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Effective Integration of ICT in Science Class Room: A Technology Integrated System Model Approach

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Abstract

Technological integration in science education encompasses sound investment in view point of money, time and being. At the same time it gives rise many eye catching success summaries and faced the critical criticism for its pros and cones. With need of hour it is rectified a lot with ever changing dynamism. However there is certain unfilled gap i.e. usage gap, acceptance gap and the most important gap is the outcome gap. Furthermore tries to explore the cause of these unfilled gaps as well as provides some connotative measures to bridge the gaps. This article discussed some of the advanced technological integration into pedagogical practices to transform the science class room into an egalitarian and engaged platform. Also provides a technology integrated system model underpinned with teacher effectiveness, teaching effectiveness, school effectiveness and ICT planning in light of review for transformation of science class room. Extend its Emphasis on the professional development program for teachers (Modeling and peer coaching, teacher incentives and district resource center for knowledge generation) to foster the technology culture inside the science class room at the same time to make effective teachers.

Keywords: Technological Integration; Science Education; Usage Gap; Acceptance Gap; Outcome Gap; System Model.

Introduction

Technological integration and investment per capita increases manifold in the couple of decades, more correctly at the advent of 21st century. However the annals of history extend its suggestion that educator should renounce the technological use as it does not fit the social organization of schooling (Zhao & Frank, 2003; Cuban, 2005). Since 1920 different technological innovation raise its argumentative head i.e. T.V would replace textbook, radio would challenge the role of teacher and finally utmost argument comes forward with computer that it would simultaneously replace and challenge the role of teacher and textbook. Till now there is no reliable substitute of either teacher or textbook and the schools are dependent on teacher and textbooks. The content and intent behind this paper is not to argue that there is no role of technology in today's schooling scenario or the investment is wastage of time and money but in the other hand exemplify the success summaries like the information technology in education studies (Law, Pelgrum & Plomp, 2008.) that involves 28 countries of all five continent have shown that technology has been changing the classroom practices and learning processes. The second success summaries includes the project conducted by Apple computer called Apple classrooms of tomorrow (ACOT) aimed to explore the impact of computer saturation on teaching and learning in K-12 class room (Sandholtz,et.al.,1997) conducted over ten year period. The researchers found a positive impact on student engagement, motivation, higher order thinking, and in successfully completing complex tasks that emphasized interdisciplinary and project based instruction (Sandholtz et. al., 1997).

Current technology trend: Physical world vs. Digital world

The current day's technology is no longer a new tool which only enhances our lives but it is a part and parcel of our lives. We live more in the digital world/swipe mobile world than in the physical world. Many peoples are spending and sharing their physical world time by living in the

third or fourth life in the digital world. Internet user according to Global Internet Report (GIR),2014 Asia stood first i.e. 48.4%, then USA i.e. 21.8%, Europe 19%, Africa 9.8%, Oceania 1% of total user with respect to total gross population in current scenario. Whereas country wise China stood first about 21.97% ,USA 9.58% and India 8.33% internet users of total population. In June, 2010-11 there are approximately 1.97 billion users worldwide (GIR-2014), but recent report till September,2015 it has reached 3 billion which shows the growth, magnanimity and technology mania among world population. In class room context the learner is now less reliant on the physical text book, printed matters and teacher for information as it is all available in the Google world or in any search engine.

Technology Integration and Science Teaching

Science teaching is such a complex, dynamic profession that it is difficult for a teacher to stay up to date (Shawalter, 1984). Preparing better students for the daily invading science and technology, the current science education reform ask science teachers to integrate technology oand inquiry based teaching into their instruction (American association for the advancement of science, (1993); National Research Council [NRC], 2000). At the same time science teacher experiences various constrains such as lack of time, equipment, pedagogical content knowledge (PCK) and pedagogical skill in implementing reform based teaching strategies (Crowford,2000).

Technology Integration as Eclectic Pedagogy

Use of technology in class room and integration of technology are two different constructs. As the former indicates and decorates technology as a tool but the later direct towards the amalgamation of technology with teaching strategies to develop an innovative pedagogy to support the total learning system and learning heredity of the learner. Some of the effective technological integration that can transform science class room are:

Probe wares

Probe wares refers to the Micro-computer Based Lab(MBL) or Calculator Based Lab (CBL) i.e. learning tools that connects probes and sensors to the computer running suitable software and which allowed the learner to experience the real time data in a variety of format. From a different angle Probe ware also known as computer aided data collection devices, i.e. technology that can both capture and analyze data with the use of a computer or other digital interface such as a calculator or hand held device.

For example

A teacher who is helping students to explore the relationships between different types of motion (say for instance changing velocity and instantaneous velocity) and how they are displayed graphically, could use a motion detector in a large classroom setting.

