Redesigning the Design: A Review of Education Technology Interventions in Pakistan

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Abstract.
With new innovations in technology and decrease in the cost of technology, educational technology is increasingly seen as a panacea to educational problems in developing countries. Interventions are thus designed with a specific focus to help the students to develop literacy, numeracy and/or science skills. This paper reviews the design of educational technology initiatives in Pakistan using the framework of meaningful learning with technology by Jonassen et al. (2008) to understand the learning of students with these interventions. The framework of meaningful learning is based on the principles of constructivist learning and it focuses on the thinking skills of students. The results of the review of three large scale educational technology initiatives implemented in public sector schools reveal that the initiatives are designed to deliver academic content. The students are passive learners as teaching approach is teacher directed and students reproduce answers from the book to answer questions.

1. Introduction.

One focus of reform in education has been on measuring improvement in student learning by standardized test. Pointing towards this Jonassen et al. (2008) say, "unfortunately, the nature of the task that so many students most commonly experience in schools is completing standardized tests" (pg.2). Schools need to respond to changing needs of learners and students ought to become involved in meaningful tasks. Revisiting the curriculum and reviewing the teaching practices are areas of consideration by schools as they plan the change process. The change must be paradigmatic in nature to make a shift from teaching to student learning. Students need to be engaged in complex, cooperative, active and intentional learning while using technology for meaningful learning to take place (Jonassen, 2008). Even when students are able to answer questions on the standardized tests, deep learning of the problem does not always develop as indicated in the responses given by students (Wiggins & McTighe, 1998). Therefore, teachers who teach students to do well on the standardized tests may not always develop deep learning of the subject.

In the education sector, another reform has been placing computers in schools. The US Department of Education report of 1994 predicted that the placement of computers in the schools has increased and that this trend will continue to increase in the coming years. One perspective about technology is that the presence of technology in schools will improve student learning and the other view is that the money spent on technology and the time that students spent using technology is a waste of money and time. Many groups have reviewed the effect of technology on learning and have concluded that computers and related technologies can improve student learning only if they are used in an appropriate way (Cognition and Technology Group at

Vanderbilt, 1996; President's Committee of Advisors on Science and Technology, 1997 as cited in Wiggins & McTighe, 1998, p.198; Dede, 1998).

In this study, meaningful learning is seen as learning that is based on constructivist approach. In the constructivist approach, learners are actively engaged in the learning process where they interpret and process information which leads to construction of knowledge. Jonassen also advocates that meaningful learning with technology must lead to construction of knowledge by students. Technology can "be used as "information vehicle for exploring knowledge to support knowledge construction" (pg. 7). Technology can also work as an intellectual partner that helps the learners to reflect on what they have learned and construct personal interpretations and representations. The use of technology with constructivist perspective is particularly important for the analysis of data in this study because technology can be used in different ways.

In developing countries, education technology interventions focus on providing basic skills of literacy, numeracy and science to students and hence students end up learning from technology which limits students to passive learners. When technology is used in a constructivist way, students learn with technology, technologies do not convey or communicate meaning to students and neither do technologies control learner interaction, technologies are used instead to fulfill the needs of learners and it is the learner who controls the technology. In this study, the researcher will analyze the characteristics of technology integration in the selected edtech initiatives by reviewing the design of intervention, how technology is used by teachers and more importantly the kinds of experiences that students engage in with the use of technology.

In Pakistan today, local edtech landscape is expanding and exhibits a variety of solutions. Private sector entities and a host of edtech start-ups have also shown considerable interest and investment in edtech interventions. However, research on these initiatives to explore how students are learning is almost non-existent at present. The design of interventions as well as the use of technology by teachers will be analyzed from the perspective of constructivist approach to learning. Three edtech interventions that were implemented at a large scale and the time for implementation was approximately two years were chosen as a sample for this study. The first edtech intervention uses the model of live online teaching to teach students living in remote areas by an experienced teacher. Second edtech initiative is implementing primary grade Mathematics and Urdu content in 550 Centers by way of the tablet to target 21,000 out of school children. Third edtech initiative is targeting over 60,000 students to improve learning outcomes of children between grades 6 and 10. As such, no published research report and paper on the last two interventions are currently available.

