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Impact of Government and Private Funding on ICT Implementation in Education

Rejani KR[1] and Dr. Jyoti[2]

Research Scholar, Department of Education[1]

Assistant Professor, Department of Education[2]

Sunrise University, Alwar, Rajasthan, India

Abstract: *Despite its high cost, technology is now extensively used in education to improve teaching and learning. However, poor nations traditionally paid for pricey technology and training.*

This report recommends ways to lower the cost and boost the advantages of Information and Communication Technology (ICT) in education. The study is divided into three parts. The first part introduces cost analysis and its four methods. The second section covers the importance of cost-effectiveness analysis (CEA) of ICT in education and chooses instances and research from developing nations. The study's findings and recommendations concentrate on cost-cutting ways to maximize ICT use in education (to integrate technology into teaching and learning) with existing resources and budget.

This research also emphasizes the need for "development of cost-effectiveness integration model" techniques to incorporate ICT into education for successful teaching and learning.

Keywords: Cost-effectiveness, ICT in education, developing countries, digital learning, educational technology, e-learning, ROI in education

I. INTRODUCTION

Cost Analysis

Cost analysis in education involves evaluating and making decisions using a variety of methods (Levin & McEwan, 2001, p.4). Cost analysis aids resource allocation choices (Potashink & Adkins, 1996). There are four cost analysis methods:

2) Cost-benefit analysis
1) Cost-effectiveness analysis
3) Cost-utility analysis

Cost-feasibility analysis

Cost-effectiveness analysis. Cost-effectiveness analysis (CEA) evaluates the best options by systematically weighing costs and benefits (Levin, 1995). It was also characterized as an economic assessment process that yields efficient results (Robinson, 1993, p.793). CEA "is designed to compare the cost and effects of two or more alternatives with similar objectives" (Levin & McEwan, 2001, p.108). CEA may be characterized as considering alternatives by achieving the most efficient outcome economically, where those alternatives must have identical aims and objectives.
CEA aims "to provide a method for choosing among alternatives in order to select those that can accomplish a given result most parsimoniously" (Levin & McEwan, 2001, p.1).

Cost-benefit analysis.

The CBA compares project or educational program benefits to expenditures (UNESCO, 2011). CBA helps organizations operate, grow, and flourish (Jhamb & Pahuja, 2008). It takes all options into account and evaluates them based on their costs and advantages in monetary terms (Levin & McEwan, 2001, p.11). This method helps assess the net advantages of a program or policy used to establish a framework for tele-learning and ICT tools and software in Indian libraries.

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Cost-utility analysis.

CUA "refers to the evaluation of alternatives according to a comparison of their costs and their utility or value" (p. 19), where utility is individual pleasure from one or more outcomes (Levin & McEwan, 2001). CUA may be considered close to CEA based on many efficacy criteria.

Unlike CUA, CEA relies on one efficacy metric.

Cost-feasibility analysis. CFA "refers to the method of estimating only the costs of an alternative in order to ascertain whether or not it can be considered" (pp. 22-24) before additional analysis, unlike CEA, CBA, and CUA.

Cost-effectiveness ratio

Alternative effectiveness is measured by cost-effectiveness ratio (CER). It measures the efficacy of alternatives for the given cost: CER= C/E, where C is the cost and E is effectiveness.

Some utilize effectiveness-cost ratio (ECR) to "choose the alternatives that provide the greatest effectiveness per unit cost" (p.137): ECR=E/C (Levin & McEwan, 2001). If correctly construed, CER and ECR are same.

Cost-effectiveness Analysis in Education

CEA is recommended for educational assessment because it "can reduce the costs of reaching particular objectives" (p. 6) to meet educational goals with available funds (Levin & McEwan, 2001). Thus, CEA is an effective evaluation tool in teacher training, computer-assigned instruction, mathematics curriculum, educational television, and radio.

Two criteria are needed to execute a CEA: 1) Compare programs with comparable aims among the various possibilities, and 2) use a common measure of performance (Levin & McEwan, 2001, p. 11). CEA has numerous advantages. Comparison of CER solely across alternatives with identical aims is its biggest challenge. Cost-benefit analysis is used to assess alternatives with different purposes.