Computer Simulation

Simulation is the technique of presenting the real world situation in the absence of reality. Computer simulations are useful in science teaching for simulating labs that are impractical, expensive, impossible and too dangerous to run (Strauss & Kinzie, 1994). In other words computer simulation is the use of computer to simulate dynamic system of objects in a real and imagined world (in both 3D & 2D view). At the same time simulation provides open ended experiences to the student (Sadler et.al., 1999).

As example

Simulation for river ecosystem with software “exploring the Nardoo” (a CD-ROM package) which helps the students to solve the problems like how mining, forestry and rapid urban development affect the river system. To solve problems students works individually and in groups, for this they encounter, integrate different activities like discussing, surveying, hypothesizing for solution, identify data source, collecting data, testing hypothesis and finally presenting the findings (Harper ,2000).

Mind-mapping tools

Mind mapping is a way to visually representing information and ideas or it is the structured way of representing the relationship between ideas which leads a concrete concept formation in the mind of the learner. Mind mapping enhance student learning in a number of ways (Suthers et.al. 2006.) The science teacher can use online software like bubble.us (cost free), SpicyNodes, Comapping, Mindmeister, MindManager web software for creating mind mapping or can use available free downloadable software like Xmind and much more free downloadable software for it. This technique will foster creativity, sustain the interest among the learner and student will make better connection between old and new knowledge more effectively than traditional expository methods (Hay et.al.,2008).

For example:

Mind map for pollution:

The manual mind map and mind map created by bubble.us as shown in fig no. 1.0 & 2.0 .

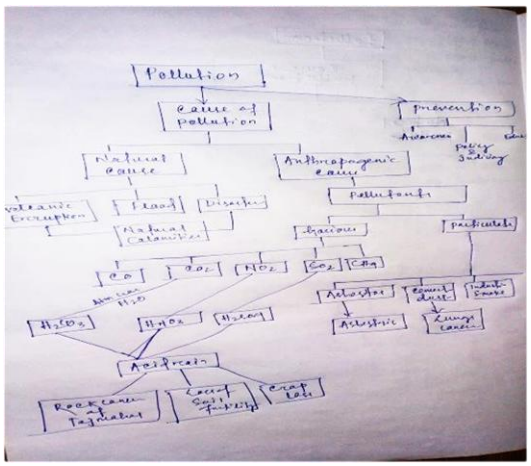

Fig-1.0 (Manual mind map)

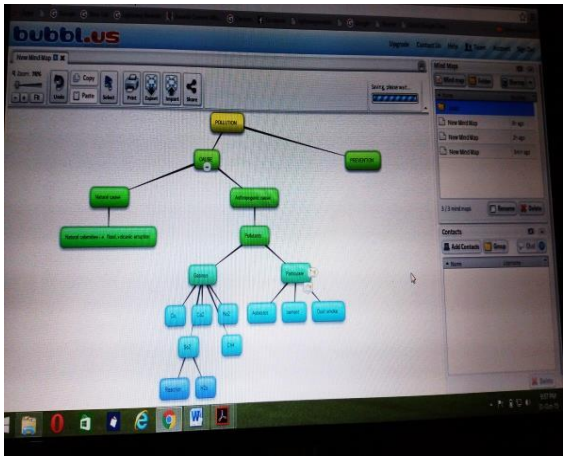

Fig-2.0 (mind map created by bubble.us)

Animated Movies

The use of animated movies was found to have a positive effect on students learning, motivation and thinking skills (Rosen, 2009). In science education abstract concepts and scientific phenomenon occurs in the microscopic level (cell division, ion transport, molecular movement and most importantly the cutting and joining of DNA fragments in r-DNA technology) can be attractively illustrated by animation. As animation is employed for enhancing the transition from abstract to concrete and vice versa (Barak & Dori, 2005).

Moodle Platform

Currently it is the best platform to track the record of the learner in digital form by the teachers and it works as an intermediate for sharing ideas, information, study materials, presentations, and assignments as well as getting corrective suggestions, feedbacks and critical comments from the peers, teachers and supervisors for rectification. It works as an information hub by budgeting information and reflections from both teacher and students.

Cloud Computing

It is a very cost effective and flexible media otherwise known as internet based computing which is a process to run a program in many computer with internet connection. Example: Google Apps, YouTube, twitter, drop box etc. The science teacher upload the class tutorials, any animated video about scientific phenomena on cloud server at any time and all user having different login for it can use, edit or give reflection by using computer or mobile device with internet connection at home or school 24×7. It also helps the teacher to analyze the strength and weakness of the learner and helps in developing and managing the interaction gap.

Virtual Classroom and Social Learning

Besides the above mentioned technology integration the science teacher may use virtual class room by using Interactive board, Multimedia, Internet application and interactive soft wares like screencast-O-Matic, Kinemaster, Kahoot, Froguts , Moviemaker & media synchronizer software to make the science class more democratic interactive, fruitful and more lively.

