**Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση**

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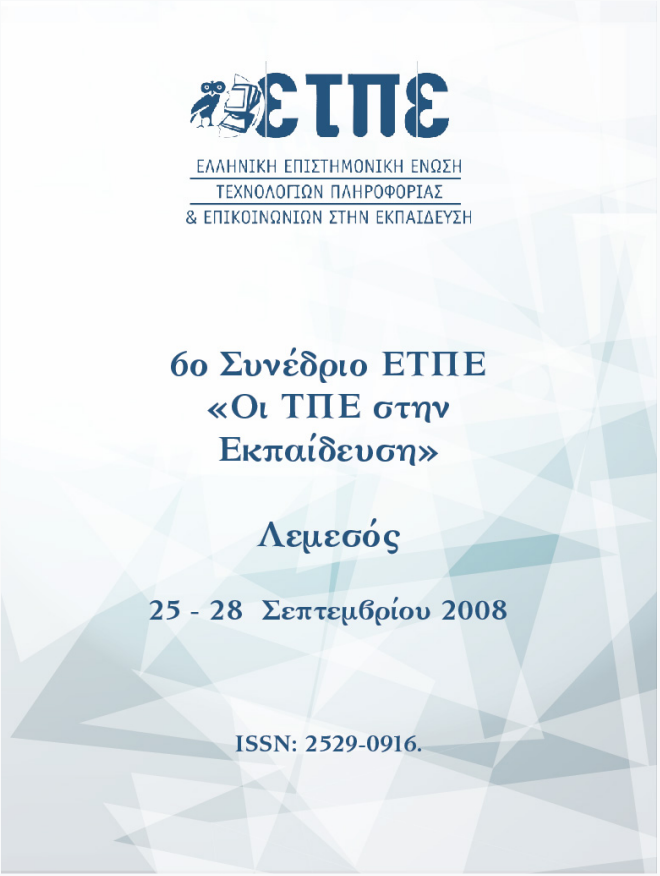


# ICT Myth Busting: Education is Not a Question of Belief, I Believe!

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# ICT Myth Busting: Education is Not a Question of Belief, I Believe!

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**ABSTRACT**

*Mark Twain once said that "In religion and politics, people's beliefs and convictions are in almost every case gotten at second hand and without examination". Unfortunately this appears also to be true in present day use of ICT in education. Educational technologists, educational reformers, local and federal politicians, school managers, and advisory groups are all jockeying to show how innovative and up to date they can be, based not upon science but upon beliefs. As a result of this implementation of change based upon beliefs or philosophies, we now find teachers, parents and students revolting against many of these so called innovations. And the newspapers, television, and other mass-media are having a field day reporting all of this. And what is the root of all of this? The reforms that we often see are most often not based on science (and specifically the cognitive sciences) and/or good scientific research, but rather upon beliefs, plausible sounding rationale and/or arguments, poorly designed research and the strange idea that 'stagnation means decline'. The reaction to these reforms - though it uses the word evidence - is also based upon beliefs about how education and educational research is and should be carried out. In my keynote I will look at both sides of the coin from the perspective of what cognitive science and good research in the field has to say about both.*

## Science versus Belief

*Science* is the systematically organised system of acquiring and testing knowledge based on the scientific method, as well as to the organised body of knowledge gained through such research. It is characterised by an assumption of something followed by the proposition of a hypothesis and its testing and completed by the acceptation of the hypothesis after proof or its rejection after evidence to the contrary. In other words, people try to acquire knowledge, to test theories through experimentation or logical analysis and when the theory shows defects or weaknesses it is adapted or thrown out.

As long as a theory has not been accepted or rejected we speak of a *belief*, based on plausibility. Sometimes this is elevated to a pseudo-science. According to the website of Committee for Skeptical Inquiry (http://www.csicop.org/), between religion and science is an area that enjoys increasing interest. Sociologists call this the paraculture. This is not only found in medicine, but also in the humanities and social sciences. Education and the Educational Sciences also suffer this burden. A belief is the trust in the truth of something based upon the presupposition or con-

viction that something is true or not true. It is the acceptation of an assertion as true without adequate proof. A belief is characterised by a conviction after a suspicion without proof, perseverance, even after proof of incorrectness, anomaly or falsity and finally denunciation, rejection of opponents.

