An emergent participatory design framework for higher education

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Abstract. *Our current society is exponentially increasing its dependency on technology and science, and this dependence is likely to get deeper in the close future. The current educational system is broken even for the needs of past decades, and it is a bad joke to consider it satisfactory for our current and future needs. This leads to a dangerous situation where a society will have a base that very few of its members comprehend.*
The educational proposal that I outline here leverages current technologies to create the condition where people can have access to top notch knowledge and technologies, so that a more democratic and efficient pedagogical approach can emerge, one that is more encompassing and that allows for much more personal control over the process.

keyword*s: education, technology, constructionism, emergent*

1. Introduction

The fundamental problem that I tackle in this article is putted by Sagan [1996] very eloquently, so I'll quote him in full:

> We've arranged a global civilization in which most crucial elements - transportation, communications, and all other industries; agriculture, medicine, education, entertainment, protecting the environment; and even the key democratic institution of voting - profoundly depend on science and technology. We have also arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces.

Or consider the synthesis that Cavallo [2004] makes about the prophetic vision of John Dewey on justice and society:

> For Dewey a just society could only be built not based upon the dictates of clergy, royalty, or an elite, but depended upon the informed collective decisions of all, where every voice should be heard.

So, clearly our current ways of learning and teaching are broken, but why? I stress that this is because of the centralized nature of the responsible institutions. It is the nature of centralized process to not being able to cope with change. As Kurzweil [2006] puts it:

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Most education in the world today, including in the wealthier communities, is not much changed from the model offered by the monastic schools of fourteenth-century Europe. Schools remain highly centralized institutions built upon the scarce resources of buildings and teachers. The quality of education also varies enormously, depending on the wealth of the local community (the American tradition of funding education from property taxes clearly exacerbates this inequality), thus contributing to the have/have not divide.

Unfortunately compounding this problem is the fact that the bureaucracies responsible for the education in most, if not all, societies in the world tend to be the most resistant to change, where exists a heavy payroll and people think they know everything about education. Negroponte [2006]

I'll call the process of decentralizing of the educational systems deschooling, paying homage to Illich [1971], because I think he was one of the first who saw it clearly needed in modern society. But what descholling means, and to whom falls the responsibility for deschooling an individual? The same work provides a clear answer to both questions.

Only liberating oneself from school will dispel such illusions. The discovery that most learning requires no teaching can be neither manipulated nor planned. Each of us is personally responsible for his or her own deschooling, and only we have the power to do it. No one can be excused if he fails to liberate himself from schooling. People could not free themselves from the Crown until at least some of them had freed themselves from the established Church. They cannot free themselves from progressive consumption until they free themselves from obligatory school.

The impact of keeping the course is huge, both socially and individually, as Papert and Caperton [1999] thinks:

The choice is not whether we will consider deep changes in school but how many children will be lost before we recognize that we have to do so.
...
As the slow evolution of school lags further and further behind the rapid evolution of society, increasing numbers of students all over the world see school as irrelevant to life. Many drop out. Many more drop out mentally, emerging from school with poor skills and negative visions of themselves and the society they are entering.

In the rest of the article I'll try to present a system that uses current technologies and networks to enable individuals to take charge of their own education, along with a path for them to prove their acquired knowledge to society in general. It is the objective of the article to make clear that, by providing the conditions to a system with the characteristics outlined in the rest of the article the problems described in this introduction would be considerably mitigated.

2. The bases of the system

Two fundamental concepts form the basis of the educational system that I am trying to communicate in this article. One is constructionism, a theory developed by Seymour

Papert, and it is the epistemological approach that runs throughout the system, and affects how the learning (and consequently the teaching) process is viewed. The second one is emergent design, and that is the organizational and structural view of the system, and affects how the system evolves and relates to its members and environment. Both concepts are intertwined, as will be shown below.

2.1. Constructionism

Constructionism is an epistemological theory that was developed by Seymour Papert, drawing from his experiences as a mathematician, his time studying with Jean Piaget (the developer of the constructivist theory) in France and from his background as an artificial intelligence and media researcher.

Cavallo [2000a] makes a clear distinction between Constructionism and Constructivism:

> Constructionism builds upon principles in constructivism. While constructivism holds that the learner constructs new knowledge based on the existing knowledge he or she has, constructionism builds on this idea by maintaining that this process happens particularly well when the learner is in the process of constructing something.