Gap between Technology and Pedagogical Practices in Teaching Science

The gap of technology integration in pedagogical practices for teaching science is the burning issue to address. Technology integration is hanging in between many constrained and conditions and these may be the technological resources of school, readiness of both teacher and students to use technology and the dynamics of social interaction in the school system (Byrom & Binghm,2001). The second difficulty to address is the dynamism of technology i.e. confronting with every morning fresh technology. Therefore a technology implementation plan that works at one time may not work at another, so a dynamic plan that reflect changes will work better than a static plan (Tondeur; Van keer & Valcke,2008). However there is no specific goal to achieve or no specific policy planning with clearly defined goal, which is directly concern with student learning (Fullan,2001).

Technology Trend and Usage Gap

The use of technology in schools is part of a complex network and change in class room technologies correlated to change in other educational factors (OECD, 2010). In one hand technology does not guarantee effective teaching, in other hand inappropriate use of technology can make learning task more perplexing and difficult. Therefore to address the usage gap, it is necessary to know who is using technology (well trend teacher having an appropriate techno-skill and well oriented learner or not). How it is used i.e. like tools means computer is used to reinforce the covered topic, internet is used to find information, students are using power point for presentation or integrated with pedagogy i.e compiling with content knowledge like animation to show cell division in biology or computer simulation to encounter refraction and reflection phenomena in physics. Finally the readiness of the teacher and learner to accept the integration is important.

Technology Trend and Acceptance Gap

This heading talks about whether the teacher, learner and administrator are open-ended (responsive and adoptive) to accept the change which is taking place in and around the techno-world for education as well as in the educational macro world. The dynamic coadaptation and coevolution of students, teachers and school leaders with technology and the system determine whether the opportunities of technology for teaching and learning can be realized in school (Zhao and Frank, 2003).

Outcome gap

An important issue is that always effect of technology is gauged with academic achievement of students quantitatively and it is very difficult to say that the achievement is due to technology intervention because many factors like environment, mutual interaction & intelligence of users may intervene in between the process. The evaluation is another question here i.e. who will evaluate the technology either teacher, student, administrator or the designer himself and if any of them evaluate then is there any pre-fixed standard on the basis of which we can say, yes the evaluation is proper or not. Definitely the answer is no, there is no standard evaluation method and technique or any fruitfully implemented technological policy and planning. So evolving the evaluation method and technique with fresh research is necessary.

Filling the gap

To fill the gap of technological integration in science class room, it is necessary to concentrate on four major components like (i) teaching effectiveness (ii) teacher effectiveness (iii) school effectiveness (iv) and ICT planning.

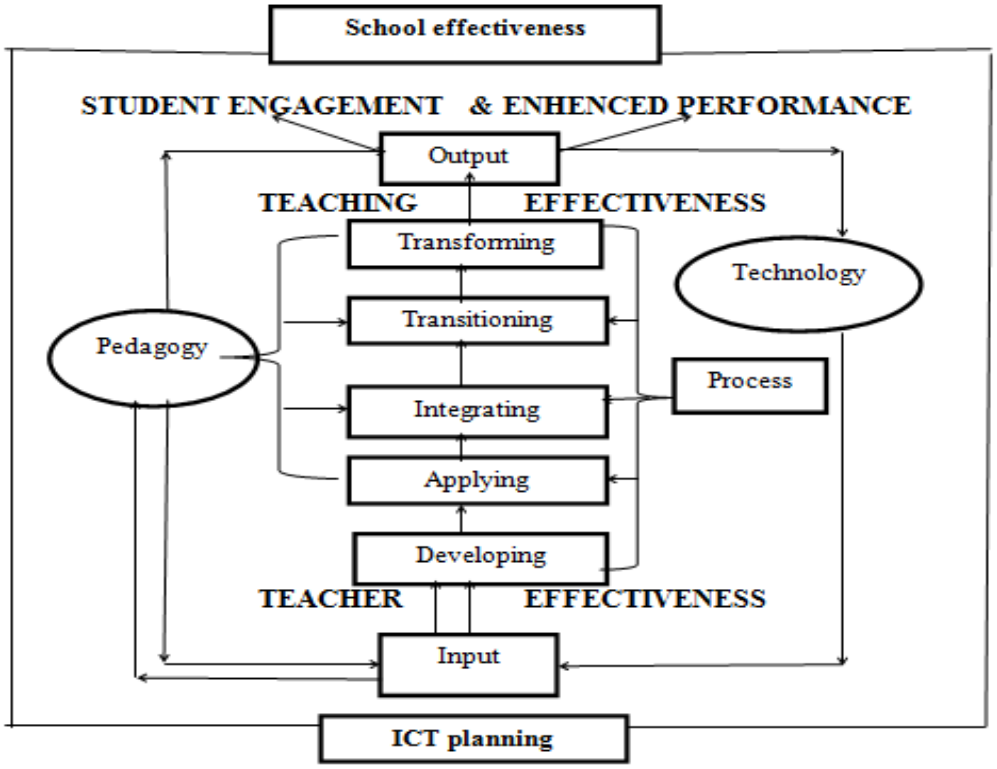

Fig: 3.0 (Technology integrated system model designed for transforming science class room based on review)

