Study of Barriers to use of Computers by School Teachers in Teaching-Learning Process

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Abstract The potential of computers usage towards enhancing teaching-learning process has received considerable attention in recent times. The present study systematically investigates various barriers that impede use of computers by school teachers in teaching-learning process. With a view to provide a nation-wide perspective and curb any regional and cultural bias, the teachers were selected from Kendriya Vidyalayas, run by Kendriya Vidyalaya Sangathan. The findings suggest that insufficient time for planning, preparing, and presenting computer-based instructions is the most important barrier. Various other barriers listed in order of descending importance based on school teacher responses, were as follows: access (hardware), access (software), support, training and competence. In addition, important barriers related to characteristics of students and attitude of teachers are also prevalent. The findings emphasize that unless suitable measures to overcome the existing barriers are adopted, the transformational potential of computers in education would not be harnessed in the truest sense. It is believed that the present study would empower stakeholders responsible for policy and strategy formulation with vital information and aid implementation of suitable measures for effecting widespread adoption of computer use in teaching-learning process.

Keywords: Barriers; Computer Use

1. Introduction

The past two decades have witnessed a dynamic shift in the way computers have been used as a tool in teaching-learning process. During the 1980s, curriculum practice emphasizing learning about computers gained dominance and specific subjects were developed to teach about computers. However, later, during late 1990s, the pendulum began to swing in favour of learning with, through and from computers across the curriculum and the shift reflected a growing awareness and an increasing consciousness of the interactive nature of computers, as tools for learning and discovery (Hodson, 1990). This great change has brought forth a fresh perspective in the process of teaching and learning.

The potential of computer technology to enhance teaching and learning has been recognized for some time. Generally, it is accepted that technology has the potential to enhance teaching and learning and provides students with a learning experience that other strategies cannot provide (Wellington, 2005). Schools have also recognized that use of computers in teaching-learning process is important as it presents unprecedented challenges that help students to acquire an inquisitive, critical and creative mind to capitalize on the opportunities driven by the explosive growth of information, knowledge and technology (Cuban, 2001). Computer technology has opened wide opportunities for school teachers to integrate computers in teaching-learning process and to improve the achievement of students (Jonassen, 1995). For the past decade there is a major push towards integrating computer technology in teaching-learning process because of the vast promise it offers such as cheap, accessible and instantaneous information, enormous potential for interactivity and media-rich communication, and powerful educational tools it will put at the service of students (Mouza, 2002).

Technology does not hold the potential to be transformative on its own - school teachers are integral elements that are required to play a key role in adoption of technology into curriculum. Hence, it is important for school teachers to be forthcoming to adopt information technology such that being prepared to exploit technology for supporting student learning must become integral skills in every school teacher's professional repertoire.

In India, various initiatives, mandates, and recommendations such as those put forth in National Curriculum Framework for School Education 2000, Curriculum Guide Syllabus for Information Technology in Schools by NCERT 2001, 11th Five Year Plan National Mission in Education through ICT, and National Policy on ICT in School Education 2009 have definitely served as catalysts to motivate school teachers in this direction. The policy-makers in the country have identified several fundamental tenets of strategy for assessing school teachers' ability to utilize modern-day

instructional technology. These principles include: (1) ability to provide relevant instruction that reflects contemporary and future social and economic demands on students, (2) compatibility of certain computer technology with newer, research-based approaches to teaching and learning, (3) student and parent expectations.

Despite several measures in this direction, it has been found that the adoption of use of computers in teaching-learning process has been slow over the years (Krysa, 1998). According to Carlson and Gadio (2003) school teachers' acceptance of computers (positive attitude) is absolutely essential if technology provided to schools is to be used effectively. The literature suggests that: (1) only a few school teachers routinely use computers for instructional purposes; (2) when computers are used, they are generally used for low-level tasks such as presentations, drill, word processing; and (3) computers are not sufficiently integrated across the curriculum.