Constructionism is also a true pedagogy of autonomy, in a very Freirean way:

> ...teaching is not transferring knowledge, but creating opportunities for their own production or its construction. Freire [1996]

We can observe the deep connection of constructionism with computers and technology. But that it is far from technocentrism, where technology is used just for the sake of using technology. That connection comes from the almost endless capacity of the computer to create simulations and concept of microworlds:

> Learners in a physics microworld are able to invent their own personal sets of assumptions about the microworld and its laws and are able to make them come true. They can shape the reality in which they will work for the day, they can modify it and build alternatives. This is an effective way to learn, paralleling the way in which each of us once did some of our most effective learning. Piaget has demonstrated that children learn fundamental mathematical ideas by first building their own, very much different (for example, preconservationist) mathematics. And children learn language by first learning their own ("baby-talk") dialects. So, when we think of microworlds as incubators for powerful ideas, we are trying to draw upon this effective strategy: We allow learners to learn the "official" physics by allowing them the freedom to invent many that will work in as many invented worlds. Papert [1981]

That kind of characteristic is crucial to deeper changes in education and what is meant by knowing.

> The need to distinguish between a first impact on education and a deeper meaning is as real in the case of computation as in the case of

feminism. For example, one is looking at a clear case of first impact when "computer literacy" is conceptualized as adding new content material to a traditional curriculum. Computer-aided instruction may seem to refer to method rather than content, but what counts as a change in method depends on what one sees as the essential features of the existing methods. From my perspective, CAI amplifies the rote and authoritarian character that many critics see as manifestations of what is most characteristic of–and most wrong with–traditional school. Computer literacy and CAI, or indeed the use of word-processors, could conceivably set up waves that will change school, but in themselves they constitute very local innovations– fairly described as placing computers in a possibly improved but essentially unchanged school. The presence of computers begins to go beyond first impact when it alters the nature of the learning process; for example, if it shifts the balance between transfer of knowledge to students (whether via book, teacher, or tutorial program is essentially irrelevant) and the production of knowledge by students. It will have really gone beyond it if computers play a part in mediating a change in the criteria that govern what *kinds of knowledge are valued in education.* Papert and Harel [1991]

2.2. Emergent Design

Emergent design is a strategy for building systems that are too complex to be tackled in a top down, plan first manner, as Cavallo [2000b] puts is:

> Popular views about design, about reform, about planning, about control typically lag behind progress. New organizations are pioneering new means of control and change. Emergent design is the recognition that certain systems are too complex, dynamic, interconnected, and chaotic to attempt to manage them by top-down, pre-planned, rigid means of control. Large educational systems are one-such system. The human brain is another. That this project is simultaneously involved with both systems is all the more reason to take an emergent approach.

So the point of the strategy is to build systems that provide a base for systems to be built on it, by the users of the system itself. A global participatory architecture that connects several systems that grew on top of it. That view has several advantages as Cavallo [2000b] objectives for workshops in his emergent design system in Thailand shows:

> The workshops were intended to:
> - provide powerful personal experiences of a different approach to learning,
> - break pessimistic mindsets about people's ability to learn,
> - surface, reflect upon and discuss participants' own prior explicit and implicit assumptions about learning to the surface, and compare them to the new experience,
> - encourage participants to think about the learning process itself,
> - engage in thinking about the design and practice of learning environments in the local context,

- identify local people whose thinking and acting appear promising so that they can take on greater roles for change,
- debug our own thinking about the mechanisms of learning and our own pattern of practice in designing learning environments.

3. Description of the system

The overall system has the objective of graduating individuals in a manner that is at the same time democratic, stimulating, meritocratic and able to prepare those same individuals for a life in a society where computers will play a major role.

In order to do that with a decreased cost, both financial and social, it is wise to use the existing structure where it is possible to do so, so that factor is embedded in the project as well.

3.1. The relationship with knowledge

The first step of the system would be the self preparation of a given student through a process of interaction with the knowledge. But what knowledge? Well, before the system is constructed it will be the job of the competent authorities, both private and public, to digitalize the best available content of the existing superior educational system. That could be done through the video capturing of the federal universities classes, plus the digitalization of all the non copyrighted material.

That content should be placed in a free and open environment in the internet, where it would be available to every citizen that would be interested in it. Systems that could be used as base are already in place, and they are already being used by global populations, which, shows its demand, as can be seen in Abelson [2007]:

> The MIT OpenCourseWare web site has, as hoped, become a significant global educational resource. Fewer than half (43%) of its visitors originate from within North America, the others coming primarily from East Asia (17%), Western Europe (14%), South Asia (7%), Latin America (5%), and Eastern Europe (4%). Access to MIT translation partners is also substantial: in January 2007 there were 75,000 visits to the Universia translations, and a quarter-million visits each to the CORE and OOPS translation sites.

