Objectives of ICT Use in Education

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Abstract: *E-learning, distance education, digital textbooks, virtual laboratories and other new words and concepts are getting in focus of researchers and educators worldwide. As time goes by new terms and ideas will join them and pioneers will embrace and explore them further.*
However, real benefit will be apparent when they leave the laboratories and experimental programs and spread throughout academic and educational community as a common practice.
For a broad acceptance and deployment of ICT in educational process necessary technical infrastructure, legal framework, financial support and psycho-social climate need to be recognized, defined and established. In order to do that educational policy and decision makers should have clear understanding of the benefits and costs of ICT.
The leverage of ICT in education can be broadly separated in three areas: administrative, technical and other supportive functions for education; automation, assistance and support of learning and teaching and completely new teaching and learning methods, techniques and tools.
This paper aims at identifying objectives, leaders, drivers and requirements of the ICT implementation in all three areas.

Keywords: *ICT in education, e-learning, distance education, objectives, change process, virtual labs, remote labs, teleconferencing*

1. INTRODUCTION

The 21st century is already the age of knowledge, the knowledge society and the educational age. The educational industry will be the industry of the 21st century. It is only natural that new technologies, ICT (Information and Communication Technology) above all, are in the focus of those who are contemplating the novelties in education. ICT has brought a range of new terms in the education like: e-learning, distance education, virtual classrooms, etc. While new terminology is being defined and redefined, hundreds of pioneers experiment with the usage of ICT in education.

The strategists of education, politicians and decision makers on the national and international level are prophesying, proposing, planning and talking about major benefits from ICT implementation in education.

2. The Hopes

The most important benefit from ICT in education it is hoped for is improved learning outcomes. It would provide necessary skilled workforce for the knowledge society while boosting cost/benefit ratio. No less important is hope to speed up learning process making it in average much faster than today. Democracy would get to its full potential by democratization of learning, lowering all sorts of boundaries between students and knowledge while bringing knowledge to all students and unlimited number of them. This hope is combined with already an urban legend that ICT will make learning and teaching much cheaper. Finally, while quality learning does require substantial effort from students and teachers, the process itself could be much easier and more pleasant.

3. The Vision

Fueled with these hopes and based on proliferating use of ICT in almost every aspect of modern life, almost universally shared vision is created. This vision believes that overall human knowledge (already mostly is, but certainly) soon will be fully digital and available to any student globally for whatever purpose. The world where a student is restricted to locally available teacher is the past and we see the world in which student and teacher are globally matched and paired for a specific learning activity based on desired outcome, psychology, timing, cost, and multiple other factors. It is envisioned that students will learn anytime when their need and ability meet, at the pace that best suites them. Finally, it is clearly seen that education process will be freed from non-educational activities like: administration, support, organization, etc. They will be minimized, automated, reprogrammed, asynchronous and delegated.

4. The Reality

While an army of researchers are seeking technical and organizational solutions, while pioneers all over the world already for more than a decade [2] experiment "in vitro" implementing those solutions and while politicians talk and beehive as if they single handedly created the vision and bore solutions for it and as if the vision is already implemented and realized, the reality is quite different.

ICT is still far from the mainstream of education. It is predominantly in hands of pioneers and early adopters, still on the margins of early majority.

The furthest most "mainstream educators" came is to publish "digital photocopies" of their educational materials. They simply switched media leaving materials in the form of "paper age".

Even worse, e-learning is still mostly illegal. Not that someone will be prosecuted for doing it, but in the sense that only minority of educational institutions recognize e-learning as their regular way of teaching and learning and even smaller number makes it their strategy and priority.

The whole initiative is operating in an organizational vacuum in most educational institutions, globally. The expectations form ICT leverage are greatly exaggerated while not being properly planned for and without or with only symbolic financing. The key problem are missing and unassigned responsibilities in the envisioned change process.

5. The Forces

Thus those visions are nothing more than dreams tending to become illusions. So, what can be done to change that situation? The first thing to look at are the forces to change. Without a change driver there won't be any change. The forces in any process come from the customer, internally and from the environment [5].

The ultimate customer of the educational industry is the one who uses skilled professionals: the industry. The industry is already demanding well educated highly skilled professionals. There is increased demand for customized education targeted at specific subset of knowledge or tailored for a specific project [9]. Another demand from industry is globally standardized certification of knowledge and skills.

Internal change forces are students and teachers. Because of the industry demands, students need customized education, now and fast and they do not want to waste time on any kind of overhead: administrative, organizational or any other. Teachers want to reach every student globally available in order to maximize the gain from their investment in designing educational materials, tools and processes. They too want to reduce overhead in order to boost their own productivity.

The globalization process creates pressure from the environment creating competition where there wasn't any and bringing it from sources unknown till now. For example, globally available virtual labs and remote labs compete with physical facilities at local school. Competitors are no longer only other local or national schools not even well established and recognized schools from the world. Competition today comes from countries and institutions one barely heard of or even from industrial

education facilities whose educational certificates are globally recognized and demanded (Cisco, Microsoft, LPI, ECDL, …). Finally, the process of decoupling teaching from certification (ECDL, LPI, …) is a force in itself that will irreversibly change the landscape of traditional educational institution we all are familiar with.