Inspite of growing support for computers as tools for teaching and learning, the general unwillingness among school teachers to promote the use of computers across the curriculum points at some inherent barriers towards desired adoption of computer use. Notably, there remains a wide variation among schools and even classrooms in terms of quantity and quality of use of computers by school teachers. It is reasonable to conclude that selection and use of technological tools by school teachers in the teaching-learning process is inhibited by not only systemic and organizational barriers but also personal and individualistic barriers; and systematically recognizing such barriers in computer use by school teachers in teaching-learning process is a first step towards gaining insight into reasons for variation in use of computers by school teachers. It is only through such recognition and realization of existing barriers causing reluctance of school teachers towards incorporating use of computers to a desired extent in teaching learning process that, in a next logical progression, suitable measures could be designed and developed towards promoting use of computers by school teachers.

The study is intended to identify various existing barriers in the aforementioned context. The study will help to demystify seeming inconsistency and variation with regard to use of computers. What causes one school teacher to embrace the use of computers while another school teacher remains reluctant to use computers for any purpose whatsoever in teaching-learning process? Will school teachers tend to use computer technology in ways that fundamentally transform their instructional processes or will they be more likely to use it to facilitate and reinforce their current practices? What kind of individual characteristics of school teachers most significantly influence the way the computers are actually used in teaching-learning process?

The identification of various barriers will certainly pave the way for systematically planning reduction and complete elimination, wherever possible, of these barriers. Accordingly, it is believed that the study would empower the policy and decision makers with useful information to aid strategy formulation to implement widespread adoption of computer use in teaching-learning process.

2. Review

Over the past several decades technology has been exploited in various ways to achieve a variety of educational goals. In the past, various researchers employed several research methods in an attempt to understand the distinct ways in which computers can help educators in improving the teaching and learning process (Novak and Knowles, 1991; Becker, 1994; Ely, 1995; Stratford, 1997; Drury, 1995; Blankenship, 1998; Sinko and Lehtinen, 1999; Smeets, Mooij, Bamps, Bartolome, Lowyck, Redmond, and Steffens, 1999; Wallace, 2001; Dawson, 2008).

Researchers Harris (2000); Kellenberger and Hendricks (2000); and Martin and Ofori-Attah (2005) identified that school teachers could use computers for different purposes like, for teaching purposes, administration purposes, and personal purposes. The literature on computers and constructivist reforms also described a variety of activities that were permitted with the use of computers that were not feasible otherwise (Sheingold and Hadley, 1993; Shute and Psotka, 1996; Glennan and Melmed, 1996). Regarding the efficacy of the use of computers in these ways, there was a general concurrence that when combined with traditional instruction, the use of computers could increase student learning and produce higher academic achievement in a variety of subject areas than does traditional instruction alone (Means and Olson, 1995; Sivin-Kachala, Bialo and Langford, 1997; Bracewell, Breuleux, Laferriere, Benoit, and Abdous, 1998).

It was observed that mere introduction of computers and related technology in the schools could not result in desired adoption of computer use by school teachers, suggesting that there were several systemic and individualistic barriers that seemed to inhibit adoption to a desired extent. As a result, fostering technology usage among individual school teachers remained a critical challenge for school administrators, technology advocates and policy makers.

Hadley and Sheingold (1993) revealed (a) lack of time, (b) scheduling computer time, (c) too few computers, (d) not enough time in school schedule for computer-based instruction, and (e) inadequate financial support for computers as some of the significant obstacles towards use of computers. In a similar study, Ely (1993) identified (a) dissatisfaction with

the status quo, (b) insufficient knowledge and skill, (c) lack of resources, (d) available time, (e) commitment from supervisors, (f) lack of inspiration from leadership contingents, and (g) lack of rewards/incentives, as major barriers.

Fisher (1996) in his book entitled "*Education and technology: Reflections on computing in classrooms*" primarily identified convenient access to hardware and software as the major barriers for the school teachers for not using new media instruction. In a study conducted in Western Sydney, Morton (1996) concluded that dependence on school teachers' self-initiative for acquisition of computer skills, high levels of anxiety in using computers, lack of computer resources, focus on 'learning about the computer' instead of 'learning through computers', were the predominant barriers.