2. Review of Related Literature.

Integrating technology into instruction in the classroom needs to be designed carefully to engage students in active, constructive, intentional, authentic and cooperative learning. If technology is just added to the existent teaching approach, we get, "educational practice that is technologically sophisticated, but still fundamentally conventional: using PowerPoint instead of a blackboard or overhead projectors for a classroom presentation…." (Rappaport, 2003, p. 28). Chen and Reimer (2009) also emphasize that integration of technology ought to give less importance to technology and emphasis should be on the use of technology by teachers to engage students in tasks

appropriate for different grade levels. It is critical that the introduction of technology should enhance the learning process for it to be an effective or relevant addition.

Technology integration becomes even more challenging in the context of a developing country, where there is a lack of support to teachers, the curriculum is not developed in depth, and assessment is based on rote memorization. Most research studies on the use of educational technology in developing countries tend to overlook the design aspects of learning, and the learning of students in terms of the use of thinking skills and knowledge construction. These studies focus primarily on test scores, which "don't necessarily provide evidence in a format that is useful or meaningful to practitioners, or those designing and implementing programs, or the teachers and students participating" (Power et al. 2014, pp. 35).

To address the critical questions of "how and why" the change occurred, and to understand the "extent" of skills and knowledge attained, educational technology initiatives need to focus on the design of the intervention and teaching practices in the classroom to ascertain learning of students. In order to develop conceptual understanding, students need to be engaged in tasks that require authentic, intentional, active, constructive and cooperative learning processes (Jonassen et al. 2008).

The theoretical framework for this study is based on the five attributes of meaningful learning propagated by Jonassen et al. (2008). The five attributes along with the corresponding indicators adapted from a study done by Kean & Kwe (2014) are listed below:

a) Indicators for Active learning:
    - Students manipulate objects and parameters of the environment
    - Students observe the results of their manipulations

b) Indicators for Constructive learning:
    - Students articulate what they have learned, and they reflect on an activity or observations
    - Students are puzzled by what they see or the experience and this leads to meaning making as they integrate new experiences with what they already know
    - Students establish goals for what they need to know, to understand what they have observed
    - Students make their own simple mental models to explain what they observe

c) Indicators for Intentional learning:
    - Students do skillful planning for doing tasks, or for researching a problem they want to solve
    - Students use technologies to represent their understanding and actions

d) Indicators for Authentic learning:
    - Learning tasks are linked to the meaningful real-world scenario or simulated in case-based or problem-based learning environments
    - Students practice ideas in real-life contexts

e) Indicators for Cooperative learning:
    - Students discuss with partners to have a common understanding of a concept
    - Students converse with peers to agree on the methods to accomplish a task

Many aspects of technology are used to set up learner-centered environments based on the principles of constructivism where learners engage in independent and collaborative learning. With computers, learners get access to a variety of tools and resources to work with. With internet students can work independently at their own pace and multimedia can be used to provide a different learning experience to students. Students also get a chance to share their experiences with others which leads to collaboration and peer learning (1999 Southwest Educational Development Laboratory). With technology students can also have access to interactive learning environments where students can explore things in detail by getting feedback on their input which helps them to test their ideas and develop deeper understanding of concepts. Video tapes are non-interactive learning environment and are less effective (Bransford et al. 2000).

Technology is not always used in a constructivist way, such as when students use the computer as workbook to choose the right answer, but students cannot change or manipulate information and neither do students get any feedback on their response which may help them to understand why their response is incorrect (Brown & Campione, 1996). Other such uses of technology are when technology is used to administer standardized tests. Papert (1996) contends that the important change with or without technology is to change the teaching and learning methodology:

> It is 100 years since John Dewey began arguing for the kind of change that would move schools away from authoritarian classrooms with abstract notions to environments in which learning is achieved through experimentation, practice and exposure to the real world. I, for one, believe the computer makes Dewey's vision far more accessible epistemologically. It also makes it politically more likely to happen, for where Dewey had nothing but philosophical arguments, the present day movement for change has an army of agents. The ultimate pressure for the change will be child power (p. 12) .

In this study, the researcher will focus on the changes in teaching and learning pedagogy that may happen with technology based on constructivist perspective and also on the design of technology in the selected edtech initiatives. The following research questions are explored in this study:

1) How is technology being integrated by teachers in the selected edtech interventions?
2) What factors in the design of edtech interventions inhibit or facilitate the use of technology?

Research methodology used in this research is described below.

