ASEE 2014 Zone I Conference, April 3-5, 2014, University of Bridgeport, Bridgpeort, CT, USA.

Factors Affecting Education Technology Success

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***Abstract*— The purpose of this paper is to examine particular and relevant factors that affect the outcome or implementation of educational technology approaches in school classrooms. The analysis inspects factors that affect education success in general, but we concentrate on how they specifically affect technology as an enhancement to integrated teaching. The presumption is that technology magically makes everything (tasks, learning, human-interaction, etc.) "better". On the surface It seems plausibly so, but such a general evaluation should be arrived through the scientific approach. This paper breaks the chose factors apart and analyzes each relation to the success of education technology.**

Keywords—component; formatting; style; styling; insert (*education, technology, learning, classroom, teaching, teacher, instructional technology, professional development, classroom computer)*

I. INTRODUCTION (*Why is educational technology important to review?*)

Effective use of instructional, educational, or information communications technology (ICT) has been a hot topic not just in the United States but internationally. Windschitl finds that researchers have only recently invested themselves in serious study of how teachers come to use technology in their classrooms and what kinds of influences shape their thinking [5]. In social context of education and knowledge, learning is never stagnant – it is dynamic. To analyze how technology changes the way or means in which we learn, we must understand the way in which we absorb knowledge [6]. Straub notes that, as humans, we must understand how education technologies contribute to our learning environments and convey knowledge. In addition, technology literacy is increasingly becoming mandated in K-12 curriculum [7] which puts more stress on curriculum administrators to integrate technology into lesson plan requirements. Owen and Demb have found there is much pressure to use technology in the classroom as well as other education environments, including those at the college-level [8]. With the variety and access at our disposal, funding for integration projects have sprouted left and right [9] which exacerbates the technology appetite of school. However the greater variety, it becomes a challenge to conduct the best cost-benefit analysis to advocate a particular technology [10].Since its inception, instructional technology has been designed and manipulated for almost every subject at academic level from study skills [11], to music [1], biology [12], to literacy [13], to college-level economics [14], and elementary mathematics [15]. Of course, like anything too good to be true, technology also brings some setbacks. For example, Bruce finds that the evolution of technology itself is rapid and it becomes increasingly difficult to evaluate technology as education tools [16]. Not to mention, even though studies of subject-specific technology is wide and ongoing, comparisons between tech-savvy and non-tech-savvy classrooms remain a constant debate [17]. Furthermore, according to Zhao and Frank the educational systems on top of which technology rests resists the very nature of technology due to lack of development [18] and some environments experience less success than before technology is implemented [19].

Despite these challenges, there lies a willingness and excitement from students to use classroom technology. Wartella and Jennings find in their study, "Children are drawn to computer technology that enables--even demands-more active engagement. Across the range of software programs, 37 studies indicate that children generally prefer more participatory forms of computer-assisted instruction [20]." External forces coax education institutions to drastically alter their objectives. Going back to Owen and Demb, "With missions closely tied to the needs of workforce development and businesses, community colleges have already exhibited an innovative level of responsiveness and leadership with technology-based programming [8]." Owen and Demb focus on higher education, but if social forces constantly nag us with the usual rhetoric about preparing our youth for a 21st century education, we, collectively, have to start with our youngest. In secondary education settings, students are ready to use the technology at their disposal [14]. We will look at four broad factors, all of which are independent from each other but possess a connection to our goal of educaitonal technology implementation (See Fig. 1).

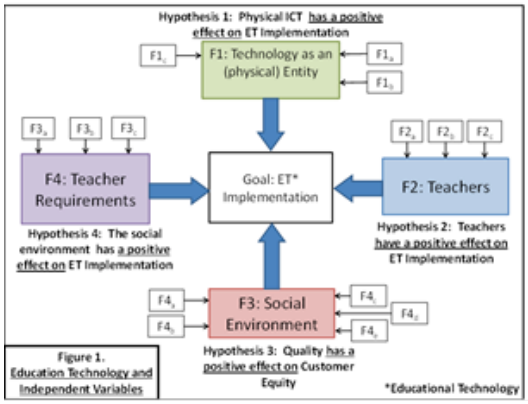

Fig. 1 – Four Factors affecting ET Success

II. GOAL: IMPLEMENTATION FACTORS FOR EFFECTIVE EDUCATIONAL TECHNOLOGY USE

What is the idea behind educational technology?

The versatility of technology gives educators the ability to be creative when it comes to technology-enhanced pedagogy or skills. Having to satisfy administrative pressure, teachers should come to an understanding of best-practices that lay the foundation for successful approaches. However, the best practices only work if other factors work in their favor and function in harmony [5]. While technology has been gradually eased into education environments, as a tool, it must not be taken for granted – otherwise under-utilization can ensue. In other words, not all factors and circumstances favor the use of educational technology as you will see in this paper.