Blankenship (1998) investigated major barriers to computer use experienced by school teachers in Carroll County (Virginia) Public Schools. His study concluded that availability of computers, quality of available software, training, lack of sufficient time for planning and preparation, were the major barriers listed in order of frequency of responses.

Fairbrother and Kurina (2000) studied the factors for constraints on school teachers' use of ICT in England. Some notable obstacles reported by the school teachers included: school teacher's lack of confidence, lack of supportive organizational culture within the school, limited access to resources and lack of adequate technical support. Investigators confected that 'innovation and adaptation are costly in terms of time energy'. They reasoned, when 'initiative-overload' made competing demands, lack of time was the most significant constraint as reported by 86-88 percent school teachers.

In a worldwide survey conducted by Pelgrum (2001), of nationally representative samples of schools from 26 countries including India, 38 obstacles for implementing computers in the classroom were identified. These obstacles were both material and non-material conditions. The top five obstacles in his list were insufficient number of computers, school teachers' lack of knowledge/skills, difficulty in integrating with instruction, scheduling computer time, and insufficient peripherals. Pelgrum's study revealed that the failure to equip schools with sufficient number of computers and to update school teachers with new knowledge and skills in computer use were the major reasons for the unsuccessful implementation of computers in schools.

In a report on the barriers that existed in schools that prevented school teachers from making full use of ICT in teaching, Jones (2004) summarised some of the key findings: a very significant determinant of school teachers' levels of engagement in ICT was their level of confidence in using the technology; levels of access to ICT and training styles were also significant in determining levels of use of ICT by school teachers; school teachers were sometimes unable to make full use of technology because they lacked the time needed to fully prepare and research materials for lessons; technical faults with ICT equipment were likely to lead to lower levels of ICT use by school teachers; resistance to change was a factor which prevented the full integration of ICT in the classroom; school teachers who did not realize the advantages of using technology in their teaching were less likely to make use of ICT; there were close relationships between many of the identified barriers to ICT use; any factors influencing one barrier were also likely to influence several other barriers.

Aduwa-Ogiegbaen and Iyamu (2005) reported the effort of ICT usage and obstacles to use ICT in secondary schools in Nigeria. They claimed the obstacles for ICT use in secondary schools as cost, weak infrastructure, lack of skills, lack of relevant software, and limited access to the Internet. The findings of another study by Mohd Yunus (2007) regarding the main challenges to ICT integration perceived by the school teachers who taught in Malaysian technical schools revealed that ICT integration in teaching learning was dependent upon adequate access, adequate computer resources, school teacher development opportunities, and onsite support – all of which require funding, thought, planning and support.

As a conclusion of the review of research in this field and the published literature thereof, it is evident that various researchers have extensively made an attempt to study various barriers influencing computer-based instruction in the developed countries and to some extent in developing countries. As geographic and demographic factors can markedly influence various systemic and individualistic characteristics, and there exists a stark difference between the developed and the developing countries in terms of various socio-economic factors, a need was felt for conducting a systematic and comprehensive investigation of various barriers that are generally applicable in the context of developing countries and more particularly, in India.

3. Study

The present study systematically investigates various barriers inhibiting the use of computers in teaching-learning process in an Indian context. Due to similarity in socio-economic environment, it is believed that the barriers thus identified should be applicable to other developing countries to a large extent.

While the state of educational infrastructure and several other pertinent factors vary drastically across various schools in private, public and state government school systems in different regions of the country, Kendriya Vidyalayas, owing to inherent design, mission, and objectives, maintain considerable uniformity in various establishments across the

country. Kendriya Vidyalayas administer common curriculum, common text books, uniform academic calendar, uniform examination and performance assessment system, and uniform infrastructural facilities (as much as practically possible) across various schools. Hence, from the perspective of the present study, Kendriya Vidyalayas provided as ideal population. The implications of the study could be generalized to design recommendations for formulating policies and strategies at a national and international level.