6. The Aim

Leveraging the forces available and bearing in mind the vision, a realistic aim should be agreed upon. An aim on which change agents, implementers and all other players could keep an eye while embarking on this exciting journey of fundamentally changing the activity which makes humans essentially different from all other species: learning [6].

This aim could be surprisingly simple. It is to move ICT from labs, experimental institutions and pilot projects to every days practice in a broad number of activities in majority of schools.

7. The Way

Using this aim as an orientation point, a way towards it needs to be designed. The way is a stepwise process to be followed both globally and in each segment of the way or specific activity. It needs to:

- define objectives,
- for each objective identify: change drivers, players, resources, outcomes, leaders,
- set the infrastructure,
- plan,
- publicize.

The first step is to define objectives. Objectives are clearly defined realistic goals to be accomplished. In the next step, for each objective change drivers, players, available and needed resources as well as measurable expected outcomes need to be identified. Leaders are those who initiate and sustain the change process.

The third step calls for setting the infrastructure. It encompasses everything that will be used in the change process or that will support it: strategies, materials, equipment, money, time, people, education, consultants, …

With infrastructure set, a change plan consisting of sets of well documented procedures needs to be designed.

Finally, the players in the change process need to become informed and familiarized with all this through extensive and continuous process of publicizing.

8. The Objectives

This paper's scope is to propose one possible set of objectives that could realize above defined aim. For each objective a set of applications, change drivers, requirements and possible leaders will be identified.

Education processes differ among themselves because of the subject of learning, required learning outcomes, previous knowledge, learning styles, culture, industry and many other factors. On the other hand, ICT can be used in a variety of ways in any traditional or new activity.

These two factors combined derive numerous activities in educational process in which ICT is or can be implemented. In order to streamline them and to try to identify some common points and shared resources, it is proposed to group them in three sets of objectives:

- Support functions: administrative, technical and supportive functions ,
- Learning assistance: assistance and support for learning and teaching,
- New learning: new teaching and learning methods, techniques and tools.

9. Support functions

Support functions are all those administrative, technical and supportive functions that are (considered to be) necessary in today's educational processes but which do not increase the knowledge or skills of students by themselves. In particular they are: enrolment to courses and programs, certification (a formal and administrative process as opposed to knowledge verification) and payment. They are also: scheduling of classes, exercises and exams; attendance granting and monitoring; resource allocation and usage monitoring and billing. Surveys, statistics and reports belong here, too. Supplemental functions are provision and usage of libraries and info services, counseling and student assistance. Finally, the mere physical presence at the premises of a school is a support function, as well,

Today, a substantial amount of student's and teacher's time is used for those functions. By intensive, extensive and proper use if ICT all mentioned functions can be reduced, automated, asynchronized or avoided at all.

The goals should be to avoid (the need for) physical presence for all administrative activities and for all those learning activities where possible. The data which a user (student or teacher) enters into the system should be available system wide and should never be entered again. Every function that can be described by rules and programmed should be performed by computers, automatically, not requiring human effort. The communication among all players in the educational system should be available on-line 24 hours a day 365 days a year using the variety of communication techniques (phone, Internet …) preferably asynchronous ones: SMS, IM, e-mail.

This means that administrative information systems, automated information systems and digital libraries should be built. Teleconferencing should be routinely used. Virtual communities need to be established providing legal assistance, support groups etc. Finally, virtual and remote labs should be designed.

All the technologies exist, applications have been tested world wide and concepts proved in practice. So, what needs to be done in order to implement them on the broader scale?

The change drivers fall in two categories: financial pressure and market competition. The need for administrative cost reduction and efficient resource usage make financial pressure on school administrations. Market competition in form of increased offer from other educational institutions and new players from the industry will result in increased demand from both students and teachers to reduce non-educational burden on their time.

In order for those changes to take place, certain requirements need to be met: educational institutions need to be (at least partially) cost based instead of fixed budget, students need to be empowered and regulational framework in place supporting remote work and education in general.

Finally, the leaders of change need to be identified. In this case these are students, their organizations and leaders and leaders from administration (school, local, or national) [1].

10. Learning assistance

Learning assistance are all those functions that provide assistance and support for learning and teaching. They are closely related or bound to learning content and process but do not directly increase student's knowledge or skills in the learning domain. They are comprised of resources and systems that make learning and teaching faster, easier, better focused, broader and deeper thus enhancing the understanding and mastering domain knowledge and skills. They are also systems that continuously improve teacher's competences [4] as well as student's knowledge and skills outside (but in "neighborhood") of the learning domain.

The goals within this objective are to provide students with all necessary and desired information and knowledge and to do so in digital form suitable for any type of processing and manipulation they deem desirable. A goal is also to further physically and temporally decouple student from any other individual, resource or process required or desired in learning. Assumed goal is that all necessary resources are available to a student as well as training and support to efficiently use them. An

important resource in learning process are centers of excellence: points of referral when in doubt or need for clarification and assistance.