I am a SCEPTIC and will dismember some beliefs and bust some myths.

**The Myths**

*Old learning doesn't connect – Kids multitask*

Multitasking is the simultaneous carrying out of two or more processing activities at the same time. Until recently, science has shown that human beings were not capable of such a feat. At best they were able to switch from one activity to another. A look in both scientific literature and the best seller lists reveal that many authors and even some scientists believe that there has been a wonder in human evolution. While most changes in a population take hundreds of generations and even millions of years, apparently the previous generation of children have been able to evolve their brains so that they can multitask. Since 1935 (Stroop) we know that this is not possible, but apparently some feel that this is no longer the case.

Actually, we can only multitask that which is automated and where thinking does not play a role (e.g., chewing gum, walking, and talking at the same time though even this often leads to walking into streetlamps). What people really mean is that the current generation has, through practice, developed the ability to quickly switch between certain tasks or media. Unfortunately, though they do this, this does not mean that it is beneficial or positive for them or for learning. It has been broadly shown that such rapid switching behaviour leads to poor learning results. If you try to do two things at once that require thought or if you have to switch quickly between two or more tasks that require thought, then you make more mistakes and it takes twice as long as compared to sequential work (National Academy of Sciences).

According to David Meyer, director of the Brain, Cognition and Action Lab at Michigan State, "If a teenager is trying to have a conversation on an e-mail chat line while doing algebra, she'll suffer a decrease in efficiency, compared to if she just thought about algebra until she was done. People may think otherwise, but it's a myth. With such complicated tasks [you] will never, ever be able to overcome the inherent limitations in the brain for processing information during multitasking.

*Learning results are low – It's going wrong*

Educational reformers and ICT gurus are intent upon convincing us that learning results are going off the deep end and that education needs to radically change to save us. The question is whether this is the case. International (PISA, TIMMS) and national studies of learning do not prove this belief. Actually, many surveys show the exact opposite.

*The info-society requires different learning – Discovery learning*

The third belief is that knowledge has the longevity of fresh fish and since this

is the case, we must not teach but we should rather let learners discover. But is this the case. First, does knowledge have such a short half-life? Is the theory of Pythagoras no longer true? Is the acceleration of a falling body no longer 9.8 $ms^{-2}$? Does an adjective no longer modify a noun? And is the summit of Mount Olympus on Cyprus no longer 1,952 metres? I think people mean that there is a stream of new information that increases in size and tempo daily. Unfortunately, to understand and evaluate that information we need a knowledge basis. What we know determines what we see and understand and not the other way around.

And even IF this was the case, can inquiry work? Information (actually stimuli) comes to us through our sensory organs and enters a sensory memory for microseconds. If we attend to a stimulus, then it goes into our short term memory which is limited in both size (5±2 elements; Miller, 1956) and duration (2-30 seconds; Peterson & Peterson, 1959). If further processed or rehearsed it enters our long term memory; if not it will be lost. Kirschner, Sweller and Clark (2006) thoroughly debunked the myth of discovery learning. Such learning and instruction requires the learner to search a problem space for problem-relevant information which makes heavy demands on working-memory and which does not contribute to accumulating knowledge in long-term memory because working memory is being used to search for problem solutions and is, thus, not available nor can it be used to learn.

But cognitive architecture is not the only problem here. This approach to learning also assumes that learners (i.e., children, adolescents or adults) have the ability to use this – in essence epistemology – as a teaching or learning approach. However they seem to forget what we know for years and continue to prove, namely that children are not small adults and that novices are simple dumb experts. Children and novices see and think differently than adults and experts respectively. In 1990 I wrote: In spite of the clear difference between learning a domain and practicing in that domain, many educational technologists, curriculum designers and teachers confuse learning that a discipline is based on discovery is different from teaching a discipline through discovery. Hurd wrote in 1969 that this makes the mistake of ignoring the difference between the methods and behaviours of an expert in a domain and a student that has to learn that domain. A novice sees, experiences, and learns differently than an expert. Again, what you know determines what you see and not the opposite.