This system would be described only superficially here, because ideally it would leverage all the modern existing web development techniques in the "web 2.0". Those techniques would serve to guide the students, to promote socialization in the form of forums, tests, iterative games and so on, where the students would play not only with the resources available on the system, but with each other projects and exercises. That, as Papert [1981] puts it, places the fun on the learning process:

> Part of the fun is sharing, posting graphics on the walls, modifying and experimenting with each other's work, and bringing the "new" products back to the original inventors. Although the work at the computer is usually private it increases the children's desire for interaction. These children want to get together with others engaged in similar activities because they have a lot to talk about.

This space would, of course, grow in richness with every user increasing the opportunities and sharing it's own epistemological experiences, not only in some particular subjects, which of course would take place, but of the medium itself, smoothing the learning curve with each generation of users and producing a more fitted social intelligence in the process, like Papert [1981] again makes clear:

> As with writing, so with music-making, games of skill, complex graphics, whatever: The computer is not a culture unto itself but it can serve to advance very different cultural and philosophical outlooks.

Of course, one does not expect the users would be the only responsibles for the system. The hired professors of the competent authorities should be available with enough consistency to increase the quality of the discussions and of the official content of the system.

One important aspect is that the form of the courses could be highly flexible, which means that one could approach some subject from several points of view, according to one's own pace and vocation. That would be a form of Piagetian thinking, because although there would be goals, as the it will be discussed later, the student is completely free to choose how and when to face those goals, and if they would be faced at all.

3.2. The guarantee of quality

A skeptical of the last scenario could, with quite a lot of reason, ask: "But what about the quality of those students, or should we just hand diplomas to everyone who claims to be ready?". Our society clearly must have a way to assure itself of the quality of those who want to perform critical functions, such as engineers, physicians and several other professions who deal with human life in their craft.

The way that was proposed so far concerned itself with the student acquiring and holding the knowledge. But what about testing? To that we should turn to what society usually turns to find credibility, specialized institutions and the government, and those credible institutions could build a streamlined, on-demand certification scheme. More specifically in the Brazilian case, the very structure of the vestibular system (which is highly effective and encompassing) could be used to certificate students on general or specific points. Those authorities would have control over the tests and what set of tests would encompass a given course.

For instance, to be fully graduated in medicine one should have to complete the certifications of medicine 1 all the way through medicine 10, each sequentially and with a minimum grade. To ask for a given test to be applied some person would only have to provide some documentation and pay some fee to cover the costs of using the system, and in the next round of testing the wanted test would be available on some testing facility that is nearest to the requirer. The testing procedure per se would be audited by payed officers. The system would indeed be the same as a normal vestibular.

3.3. The needed physical step

The model so far would be incomplete on our day and age, mostly because of the limitations of the digital distribution model. That will probably change if we follow Kurzweil [2006] ideas:

Because of current bandwidth limitations and the lack of effective three-dimensional displays, the virtual environment provided today through routine Web access does not yet fully compete with "being there", but that will change. In the early part of the second decade of this century visual-auditory virtual- reality environments will be full immersion, very high resolution, and very convincing. Most colleges will follow MIT's lead, and students will increasingly attend classes virtually. Virtual environments will provide high-quality virtual laboratories where experiments can be conducted in chemistry, nuclear physics, or any other scientific field. Students will be able to interact with a virtual Thomas Jefferson or Thomas Edison or even to *become* a virtual Thomas Jefferson. Classes will be available for all grade levels in many languages. The devices needed to enter these high-quality, high-resolution virtual classrooms will be ubiquitous and affordable even in third world countries. Students at any age, from toddlers to adults, will be able to access the best education in the world at any time and from any place.

But what could be done today to reproduce the physical training and socialization required for the formation of a fully fledged professional or researcher? That today would still need a physical gathering place.

The steps explained earlier would provide that space, by freeing up the existing classrooms that before were dedicated to teaching repeatedly stuff. Not only the classrooms would be liberated, but the professors would be alleviated of most of the burden of direct teaching the horde of new students that would arrive each semester.

If both professors and classrooms would have more capability, so workshops could be created based on demand, and labs could use students with some qualifications or characteristics for assistants. There would be a very lively interplay between the institutions and those who wanted to partake on those activities, and that process would be guided much by the individual, choosing when and how to approach the institution.