Scientifically speaking, too much of a good thing can be detrimental; just as too much of anything ingested by the human body produces a negative effect. It is not so much the computers that aren't working but the way in which they are used. It can be argued that technology is double-edged sword in terms of plagiarism and Internet research [14]. The goal of this paper is to analyze broad factors that contribute to integrating technology into a pre-existing, non-existing, or existing technologically savvy environment or scenario.

III. FACTOR 1: THE COMPUTER AS AN ENTITY OR TOOL / SIGNIFICANT IDENTITY

Hollebrands quotes Wertsch who says the affordances of tools is how a tool can enable and empower students' actions and thoughts [21]. For, Hollebrands, 'tools' includes computers. In the teaching-learning process, the computer can mediate learning because it provides a language and notational system that must be used to perform actions [21]. As a tool, the computer conveys a concept by a means which is shared between the teacher and student; much like two individuals who speak English and French as their dominant languages respectively, but can communicate if they are both fluent in Spanish.

1. Computer technology's place in the classroom

The computer, as an entity with physical or conceptual presence, gives us a perspective to analyze. Computers have become increasingly ubiquitous in schools since US federal government mandated it in 2000 [22]. Rather than conceptualizing the technology as a discrete object that acts on people, they would want to understand the way the technology participates in an organic relationship with living social practices [16]. The computer's physical presence changes the atmosphere and structure in a classroom due to its very nature. Mehan, summarizes it well – when used in educational settings, the computer is always a part of a larger social system which includes the students, the teacher, their history of past relationships, the history of ways of teaching, the history of ways of organizing classrooms, the relationship that the classroom curriculum has to the classroom surroundings, and the relationship between the classroom and the school, community, and agencies beyond [23]. A computer (more often, computer centers) has an immediate effect on social patterns at all levels so it is important to understand not only the computer's function, but also its function in a complex, social environment.

2. Computer technology as an individual learning tool

Harnessing a computer's potential to enhance instruction makes it a value to students. In a research study by Morrow, Barnhart and Rooyakkers, the computer provides opportunities for cooperative learning as children work in pairs or small groups. Cooperative learning promotes academic achievement, social interaction, and positive attitudes in the class room [13]. An excellent example is found in Collinson's article where the author's student asks distracting questions, which slows down the lesson. Instead of taking time to respond, the teacher asks the student to go and look up the information on the Web. This action yields two positive results: a student conducts research while the instructor carries on with the rest of the class – thanks to a computer in the classroom [22]. The dual action provides the opportunity of positive attitudes mentioned earlier. In an English-language learner (ENL) study, students found the technology not only supportive but essential to their language education [24]. Interestingly enough, the author also notes that the language itself is not meant to be an end in itself but a means to an end.

3. Computer technology as a supportive teacher tool

Technology can be used as an instructional tool to support literacy development. Computer technology is effective when it is used to supplement, not to supplant, the teacher [13]. In other words, technology should be facilitated by the teacher to bring out the optimum setup of the class and, in effect, the students. This accomplished by the teacher but only if the technology, whether software package or hardware adaptation, is suitable. To use the technology as either a distraction or entertainment source is an inefficient means.

The computers' function is only as good as the function of the lesson plan at hand. In several situations (if not, all), the technology is engineered to the instruction or project effectively if the project is thoroughly planned. For example, Hickey's team discovered that laptops work better than

computer lab stations for his GenScope project [12]. The power of choice gives instructors more flexibility and options over how to further enhance the lesson. In my own experience, teachers may be able to alternate between technology types to gauge the best outcome only if financing is available.

IV. Factor 2: Teachers as elements of facilitation

Teachers (as always) have a distinct significance in the lives of students so they need not worry of being "outsourced" by technology. As more electronic tools find themselves at the classroom door, teachers can use their professional expertise to embrace the potential, because learning isn't a technology in itself [25]. It is a social activity facilitated by teachers.

1. Teachers as teachers

There exists the notion that as more processes become automated, teachers will become obsolete. On the contrary, human behavior and social development occur, despite technology influence and teachers must be present. In addition to facilitating focus on technology-enhanced lessons, teachers can empathize with the social development at all stages. Social and moral development needs attention because they affect a level of computer-discipline [22]. Teachers have a positive impact on how technology is implemented.

Classroom teachers possess a great deal of responsibility for the learning of students which includes the method of instruction delivery. Whether the instructor is a grade school classroom teacher, college professor or trade instructor, they make the learning happen in their environment. In Taylor's analysis, the diffusion literature suggests that teachers' attitudes toward, and expertise with, technology often are key factors associated with their uses of technology [19. In Davis' work of predicting user acceptance, perceived usefulness and ease of use are two determinants to people's acceptance or rejection of technology [26]. Thus, a teacher's attitude and trainability can affect how significant the role of technology plays in their classrooms and ultimately, in students' learning.