In the present study, the term "use of computers" (or "computer use") is intended to refer to various ways in which school teachers use computers for instructing their students. Thus, broadly speaking, any application of computers for instruction is intended to be referred to through the term "use of computers" (or "computer use"), as used in this study, this term shall be meant to include use of computers in both instruction and management of the teaching-learning process. The term "barrier", as used in the present study, is intended to refer to any teacher-perceived impediment – systemic or individualistic – that may inhibit use of computers by school teachers in the teaching-learning process.

4. Method

Keeping in view the nature and wide perspective of the present study, it was decided to conduct the study in Kendriya Vidyalayas, run by Kendriya Vidyalaya Sangathan, a premier organization in India administering 981 schools not only in India but also in foreign countries such as Moscow, Kathmandu and Tehran.

Under the guidance of subject experts, a questionnaire including an open-ended question was framed to obtain a list of factors that school teachers perceive as barriers to using computers in teaching-learning process.

A request letter was submitted to the Assistant Commissioner, with a covering letter and the list of intended schools (the 20 schools selected from a list of Kendriya Vidyalayas, Delhi Region, based on random sampling) for data collection. Upon obtaining permission therefrom, the Principals of 20 schools were contacted to administer the questionnaire in their schools. After seeking permission from the Principals, the school teachers teaching various grades and various subjects (excluding computer teachers) were randomly selected. The questionnaire was provided to each selected school teacher in their free periods. The school teachers were given three days to fill-in the questionnaire as per the instructions provided therein and the filled-in questionnaires were collected from the school teachers on the agreed dates.

The open-ended question asked school teachers to list barriers to computer use in the classroom. The school teachers listed various factors that they considered as being barriers to computer use in the classroom. The responses were categorized according to major themes and subthemes. The frequency of each response was tallied and recorded in the matrix. The Matrix of Barriers to Computer Use by School Teachers (Table 1 in the following section) represents the data, thus collected.

5. Findings

The survey question was an open ended that asked the school teachers to list the things that they considered barriers to computer use in teaching-learning process. Table 1 is a list of responses by school teachers' perceptions regarding barriers to computer use. The frequency of each category of school teachers' responses was tallied; percentages were calculated and recorded in the matrix of barriers to computer use tabulated in the table.

Table 1: Matrix of barriers to computer use as perceived by school teachers

Category	*Sub-Category of Responses*	*%*
Time	Insufficient time to practice	87.2
	Insufficient time to plan computer based lessons	33.3
	Insufficient time for preparation of instructional material on computers	12.7
	Insufficient classroom time for using computers	8.5
	Time consumed to travel from one classroom to other classroom	8.2
	Insufficient time for individualized instruction for students	0.3
Access (Hardware)	Laptops not provided to each school teacher	75.3
	Occupancy of computer lab/resource room	45.7
	Unavailability of the required facilities in classrooms	37.5
	High student computer ratio	23.1