3. Methodology.

Three types of educational technology initiatives were chosen as a sample for this study, based on the following criteria:

- The initiative is large scale (implemented in approximately 100 schools)
- Time for intervention has been approximately 1-2 years
- Representation from more than one province in Pakistan

Three educational initiatives met these criteria and were chosen as the sample for this study. The first initiative uses an online live teacher model to deliver lectures to students in far-flung areas of Pakistan. Subjects being covered are Mathematics and Science. The second initiative has developed videos to make learning interesting for learners by using a storyline to explain concepts in each video and by using cartoon characters. This initiative focuses on teaching Urdu (local national language of Pakistan) and Mathematics to students in lower primary grades, KG and grade 1. The third initiative used videos and gamification to teach Math and Science to students in grades 6 till 10.

This research used qualitative data to find out how technology is being used by teachers in the selected edtech initiatives and secondary data is collected from the website to explore the design of initiatives.

To find information on the first research question, classroom observations were done to find out how edtech intervention is actually being used in the classroom. Secondary information about design was collected from the websites of sample interventions. Non-participant observation notes explained the teaching and learning approaches being used in the school and hence are an important source of information to find out the ground reality. As already explained, constructivist perspective was used as the theoretical framework for this study.

4. Findings and Analysis.

Using the theoretical framework of Jonassen (2008), the websites of sample edtech interventions were analyzed to understand: 1) the design of edtech interventions; and 2) the design of videos and games being used. Classroom observations were done to understand the teaching and learning approaches.

The first edtech initiative uses the model of a live online teacher, who teaches concepts to students just like an experienced classroom teacher. Students listen to the lecture of the live online teacher and the class teacher sits at the back to make sure that students listen attentively. The live online teacher can see the students through a camera. At the end of the lecture, the teacher may ask questions and the students answer questions by raising their hands. This initiative has been implemented in public sector schools in rural areas where experienced and trained teachers are not available, and in certain schools, teachers are doing multi-grade teaching. The questions asked by the teacher are based on factual knowledge. The questions do not engage the students in drawing inference, making hypothesis, constructing knowledge, or relating knowledge to real life context. Students reproduce knowledge from the book to answer questions. Students are not using the five attributes of learning described by Jonassen (2008).

In the second edTech initiative, videos are developed to make Urdu (local language of Pakistan) and Mathematics, interesting for students. Each video has an interesting storyline and uses cartoon characters. This initiative has been implemented in CARE foundation schools where free education is given to students from the neighborhood. There is a lack of resources in schools, for this initiative a special AV room has been set up with a TV where students watch videos once a week. Students watch the video silently and then the classroom teacher asks questions to test comprehension of knowledge.

As already stated in the review of literature, videos are noninteractive learning medium and hence are less effective for learning. The design of the video being one way by default makes learners passive. There are no activities at the end or during the video that make students active learners, and questions are not posed to facilitate construction of knowledge. Students do not engage in active, constructive, intentional, authentic and cooperative learning.

In the third edTech initiative, videos are developed to teach Math and Science to students of middle school. At the end of the video, MCQ questions are shown and students answer by using clickers. Responses of students are saved, and students get virtual coins for answering correct questions. This initiative is implemented in low cost private schools where schools buy the system from the edTech company and install a TV in classroom. The classroom teacher discusses the mistakes of students at the end of the lesson and shares the correct answers. Videos as already shared are a passive medium of instruction. Clickers in this initiative are not used to engage students in discussion on the submitted responses to facilitate construction of knowledge. MCQs in this initiative test basic content knowledge of students. In the current design of intervention, students are not engaged in active, constructive, intentional, authentic or co-operative learning.

In the three edTech initiatives mentioned above, students are passive learners and teaching approach is teacher directed. The focus of the initiatives is on finding techniques to have the content delivered to students so that the students understand the content. However, for students to transfer what they have learned and to process it a deeper level, they need to be engaged in active, constructive, intentional, authentic or co-operative learning (Jonassen et al, 2008). In the two edTech interventions, using live teaching and videos in the classroom, a clear message is sent to teachers in schools of their incompetency. If the focus of the edTech initiative is also training of teachers in the classroom then there needs to be a mechanism to fade out the delivery of content with technology, so that the classroom teacher learns pedagogical techniques and starts teaching independently.

Students are more than ready to think, to learn, to engage and to solve problems. Learning experiences need to be designed using the five attributes of learning to help the students to reach their full learning potential.

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