This model indicates the transformation of science classroom with techno-pedagogic amalgamation/integration in the learning ecosystem i.e. teacher effectiveness as input transform into teaching effectiveness and enhancement of student engagement and performance as output. The teacher will apply and integrate the techno-pedagogic strategies to transform the science class into an effective and eclectic platform in association with demanding learning environment.

Teaching effectiveness

Teaching effectiveness with technology depends on the brain compatible technology integrated method and strategies followed by the teacher to teach and to fulfill the learners need and aspiration. This needs successive refresher and orientation program for teachers in techno-pedagogic skills, training for how technology can be merged/ integrated into pedagogical content knowledge (TPACK). Flander's interaction analysis category system may be used to rectify and modify class room interaction in turn teaching. Burdsal & Harrison (2008) proposed that a multidimensional profile should be used to provide evidence for the overall evaluation of teaching effectiveness.

Teacher effectiveness

Teacher effectiveness is associated with the content, context and conceptual knowledge of the

teacher as well as positive expectations from students, enthusiasm for egalitarian class room climate, ability to make rapport with students. For all these qualities well planned effective professional development programs is a key component also for technology integration and fostering the technology culture in science class room. Effective professional development programs utilize: i) modeling and peer coaching methods to help teachers integrate technology and becomes coaches and facilitators of learning with technology as a tool. Again collaboration requires time during weekend /monthly a day to share ideas, experiences, success and challenges. ii) development of district curriculum resource center or building a school site for sharing activities, ideas, success, failure and challenges faced by the science teacher and how to overcome these challenges(individual views) can help ideas beget more ideas and innovations. Incentives for best ideas engender a best practice environment. Hence a district knowledge resource can be created iii) teacher incentives are yet another key component for teacher motivations to become effective teachers/facilitator.

School effectiveness

School effectiveness mostly hinge on the teaching and teachers effectiveness but sometimes an effective teacher may be in an ineffective school or vice versa. In this case the infrastructure of the school, equipment availability, technological lab and well organized science lab plays a very crucial role for making a school effective in all respect. In today's scenario the effective dissemination of scientific knowledge and imbibing scientific temper among the learner is possibly possible in practical integration of technology. As for instance Moodle can be used to keep the record of students, circulate ideas, teaching learning material, formal comment, corrective feedback as well as summiting assignment which is accessible to all learner and teacher, makes the school effective in due course of time with teachers accountability and students responsibility .

ICT planning

Without a proper policy and planning framework fruitful integration of technology seems a very tough task. In a technology policy plan, a school describes its expectations, goals, content and actions concerning the integration of ICT in education (van Braak & Tondeur, 2010). Technology integration is a complex process and a demanding task for teachers and school administrators. Gulbahar,(2007)found that even teachers and administrators who felt themselves competent in using ICT, reported that there was a lack of guideline that would lead them to successful integration . Learning technology and integrating technology in real life situation are two different foci. According to Fishman & Zhong (2003), technology plans are the interface between research and development in learning technologies and their actual use in schools. Hence it is the time to develop technology planning blue print for all stake holders including educational planner and for administrator at school level, for teacher at class room level, most importantly it should be a dynamic process to meet the situation demand. Collaboration with teacher training institute and corporate sector is a very necessary step.

Conclusion & Recommendations

The unprecedented invasion of technology waves a brain storming situation in educational sectors. The process and product oriented job i.e. teaching learning becomes more challenging at the same time growth provoking and phenomenal. Successful integration of technology helps in connecting the world with the network of scientific innovations and innovativeness (ideas, methods, techniques, strategies) within a fraction of second. Information inclusion is just approaching the peak. With the presence of all still some gapes in usage, integration, policy and planning makes the total process less efficient and ineffective. So it is the right time to fill the gap with evolutionary changes in curriculum, teaching practices and teacher education with technological integration. The science class room (especially the government schools) still searching for technological supplement and its students searching for something new, something interesting and something which is compatible to their brain. Therefore, it is necessary to adopt these underprivileged government schools by government and intellectual masses to bring them into the main stream with technological feedback. At the same time allowing the teachers to design the policy and planning as they are the true implementer and get exposed to action research every day, can make a change. Lastly the researchers should open up to freshness in their research and teacher's continuous experimentation in technology integration may works as a panacea for the unfilled gap of technology integration.

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