2. Teacher's attitude or philosophy

Further to attitudes, motivation from teachers must be strong so as to positively affective. If teachers find intrinsic value in technology, it will create the context for successful implementation. According to Hadley, teachers motivation appears to come, in large measure, from their belief in the educational value of the technology for students and from what they see happening in their classrooms. These teachers are inspired by their students' accomplishments with and enthusiasm about the technology [27]. Teachers should exercise caution for their choice of available tools, however. Oftentimes, teachers make decisions based on limited information and in response to pressure [19].

3. Teacher's Resourcefulness

Going back to Windschitl and Sahl, technology use should be within lines of what teachers believe would be effective teaching and includes ICT to help [5]. Teachers have the option to be creative and there exist resources for ideas.

Goffe, however, mentions a study involving online courses that yielded negative or neutral findings involving ICT[14]. This case relates back to an aforementioned philosophy that too much of a good thing is just too much. If teachers are allowed to be creative and strike a balance, they have achieved a feat that can be replicated and shared.

If a teacher is gung-ho and is granted to use technology, they must then be resourceful in finding good solutions. For example, teacher-training programs often include a mentoring component so new teachers gain insight not only about instructional methods but also through technology resources tapped from veteran teachers. By teaching the elementary classes, the mentor modeled the use of technology to the mentees [28]. This approach cuts some work out for the teacher because they don't have to conduct original searches for effective programs – no sense in reinventing the wheel.

V. Factor 3: Social environment

Technology can either enable or restrict, depending on the context. Orlikowski explains that this duality is caused by technology acting as a medium of social practices [29]. While the author's work focuses on corporations, we can safely include education organizations as a landscape to study. The particulars of our chosen landscape however, prove to be detrimental to ICT.

1. Student Behavior

As a particular example of social challenges that computers present, morale is a high contribution as noted in Collinson's work. The teacher had to manage not only classroom control, but also the ethical implications of technology and the moral hazards. Those hazards include not only plagiarism and threats, but also external circumstances which took students' attention away from the plans she created involving the technology [22]. Teachers must be concerned about customizing technology for students of migrant status, economic status, disabilities and their perceived attitudes about social responsibility [30]. Students must develop intellectually and morally. Those types of challenges cannot be solved with classroom technology. Socio-factors can derive from within ICT or come from external forces; they affect the technology-use and ultimately, the lesson at stake.

2. Environment

Zhao and Frank accredit Cohen in their research. Cohen observes that schools naturally and necessarily resist changes that will put pressure on existing practices. In addition to this inherent resistance to change, schools are also said to have a structure that prevents widespread uses of computers [19]. This scenario does not make for a conducive place for technology and is therefore opposed. In research, authors may argue that schools have become more open to technology because it improves social patterns; but each school environment is different. The evidence, in fact, goes so far as to explain that technology is built and used within certain social and historical circumstances and its form and functioning will bear the imprint of those conditions [29]. If the social context into which technology is implemented is

disorganized, as it is above, the optimal gain of technology is less likely to be achieved and loses value.

3. *Community*

Gummesson illustrates how network structure is made present between relations in business environments; as in network theory, everything is related to everything; there is nothing in isolation [31]. His definition establishes that effective implementation of technology is curbed by various particulars – within the classroom and surrounding the classroom – can have mixed results. Hamilton et al states that technology (generally) has always been part of both the problem and the solution from a sociocultural aspect [6]. Furthermore, it is this social organization and not the microcomputer that changed both what was taught and the way in which it was taught in the project classrooms [23]. Technology is as useful or effective as humans make it. The common saying 'The most dangerous part of the car is the nut behind the wheel', (however extreme), is applicable.

4. *Intellectual Study/Background*

Educational technology also suffers from a lack of scientific longevity. Because it is only a recent emergence, not much theory has been developed surrounding its scientific value much less substantial context. Zhao and Frank summarize it well: It has been shaped substantially by a disparate but powerful coalition of public officials, corporate executives, manufacturers and educationalists operating through both rhetoric and policy [32]. This haste action yields results which involve pushing teacher-training without understanding its science. Dillon observes that the obsession with skills at the expense of developing a viable theory of ICT in education, a meaningful academic content for the ICT specialist and a curricular niche for ICT, has constrained education systems worldwide [32]. Hamilton sums it up best in his 2003 analysis (albeit, not the article's main idea): the turbulence of the last 70 years has failed to create shared understandings about ICT. The field is a junkyard of discarded jargon, mantra and acronyms [6].