Category	*Sub-Category of Responses*	*%*
	Insufficient number of peripherals (eg printer, scanner, pendrive, projector)	17.2
	Internet is not available all the time	15.6
	Less computers with internet in the library	4.7
	Less computers with internet in staffroom	4.2
	All computers are not networked in the school	3.2
	Cumbersome equipment with so many wires	2.9
	Poor quality computers	2.0
Access (Software)	No enough software for instructional purposes	65.3
	Software too difficult to use	56.7
	Software not adaptable as per the subject requirement	18.0
	Manuals and support materials not properly designed	16.3
	Software not available in the language of instruction	3.0
	Unavailability of paid educational websites	3.0
Support	Heavy workload of school teachers	43.0
	Pressure to cover syllabus	40.2
	Lack of conditions for integration of computers	36.7
	Insufficient maintenance facilities	32.3
	Power failure	12.7
	Not enough technical assistance	10.0
	Insufficient expertise for school teachers to use computers	10.0
	Not enough help to supervise students	10.2
	Untrained technicians	5.2
Training	Insufficient training opportunities	32.4
	Lack of relevant, application based training	20.6
	Timing of training (no release time from classes or responsibilities; training on holidays/after school)	7.8
Competence of School teachers	Difficulty to adapt software to curricular needs	22.7
	School teacher lack knowledge/skills about using computers	13.3
	Lack of typing skill	10.0
	Less proficiency in English language	3.0
Characteristics of Students	Lack of computer at home	18.3
	Students are not given proper training to use computers across the curriculum	12.3
	Lack of facilities like internet and peripherals at home	10.5
	Parents lack of knowledge or cannot access computers	10.3
	Use computers to play games rather than study	10.0
	Students get disillusioned with beauty of computers	6.1
	Some students are too immature to use computers	2.0
Attitude of School teachers	Syllabus cannot be completed if incorporate computers in teaching-learning process	15.7
	Fear of computer – breakage/loss/damages	12.3
	Lack of willingness of school teachers to use computers	3.0
	Time consuming arrangement	3.0
	Threats regarding views on computer	2.2
	Feel uncomfortable using computers	1.0

The respondents were asked to list the barriers to use of computers by school teachers in teaching-learning process. Among all, time was perceived to be the strongest barrier. Other barriers, listed in order of descending importance based on school teacher responses, were as follows: access (hardware), access (software), support, training and competence. Various aspects related to characteristics of students and attitudes of teachers were also considered to be the barriers to computer use by a few respondents.

As perceived by school teachers, insufficient time to practice (87.2%) was the most frequent barrier. Insufficient time to plan (33.3%), prepare (12.7%), and present (8.5%) computer based lessons were also listed as barriers by quite a

number of school teachers. Some school teachers (8.2%) also found the time consumed to travel from one classroom to other as a hindrance to use computers in classrooms. A few school teachers (0.3%) mentioned insufficient time for individualized instruction as a barrier.

The next most commonly perceived barrier was access to hardware resources especially access to personal laptops (75.3%). Occupancy of lab/resource room (45.7%) and unavailability of computer related facilities in classrooms (37.5%) was also seen as a barrier to computer use, as perceived by school teachers. Reasonable number of school teachers cited high student-computer ratio (23.1%), insufficient number of peripherals (17.2%) and lack of continuous access to internet (15.6%) as problems related to computer use. Very few school teachers mentioned about less computers with internet connectivity in the library (4.7%) and staffroom (4.2%), lack of networking of computers (3.2%), cumbersome equipment (2.9%), poor quality computers (2.0%) as obstacles to computer use.

The next item in the table indicates access to software resources as another significant barrier with unavailability of enough software for instructional purposes being the strongest barrier in this category, as it was perceived by 65.3% school teachers. Even for the software that were available, it can be inferred from the table that these were difficult to use (56.7%), inadaptable (18%) and unaccompanied with proper manuals and support materials (16.3%). Some school teachers (3%) also looked forward to have availability of software in their language of instruction and availability of paid educational websites.

Lack of support was also stated as a barrier by a sizable percentage of school teachers. They found heavy workload (43%), pressure to cover syllabus (40.2%), lack of conditions for computer integration (36.7%), and insufficient maintenance of equipments (32.3%) as barriers to computer use. Some school teachers (10%) complained that there was a lack of technical assistance and if at all assistants were available, they were not properly trained (5%). School teachers (10%) also expected a computer coordinator, with sufficient knowledge, to be present in the school.

Another obstacle to computer use as reported by the school teachers was training, which included insufficient training (32.4%), lack of relevant training (20.6%) and timing of training (7.8%).

School teachers (22.7%) found themselves less competent to be able to adapt software to curricular needs. They also found themselves lacking in computer knowledge for instructional purposes (13.3%), typing skills (10%) and English language (3%).