These goals can be accomplished by digitizing all existing learning and teaching materials and making them available on-line, by establishing and opening digital libraries and opening all relevant digital collections and libraries world-wide to students while learning. Archives of student's results from previous generations as well as their questions and answers to them are invaluable source and aid in learning process. E-mail communication with teachers and other students, virtual (global) working groups, distance asynchronous teaching, live streaming and recordings of lectures, exercises and events greatly enhance and simplify learning process. Computers, communications and SW tools per se but also as means to access and use other resources should be treated as resources and readily, omni presently available to students. Training and assistance for their usage are natural part of those resources.

In order to create described learning assistance, change forces can come from three sources. Students will demand them as market competition increases and competitors start creating their own market advantage offering such assistance. Professional educational standards could come from teachers professional associations and education industry as the changing force. Educational community (such as university) could create "service level" requirements within themselves thus creating internal change force. Obvious but serious obstacles in this process area associated cost and huge effort required from all involved in providing education and traditional inertia of large systems.

In order for these changing forces to succeed there are requirements to be fulfilled. Above all it is necessity to honestly, substantially recognize the (importance of) teaching quality and achievement. Currently there are only few instances where a regulation would prevent development of learning by means of ICT, but significant changes in regulation are a must in order to foster it. Market competition of education providers is single most important factor that needs to be established in order to "wake up giants". When all this is set, the infrastructure that will support e-learning needs to be in place, too. Large financial investment is inevitable in every educational system.

The final question is: who can lead the change? In part that can be students demanding resources. Majority of burden still lies on educational authorities and governance. However, teachers and their associations cannot avoid their responsibility in this change [8].

11. New learning

New learning is a joint name for new methods, techniques and tools in teaching and learning that substantially change the outcomes, the way and the experience of learning. They do so in the way which would be impossible, impractical or prohibitively expensive without the use of ICT.

Since this is a very innovative field of ICT leverage it is difficult to set fixed goals, but on the general terms it is about full adjustment of learning process to needs and abilities of the student. It is focused on understanding and mastering knowledge modules of sustainable importance. Above all it is about putting full control of learning process in student's hands, making learning process as transparent as possible with ample reference points enabling students to measure their progress, asses acquired skills and knowledge and find their way forward in every learning situation.

These goals can be accomplished through ICT implementation in several ways. One of most innovative ways is by means of virtual laboratories in which students can perform endless experiments at no additional cost, dangerous or unethical (on simulations of human body) experiments, impossible experiments (temperatures close to absolute zero or no-gravitation environment) or experiments with compressed or elongated time line. Virtual working groups and faculty staff would add to student's ability to truly understand and grasp learning concepts. Self examination tools are those that will provide students with orientation points for their own path and milestones along it. Self paced integrated adaptive learning materials are the ultimate goal. They are as close to the real teacher silicone technology will ever get. They will liberate teachers from tedious and routine work and concentrate their skills and energy to providing teaching, mentoring and coaching only human can. Simultaneously, students will be able to learn in the way best suits them,

aiming to the goals tailored to their needs, in the process optimized to their abilities while keeping the control in their own hands.

The major driver that will force change in the learning process itself is market competition. Once students experience new, enhanced learning they will demand it from all educators. Since the major burden of changing the learning process is on teachers, market competition will result in pressure from educational employers who will require teachers to improve and develop the learning process [3]. In addition, teacher's professional associations may come forward with new set of professional teaching standards which could serve as an auxiliary change driver.

As with other objectives, market competition should not only be waited for but should be proactively created by national governments, educational communities, international associations and industry at large [7]. Strong recognition of quality (in) teaching is a must for the changes to become sustainable. It has to be understood that new learning requires more effort on side of teachers and students likewise, plenty of time and a lot of money. In addition, since teachers and students alike are walking on a completely new path they need strong support. In such an innovative process it is very difficult to precisely plan for required infrastructure and even more difficult to optimize its use. Therefore a state-of-the-art, abundant infrastructure needs to be provided to all players.

Crucial point to understand is that innovative teachers are pioneers in this process, not leaders. Leaders can be only those who can (inter)connect ideas, pilots and new achievements, obtain resources and start the change process. In general, those are decision makers at the highest level [7].

12. Conclusion

Proposed set of objectives, goals, drivers, requirements and leaders is not the only one possible but could be used as an orientation point or guiding principle to design a similar one for the educational change desired.

It is important to identify, define and design all components and put them in operation because they are all crucial. For example, even ample resources and detailed plan will bear no results if they are missing a change force or are trying to engage the wrong one. Similarly, without the proper leader there will be no sustainability and no focus in the process and thus desired results cannot be achieved.

However, if all elements are in place and are applied over the appropriate period of time, they will result in expected outcomes.

Leading authors on change in educational systems [3] [6] agree that the major changing force are teachers. Students have very important role, too. All others are "merely" in a support function but their role is therefore not less important and their responsibility cannot be circumvented. Indeed, support functions in education like decision makers, regulators and financiers are those with the major responsibility to design the change process properly and keep it in motion.

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