5. *Economic Influence*

Social factors may also include sources that do not directly interact with the classroom or teacher. For example, Straub explains how some social factors impede technology implementation but do not involve human-interaction. External forces such as state standards, cost, available funds, security, and technical support may limit not only the overall decision to deploy an innovation but also which specific technology will be adopted [7]. The notion of limited availability directly limits the teacher's options, which can lead to frustration, especially when something is just out of reach. This restriction poses a problem because, part of the less frequent use of technology by the teachers may be attributed to the lack of technology resources that are in place in their schools [33]. Consequently, frustration emerges from the students; they cannot anticipate a 21st century classroom. Johnstone's and Poulin's study notes that not every campus can afford to develop and support good technology mediated course materials, even though the current student population expects them [34]. Consequently, the lack of availability and access will impede use [35].

VI. Factor 4 - Teaching Requirements/Professional Development

Clearly, teachers cannot undertake changes on their own, especially if they lack support from the administration. Training teachers to perform the expected tasks with computer technology is essential [1]. Tasks of leadership (workshops, PD, etc.) are required to stimulate implementation.

1. *Mentoring/Sharing*

The opportunity to share technology success strategies and suggested-use is important during the opportunities of professional development. It is a time when colleagues that do not often meet or meet for other reasons to share information (like technology agents that share across a network) [2] [3]. When there is shared understanding, enough time, trust amongst colleagues, and good focus, professional development can be effective for any means to improve student performance. Harris describes professional development approaches which are enhanced through technology; Some may resist, but implementing technology for instructors on any level yields positive results and discoveries.

2. *Required Skills*

Instructional technology has become a necessary component of a teacher skill set [7]. Education reform has also demanded that teachers' skill sets change in response to external pressure. As a result, teaching requirements as well as curriculum requirements have been reformed to include ICT. In turn, as Royer puts it, professional development for computer technology needs to be ongoing, tied to student learning, focused on individual and organizational goals, driven by a long term plan, and planned collaboratively by those who will participate in it [39]. Lawless and Pellegrino state the evidence suggests that technology supports high-quality student learning and professional development should support teachers in effectively integrating technology into the teaching process. Professional development activities should include how different technologies can facilitate learning and achievement among students [40]. Treating technology as an omnibus – an undifferentiated variable in education and in the professional development of teachers – perpetuates an overly simplistic view of what it means to integrate technology into the instructional environment. There is still a great need to develop a structured and theoretically grounded approach to evaluating the impact of technology-based professional development [40]. In one professional development study, this need was strongly emphasized.

3. *Classroom Resource*

As discussed earlier, administrators would benefit by including adequate training in professional development, if not facilitate discussion thereof. Technology use should be more thoughtfully considered within the context of teachers' beliefs

about what constitutes effective teaching and how technology and information access can alter the traditional roles of teachers and students in the classroom [5]. In doing so, teachers can collaborate during staff meetings and share success stories in which technology has embellished their instruction.

In one professional development study, Bauer, Reese and McAllister found that technology is used not only to simplify classroom management, but it also is integrated seamlessly and naturally into instruction [33]. While this study concentrated on a specific subject-matter, the notion here is that technology can be integrated throughout multiple disciplines, including how to study! An administrator comments on his project of study skills, concluding that students will benefit from learning how to use the computer to improve their learning, reading and skill levels [11].

An approach to ICT implementation is to take a top-down method. In one example, a teacher created taxonomy of instructional media to better assess what amenities were at her disposal [41] and some types of instructors find they revamp their curriculum based on what technology tools are available. One teacher of Literature explains how she postponed reading further works to spend more time discussing draft papers and peer evaluations. She also used her tools to embellish her class: for example, using visual forms of art to enhance the lesson at hand [42]. If research and testing is sufficient, certain technologies such as computer-aided instruction (CAI) tools should be considered as incentives to mention in the policies or goals of teaching [43]. The use of CAI not only improves the student-learning, but also demonstrates the students' use of technology as a tool or resource that will serve them in later years in education.

VII. Conclusion

The factors mentioned in this paper identify what and hinders and helps success in educational technology implementations. Granted, these factors are broad but they are also contextual, meaning they are based on real-world findings collected by various methods of research. We see teachers have power to control the amount of influence and variety in their lessons. Professional development requires, if not, is gradually making a tech-savvy transition to support teachers. The technology (as an entity) contains an inherent pedagogical value. While the aforementioned foster a home technology, social environments impede the delivery of such educational technology to a degree. While social factors prove difficult to circumvent, it does not mean we have hit a road block and should give up. As scientists and educators, this gives us an opportunity to study these impediments as challenges to ultimately overcome. Mehan, for instance, suggests that we adopt a perspective that characterizes computers as social practice. When we do, the relationship between classroom organization and computer-use becomes mutually influential, not overly deterministic [23]. This perspective lays the foundation to create a model that fits a facilitator's goals in a social context. Metaphorically, there is no one-size-fits-all and this paper does not present a definitive solution. We cannot change the climate, but we can take advantage of the weather.

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