There are many research on educational intervention efficacy, but few on cost-effectiveness. The precise foundation for CEA of technology-integrated educational environments and comparison with other learning methods is crucial for educational policy.

Application of cost-effectiveness analysis

CEA is commonly used in the social sector to compare intervention costs and effects. CEA approaches are beneficial for project screening and ranking, since screening reduces investment options given financial limits and ranking indicates priority (World Bank, 2005). Sometimes investment rate is not measured with benefits, thus CEA is compared qualitatively and quantitatively. Increased cost may be contrasted to other treatments like higher test scores, educational assistance, etc.

Importance of cost-effectiveness analysis

"Most effective approach is not always most cost-effective" (Levin & McEwan, 2001, p.11). Without cost-effectiveness analysis, the cost-effectiveness ratio cannot be determined. Additionally, the best option may be both pricey and cost-effective. CEA is essential for achieving efficient, low-cost production. According to Hollands, Bowden, Belfield, Levin, Sheng, Shand, & Hanisch-Cerda (2013), CEA encourages policymakers to focus on the effectiveness or productivity "of alternative educational intentions and to improve the efficiency with which public and private resources are employed in education" (p. 308). This methodology was used to dropout prevention with program selection to boost completion rate (Rumberger, 2011) and educational budget investment decision-making (Tsang, 1997).

ICT in education in developing countries

Economic and educational progress should precede "ICT in Education" in developing nations. 1996 World Bank The invention of new technologies and software/applications has changed the globe quickly. Within a few years, YouTube (2005) and smart phones (2007) changed the world. Yes, a $1,000 laptop is more powerful and efficient than a $10 million IBM computer from 40 years ago (Potashink & Adkins, 1996).

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Technology has greatly impacted education, yet educational practice has altered little (Osin, 1998). Developing nations have used ICT. Developing nations emphasize the importance of ICT in education in the 21st century, implementing national programs and strategies to promote it in recent decades. Bangladesh, Pakistan, and Nepal have a "Master Plan of ICT in Education" to improve education technology.

According to the World Bank (WB), education is the key to improving the economic status of low socio-economic groups (Osin, 1998). Key issues in developing countries include overcrowded classrooms, insufficient teachers due to low salaries in remote areas, and high dropout rates due to income-generating activities. Bajracharya (2014a) identified several challenges in education in developing countries, including curriculum reform, technological gaps, conservative teacher and parent perceptions, ICT tool distribution, and teacher training. Using technology in education requires additional time, funds, and expert consultation. The author believes that a cost-effectiveness approach to promote "ICT in Education" might address technology gaps between private and public schools, ICT tool distribution, and teacher training.

In Nepal, since education budgets are continually diminishing, expanding physical educational institutions and using digital tools is unlikely (Ministry of Education [MOE], 2014). Open and distant learning (ODL) may help rural Nepalese give excellent education on a budget (Bajracharya, 2014b).

Technology in education is efficient and engaging, according to a 1995 meta-analysis research called “The Costs and Effectiveness of Educational Technology”. According to Melmed (1995), computer-based instruction (CBI) may boost performance and save costs. Finally, the study examines two situations (K-12 and aircraft rainfall) where performance and cost were assessed.

In K-12 education, comparing classroom technology versus traditional methods including lectures, textbooks, and workbooks revealed a significant rise in performance percentile from 50th to 75th. They introduced multimedia (videodisc: utilizing video in They also compared prices to tutors, class size reduction, instructional time, and CBI to improve comprehensive mathematics results. Author assessed the cost of several approaches (tutoring cost 1612 $, decreased class size 983 $ to 1195 $, increased instructional time 2667 $, CBI 192 $ to 490 $) and found that CBI is cheaper. Technology integration is cost-effective, according to research.

Second, they contrasted airplane training with real aircraft and simulation (using multimedia) and found that simulation boosted performance percentile from 50th to 65th. Cost was determined by comparing aircraft training time with and without simulation and found that simulation reduces cost. According to statistics, an hour of simulator training costs less than an hour of aircraft, saving an hour of aircraft.

This instance also showed that technology-integrated trainings may boost performance at little cost.