Certain limitations with students were also recognized as barriers to computer use by some of the school teachers. These limitations included, lack of computer at home (18.3%), lack of sufficient training to use computers across the curriculum (12.3%), lack of facilities like internet and peripherals at home (10.5%), parents' lack of knowledge or inability to access computers (10.3%), use of computers to play games rather than study purposes (10%), students disillusioned with beauty of computers rather than skilled in using its brain (artificial intelligence) (6.1%) and some students too immature to use computers for learning (2%).

A few school teachers lacked positive attitude towards use of computer, which was evident from some facts that were highlighted by them. These facts included use of computers might lead to non-completion of syllabus (15.7%), breakage/loss/damages of computer hardware and software (12.3%), lack of interest/willingness/comfort in teaching (3%), wastage of time in arrangement (3%) and threats (lead to dehumanization and school teachers might have to take a back seat in future) (2.2%). 1% school teachers expressed a feeling of inadequacy in their abilities to use computers effectively in teaching-learning process.

6. Discussion

The potential of computers to support and enhance teaching and learning has received considerable attention in recent times. The recent advancement in information technology innovations and computer usage is rapidly transforming work culture and teachers cannot escape the fact that today's teaching must provide technology-supported learning. However, the widespread acceptance of computer technology in teaching-learning process is a complex phenomenon affected by a multitude of factors. A large part of the problem stems not from lack of knowledge or expertise with use of computers but instead from several other barriers as identified through this study. Given the ever-increasing growth of computer use in education, it is essential for researchers to investigate the barriers that hamper different types of use of computers by school teachers in teaching-learning process. The study investigated the barriers to computer use in teaching-learning process as perceived by Kendriya Vidyalaya teachers in India. Findings from the study suggest that insufficient time allocation emerged as one of the biggest barriers in the present study. A majority of teachers complained that insufficient time to plan, prepare, and present computer based lessons was the strongest barrier. The barrier related to sufficient time allocation has been emphasized in the literature related to developed countries (Hadley and Sheingold, 1993; Ely, 1993; Pelgrum, 2001), and the situation in India is no exception. However, in the Indian context, the problem of insufficient time

is particularly aggravated due to much higher number of classroom teaching hours in a week. The significant difference between classroom teaching hours may be readily attributable to much extended syllabus prescribed in each grade compared to the developed countries. Not surprisingly, a large number of school teachers pointed to heavy workload in terms of not only the pressure to cover huge syllabus but also evaluate student performance within limited time as major barriers.

The second most prominent barrier identified in the present study was access in terms of hardware access as well as software access. The access-related barriers have been widely reported in literature (Newhouse, 1997; Middleton, Flores and Knaupp, 1997; Blankenship, 1998; Ginsberg and McCormack, 1998). The present study supports and extends such knowledge in the existing literature wherein this factor was perceived by teachers as being a serious barrier that had a negative effect on their using computers in their classrooms. The issues associated with access were: availability of requisite computer resources, placement of computer resources, and provision for both teachers' and students' use of computers. Middleton, Flores and Knaupp (1997) had identified only hardware factors as the key barriers. However, the present study clearly indicates that existing barriers relate not only to inadequate access to hardware but also to unsatisfactory availability of required software. Teachers' concerns about the incompatibility of computers with existing curricula indicate that educational change cannot simply be attained by placing computers in schools. Thus, merely setting up a computer lab and provisioning a limited number of computers deployed with some educational software applications is never going to ensure sufficient access to school teachers and students to satisfactorily integrate computers in teaching-learning process.

Indeed, research has demonstrated that support provided by principals and other administrators consistently predicted successful integration of computers into the instructional process (Becker, 1994; Dupagne & Krendl, 1992; Mahmood and Hirt, 1992; Office of Technology Assessment, 1995; Field Research Corporation (1995) researchers).The present study also pointed out serious concerns related to availability of sufficient support provided to the school teachers. Again, however, this support comes in many forms. It might be a technical person available on demand, a fellow teacher with some encouraging words, or a principal who believes in technology and commits to implementation (money, time, conferences, specific training). Teachers' readiness to use technology in classroom will increase with strong support systems that include communities, parents, business leaders, and administrators. In general, it can be concluded that support to teachers would lead to increased motivation among teachers to integrate computers into the teaching-learning process.