Those labs and workshops could, if certified by the authorities, also certify students who are active on them, so there would be an extra motivation for students to build their own projects, in a very constructionist way.
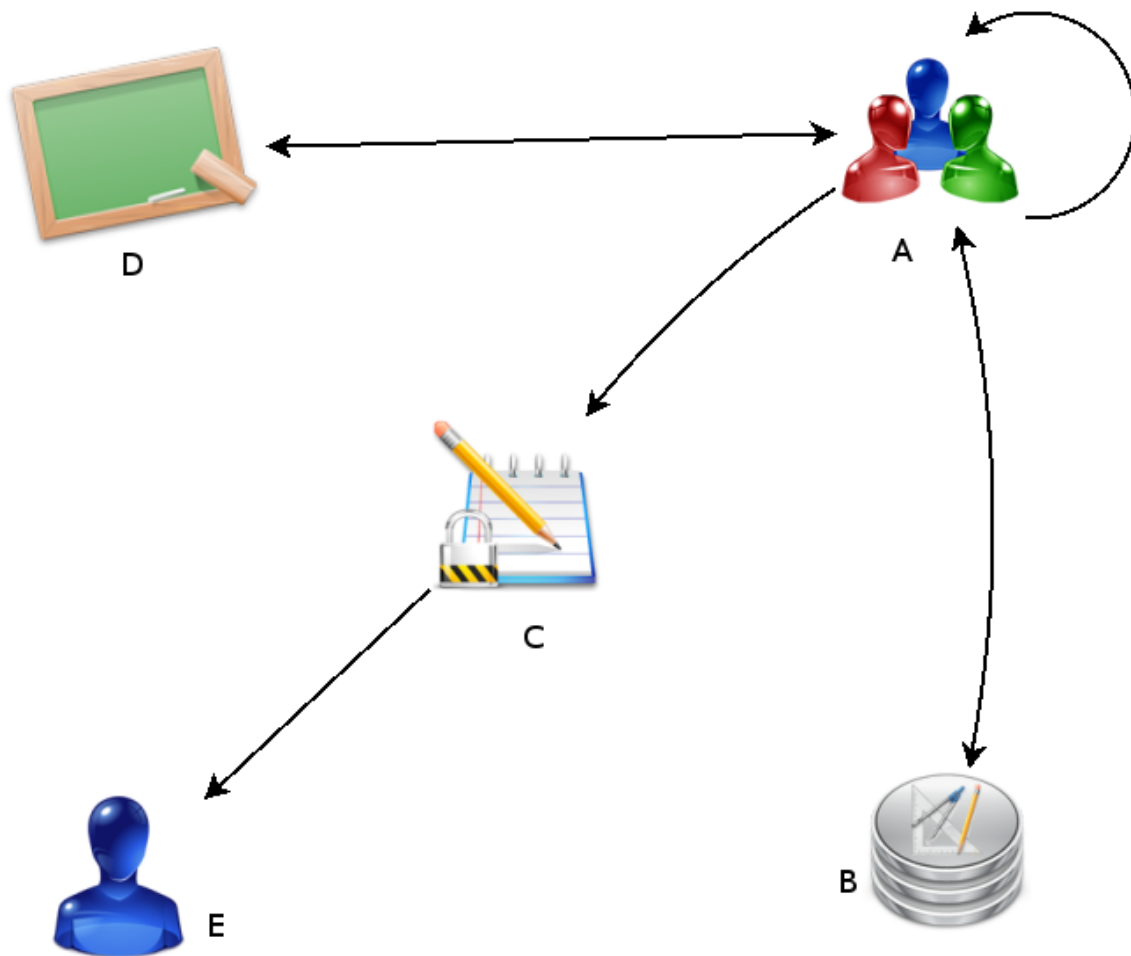
3.4. Overview

Figure 1. Overview diagram

A The population interested in the system, the candidates.
B The knowledge made available by the institutions.
C The certification procedure.
D The labs with a physical location, operated by faculty, mentors and the certificated students.
E A graduated student.

4. Conclusion

Summarizing, I am presenting an argument for an emergent design approach for education systems, one that is based on an approach for emergent design detailed by Cavallo [2000b] and that uses as its pedagogical and epistemological base constructionism, as situated in Papert and Harel [1991].

This article ends with the words of Resnick and Ocko [1991] that I find very relevant for systems like the one I proposed so far:

> Implementing these strategies is not easy. There are many unanswered questions–such as how to help students "break away" from their initial

"regions of comfort." And coordinating open-ended design activities is a challenge for any teacher. Indeed, organizing an "Inventor's Workshop" is far more difficult than delivering a lecture on mechanical advantage, or developing a step-by-step hands-on lesson. As Dewey [1997] noted more than a half-century ago (in words that still ring true today): "The road of the new education is not an easier one to follow than the old road but a more strenuous and difficult one." But it is a road well worth taking.

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