Compared to non-technology integrated courses, this paper shows how technology-integrated courses may be cost-effective. UNESCO's report also considered utilizing technology to build a "Open School" for rural students in Latin America and Africa who couldn't attend school (Perraton & Creed, 2000). Open Schools are desperately required to educate millions of youngsters without formal schooling, according to Commonwealth of Learning (COL, 2013). In 2010, 71 million kids were unschooled (UNESCO, 2012). Open school, according to COL (2013), involves learning if there is a physical separation between student and instructor and uses various technology to give education. COL maintains that adding or expanding traditional schools would be a priority, but even if one new secondary school were constructed every month for 10 years, demand will not be fulfilled. Instead of not delivering education (due to a lack of regular schools), COL recommended open schooling with suitable technology integration. Technology is another crucial open schooling stakeholder. Open schools for basic education (grades 1-4) in hilly South Asian nations like Nepal, India, and Bangladesh have been extensively recognized and implemented. The current situation in Nepal involves dropout difficulties (MOE, 2007).

Cost-effectiveness analysis in ICT in education

This part provides the few studies and case studies which employed CEA to enhance the technology integrated teaching and learning.

Despite significantly reduction of cost of ICT tools in recent years, most countries and school were still not able to afford, which makes them to rely on international agencies and donors. In 1996, “Education and Technology” team of

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WB had calculated major cost that occurred during implementation of "educational computer applications in developing countries" are as: 1) equipment cost (which is about 25-40% of the project budget), 2) market differentiation (Educational institution of developing countries consider to invest its limited budget for less capable inputs (cheaper one but still educationally effective) rather than high capable inputs (expensive with many functions). This phenomenon of the educational technology industry creates a differentiation in hardware which creates a market differentiation), 3) software, 4) professional development, and 5) property protection (to provide a safe place and necessary security place for technological tools to prevent from being robbery) (Potashnik & Adkins, 1996).

Yet one more, empirical research did by the WB concerning ICT in primary and secondary education in Latin America and Caribbean countries (Belize, Chile, Costa Rica, Jamaica & Mexico) which suggest two major alternatives for cost-effectiveness. In the first alternative; contracting instructor in a school as a private tutor could be consider to reduce the technology training cost of professional development (teachers) of educational institution. Similarly, the second alternative is: assigning the private training institutions for teaching school students rather than having schools purchase equipment and assume responsibility for maintenance, Moreover, second alternative could save high investment to buy educational technological equipment and software in school because private training institution already does have that equipment on advance.

Logically, suggested option seems to be very effective on that time (1996), where most of the government and key stakeholder prioritize to provide knowledge about using hardware and software (MS Office, programming) itself. However, present world is different. Now most of the infants were digital natives (mobile user were everywhere).

Most of the old software has been outdated, also very few peoples were using that. That's why, today's world need to consider about "integration of technology in application of technological tools and software's/applications in the content knowledge;

education" rather than technological knowledge (TK) only. Today's necessity is

which is widely known as technology integration. Here the purpose of technology integration in education means active engagement, participation in groups, frequent interaction, and connection to the real-world experts that make classroom more interesting and diverse, and also enhancing the teacher-student relationships for better teaching and learning (Euthopia, 2008).

Hence, the option which had been highly recommended by WB in 1996 might not be influential in today's world because it only concentrates on TK. In order to provide the skills and knowledge about technology integration to today's students/children, teacher/instructor need to be a confident to handle and apply technological tools and software's/applications. Orr, Westbrook, Pryor, Durrani, Sebba, and Adu-Yeboah (2013) conducted a systematic review and concluded that there is a positive correlation between teachers confident and motivation of students to learn. Another point made by Orr et al. was: teachers need to have a confident with technology integration in classroom otherwise student's motivation might be negative toward acceptance

technology for education. Authors had also pointed that trained teachers could be effective comparing to untrained or semi-trained teachers and concluded that teachers professional development is very important to increase the performance of students. However, there is still a cost issue for the teacher training trainings. Tatto et al. (1991) noted that implementation of distance education could reduce the financial burden up to some extent: to provide the teacher training comparing to the conventional way.

II. CONCLUSIONS AND RECOMMENDATIONS

This part will discuss: few strategies represented by table 1, to reduce the cost and increase the benefits of technology integrated program. Based on the above discussions following two points could be considered for effective and efficient to integrate ICT in education.