It is generally acknowledged that majority of teachers remained unsatisfied with the gap between potential of computer use and quality of in-service training in the use of computers in general. The findings of various researches have highlighted the need for adequate and careful training of teachers on the gadgets which are supposed to be used in the classroom setting by all the teachers (OTA, 1995; Specht, Wood and Willoughby, 1999; Tarleton , 2001). Some other researchers (Robertson, 1996; Seidman, 1996; Mintz, 1997) also pointed to professional development and training of teachers as a solution to successful computer implementation in education field, that would provide them with materials, strategies and new understanding to meet the learning goals. Stasz, Shavelson, and Stasz (1986) in Washington, DC also pointed out that 'lack of adequately trained teachers' presents a major obstacle to effective instructional use of computers. The present study substantiates such previous findings. Insufficient and irrelevant training is one factor that majority of respondents felt as a barrier to computer use in the present study. Interestingly, in their responses, several school teachers hinted at possible remediation steps for attending professional development and training programs to acquire technology skills and develop new teaching strategies for integrating technology in teaching-learning process. However, as noted in preceding discussion, training alone would not be sufficient, it is important to ensure that school teachers get adequate time to practice the newly-acquired skills, explore and experiment with various hardware-software resources, and thus, gain proficiency in technology use.

Researchers have indicated that although teachers may have positive attitudes toward technology (Duane & Kernel, 1992; Office of Technology Assessment, 1995), they may still not consider themselves qualified to teach with it or comfortable using it. In previous literature researchers reported that competency to use different technological tools was a pre-requisite for increasing technological use by teachers. (Wells and Anderson, 1995; Winnans and Brown, 1992; Fisher, 1996). The study by Russell, Finger and Russell (2000) revealed that teachers saw themselves as competent with basic computer skills but were less confident with activities requiring advanced use of computers. Findings from the current study substantiated this globally felt barrier. The respondents of the present study pointed lack of competence in suitably adapting software to curricular needs and also, lack of basic knowledge and skills about using computers as the predominant barriers.

Interestingly, it appears that previous studies in this field largely neglected an important factor in the teaching-learning process, namely the students. The present study revealed several barriers associated with characteristics of

students. Several teachers pointed that many students did not have access to computers at home and also, many of them did not receive proper training to use computers across the curriculum. Understandably, many students are generally not mature to use computers, and parents should play an integral role by providing necessary guidance at home. In the Indian context, several parents are themselves not sufficiently equipped with necessary skills to do so, which definitely is an impediment for required guidance to students at home. An unfortunate outcome of this situation is that a surprisingly high percentage of those students that have computers at home end-up using computers to play games rather than for educational purposes.

Findings from this study also suggest that attitude of teachers is also a significant barrier. The respondents seemed to have imbibed the rationale for integrating computer use in teaching-learning process in principle; however, it was found that there were several inhibitions that directly point towards their outlook towards such increased computer use. The school authorities must take steps to alleviate such inhibitions and create a more conducive environment such that school teachers develop a positive attitude towards use of technology.

7. Conclusion

In recent years, there had been a strong push to get educational technology into the hands of school teachers and students in India. With increased emphasis on integration of computer technology in education, a great majority of school teachers are motivated to adopt computer-based instruction methodologies in at least some form. Links have been made between computer use and constructivist, collaborative, and inquiry-based learning and also pedagogical change (Scrimshaw, 2004). Some researchers suggest that technology can overhaul education, serving as a panacea, or as an agent of change (e.g., there is a special interest group within the American Research in Education Association called Technology as an Agent of Change in Teaching and Learning). However, there are definitely some impediments that need to be addressed before the power of computers is exploited to its fullest potential to transform teaching-learning process in the most effective manner. It was important to identify these barriers, as perceived by school teachers, towards integration of computers in education so that a systematic effort to remove the barriers may be undertaken. Although the study was conducted in the Kendriya Vidyalayas of National Capital Territory of Delhi, the implications are applicable to various other government, public and private school systems existent in India and abroad.

