple to complex and to provide an opportunity to understand the topic autonomously through alternative ways and get mastery over the concept. The researchers used programmed learning sequence with provision of feedback and multimedia options for the learner. The module was distributed in different chapters, units and topics. Later the module was converted into a web application for online use of leaners.

The module was assessed through three cohorts of 6th graders in different schools at different times. It was a pre test-post test control design. The study explored that students learned quickly and engagingly. They completed their module in two to four weeks depending the length of content which was tenth of the time they spend usually for their session. The gain score of all the three experimental groups was significantly higher than the scores of control groups. Therefore, the module was found effective for learning difficult concepts. The study, though, did not employed highly technical adaptive learning soft wares, yet it supported the usability of programmed learning with simple variations and as complementary aid for students to spend off line and online time for mastery learning and for the idea of flip classroom because it is an independent learning module coping the pace of learner. The class observations revealed that students enjoyed the lessons and had fun with diversity of media and language related to their topic. The study has implications for preparation of interesting and engaging modules for all levels of education. The tool used for preparing the module, PowerPoint is accessible for all teachers and practioners in developing countries like Pakistan, so it is easy to prepare all types of modules for all educational levels.

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