1) Teacher Professional development

2) Collaboration

Cost-effectiveness Strategies

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Teacher professional development

Teacher training provides "the personal and professional skills needed in schools and other learning contents" (UNESCO, 2011, p.11). Technical implications on teacher professional development (TPD) programs are growing as ICT and technology are integrated into education.

Jung (2005a) claimed that cost-effective teacher training increases ICT adoption in education. Open computer laboratories to the public at cheap cost, negotiate equipment costs with suppliers, and share web-based training materials might be cost-effective teacher training strategies. Thus, ICT should be integrated into the TPD program with an initial focus on 1) how to use ICT tools and software/applications (like MS Office, Programming, etc.) in the classroom and 2) technology integration to perform educational tasks, such as PowerPoint presentation skills, wiki collaboration among teachers and students, moodle communication system, and Word report writing.

Additionally, several research have examined face-to-face and online TPD trainings. Jung (2005b), after analyzing qualitative and quantitative data, thought that online teacher training is cheaper than face-to-face training (p.131). The study compared the cost and effectiveness of face-to-face and online training courses. The cost of online training was 59% of face-to-face training, while the cost per enrolled student and cost per completed student were 43% and 56% of face-to-face training, respectively. This illustrates that in-person training costs more than online. Teachers who got training in both face-to-face and online formats tried to utilize ICT more often, while online trainees also used the internet. This suggests that online teacher training may be cost-effective.

Due to climate and migration, rural Latin American schools may be too expensive to build, so UNESCO recommended distance education for teachers in 2000 (Perraton & Creed).

According to Jimoyiannis (2010), pre-service teachers are eager to learn and develop new skills through authentic activities. Engaging them in solving meaningful instruction problems through authentic ICT-based activities with a solid background is reasonable (Beyervach et al 2001; Mcdougall, 2008). In addition to TPD, pre-service teacher training helps teachers incorporate ICT into their instruction (Chang, Chien, Chang, & Lin, 2012). Developing nations like Nepal only use 10-day in-service teacher training programs to teach "ICT in education" (MOE, 2014). This form of "in-service training" is ineffective because: 1) Many instructors could not take a "training leave" due to a teacher shortage. 2) In-service teachers were afraid to utilize advanced technology and lacked skills to accept it (Tap Raj Pant, Personal Communication, September 20, 2014).

The pre-service teacher training is more cost-effective and effective than in-service teacher training because pre-service teachers spend three to four years using technological tools and software/applications, which gives them confidence to teach TK and integration to future students.

Berhe, Dowling, and Nigatu (2014) offered pharmaceutical technicians pre-service and in-service training. Authors evaluated per diem, travel, food, trainer charges, and expenditures from relocating trainees to their employment. The cost of an in-service trainee was six times that of a pre-service. Evidence indicates equivalent training efficacy after graduation, since pre-service trainees do not incur transportation or pre-diem fees. Additionally, for pre-service trainees. Teacher ICT integration after becoming a teacher showed similar trends (Chang, Chien, Chang, & Lin, 2012). Thus, pre-service teacher preparation may be a cost-effective option.

Collaboration

Many approved ICT agencies and international agencies like IBM, Microsoft, UN, World Bank, and others have been working on long-term educational plans to introduce and integrate ICT into education. Collaboration examples include IBM in Chile, Costa Rica, and Mexico, World Bank in South Asian countries, One Laptop per Child (OLE) project in many developing countries, OLE Nepal in remote district areas of Nepal, and Microsoft Nepal in higher education institutions in Nepal.

Microsoft Nepal has collaborated with the government and various educational institutions on technology-based projects. It offers basic and advanced computer training on ICT and technology integration for university students (Microsoft Ventures, 2015). After passing an exam, learners get free instruction in this software (A. Bailochan, personal communication, August 10, 2015). Bailochan said that following training and university graduation, trainees

would be requested to work as trainers in their organization. So, this form of partnership would assist develop 21st-century technology skills.

Thus, partnership with 1) authorized ICT agencies and 2) international introduce and integrate ICT in developing country education. agencies and local NGOs may be cost-effective.

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