One of the main barriers to use computers by school teachers in teaching-learning process perceived by teachers in this study is insufficient time for planning, preparing, and presenting computer-based instructions. It follows that the integration of computer-based instruction in teaching-learning process will not reach desired levels unless the school teachers are provided with ample time to practice, explore, conceptualize, and collaborate. Thus, there should be an earnest attempt to ensure sufficient allocation of time towards implementation of computer use. This may be attained by reducing the teaching load for the teachers. It is also desirable to introduce computer-based student performance assessment and examination management system, which will significantly ease workload on teachers owing to manual handling of such procedures.

Various other barriers listed in order of descending importance based on school teacher responses, were as follows: access (hardware), access (software), support, training and competence. Such conclusion points to the invariable importance of existence of computer resources for the success of initiatives regarding implementation of use of computers in teaching-learning process across the world. The present study indicates that school administrators and policy makers in India adopted a "one size fits all" approach, which is understandably, not an efficient way to address technology needs for use of computers by school teachers. It is highly recommended to focus on increasing availability of more syllabus-specific software for school teachers; formulating long-term funding strategies to ensure sufficient provision and maintenance of both hardware and software; cultivating tech-savvy habits amongst school teachers; and providing incentives to school teachers.

Teachers' preparation necessitates not only merely providing additional training opportunities, but also aiding them in exploration and experimentation with computers before being able to use it in teaching learning process. Therefore, it is evident that implementation of an effective training program to codify standards for not only defining a requisite level of technology competence but also for assessing level of technology skills of individual school teachers is a critical measure that needs to be adopted by the policy makers and administrators. Towards this endeavor, it may be worthwhile to implement an assessment mechanism for gauging school teacher's computer knowledge and skills on a regular basis. It follows that, steps such as mandatory implementation of computer-based content delivery; computerized pre- and non-instructional activities and transactions; and computerized students' examination management system will also be beneficial.

In addition, important barriers related to characteristics of students are also prevalent. It is recommended that

policy makers and school authorities ought to take measures to provide training to students, which will aid students to integrate computers across curriculum. In addition, training to parents must be provided so that they can appreciate and encourage the use of computers by their children for educational purposes. Steps can also be taken to provide laptops to students at reasonable prices or discounted loans.

Other barriers reported in this study are teachers' inhibitions which may have played important role in teachers' successful integration of computers in teaching-learning process. Both policy makers and school authorities share this responsibility allay fears and qualms that school teachers have with regard to use of technology such as non-completion of syllabus, breakage/loss/damages of computer hardware and software, lack of interest/willingness/comfort in teaching, and wastage of time in arrangement of computer-based instruction.

If educationists, decision-makers, policy-makers want the successful implementation of use of computers in teaching-learning process, they have to find ways to overcome the barriers perceived by the teachers.

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Appendix

A study instrument was prepared to gather information regarding teacher-perceived barriers in teaching-learning process.

General instructions: The aim of the research is to study barriers to use of computers by school teachers in teaching-learning process. Toward this end, a survey questionnaire has been prepared. You are requested to spare your valuable time to list out various impediments that you experience in your routine work as school teachers in using computers in teaching-learning process. Please use additional writing sheets, if required.

PERSONAL INFORMATION

Name of the School: _____ E-mail: _____

Name:_____ E-mail: _____

Teaching Experience (in years): _____ Age (in years): _____

Teaching Grade (PRT/TGT/PGT): _____ Gender: _____

Curriculum : _____ Class: _____

(Science/Social Sc./Math/Language /Commerce) (considered for answering to questionnaire)

List things that you consider to be barriers to computer use in teaching- learning process:

1. _____

2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

…

Thank you for your participation in this survey!