*Teachers can implement inquiry learning*

Let's now go a step further, namely that inquiry learning in schools is not a question of pure discovery, but rather that there are teachers there to support and guide this inquiry process. But how can such support and guidance be given that "depends upon teachers having adequate knowledge of science … [and] sustained science-specific professional development in preparation and while in service" (National Research Council, ch10, p. 1) if teachers do not possess this knowledge or do not have sufficient opportunities for this development (ibid.)? Evidence for

the lack of knowledge can be seen in the statement by Patricia O'Connell Ross, (http://www.comsci.nist.gov/weekly_seminars.html) Team Leader for the Mathematics and Science Partnership Program, U.S. Department of Education. "While primary education in math and sciences is highly variable, depending on each teacher's comfort zone, by middle school it gets worse, with less than 50 percent of math and science teachers holding a major or minor degree in those subject areas. In some districts, up to 25 percent of high school math and science teachers do not have major or minor degrees in these subjects; however, this varies widely" The preceding suggests that guidance and support is vital in the preparation of science teachers.

This is not only the case in the US. In senior secondary schools in Australia, more than one quarter of chemistry teachers, 43 per cent of physics teachers, and well over half of geology teachers had not studied the subject beyond second year at university (Who's teaching science" Report prepared for the Australian Council of Deans of Science, January 2005). In the Netherlands, none of the elementary school teachers has studied or worked in the natural sciences and of those teaching science in secondary school their master thesis (if they have studied one of the natural sciences up to and including a MSc) was the one and only time that they had the chance to carry out a real experiment themselves (that is, if they did not either assist on someone else's experiment or carried out a replication).

This isn't support and guidance, but rather the blind leading the blind.

*Education should mimic MTV – Homo zappiens*

Wim Veen posed the term Homo Zappiens. It refers to the new generation of learners, who according to him, unlike their predecessors, learn in a significant different way. The name can be compared with other names given to the generation that does not know a world without mobile phones and the Internet, such as the Net generation. According to Veen and Vrakking (2006), this generation develops (Kirschner: in some magical way) the meta-cognitive skills necessary for enquiry based learning and teaching approaches, networked learning, experiential learning, collaborative learning, active learning, self organization, problem solving technologies, and making explicit knowledge to others. I prefer to call this the ADHD (Attention Deficit Hyperlink Disorder)-generation. Learners at the computer behave as butterflies. They flutter across the information on the screen, touch or do not touch pieces of information, to quickly flutter to the next piece of information – never knowing the value of it and without a plan. This butterfly defect, signalled by Salomon and Almog (1998), happens on pages with many hyperlinks. Learners are seduced into clicking the links, often forgetting what they are looking for.

Further, though children nowadays make use of many electronic devices and are called digital natives, they are not. First, they are capable of playing with technology but not really efficiently use it. The can Google, but lack the information skills to effectively find the information they need and they also do not have the knowledge to adequately determine the relevance or truth of that they have found. This

leads to essays on Baconian science with texts about the 20th century British artist Francis Bacon and on the problems that Martin Luther King had with the pope!

Further, it seems that they processing of information decreases as the media become more active. Salomon (1981) determined that in some media less is invested in information processing than in others. Beagles-Roos and Gat (1983) and Beentjes and van der Voort (1993) confirmed this showing that children learn to see TV as an easy medium that calls for a little cognitive activity. Books, on the other hand, require activity and are seen as a tough medium. According to Salomon, people invest less in an easy medium than in a tough one. Effect: information from an easy medium is more shallowly processed than information from a tough one!!

Other researchers have also alluded to the problems here, most prominent are the effects of seductive details (Harp & Mayer, 1997; Mayer, 2005) and mathemathantic (literally that which kills learning) effects of preferred media and study approaches (Clark, 1989).

*Society is more involved – student initiative*

The final myth is that society has changed from a supply to a demand based society and along with this, the student should no longer be a passive receiver, but should take the initiative for what is learnt and how it is learnt. This is quite different from the idea that the learner is not passive, but active! This is the basis of cognitive psychology and was best described by Rothkopf (1970) when, in talking about the mathemagenic behaviours involved in learning (literally behaviours that give birth to learning) paraphrased a well-known saying, said "you can lead a horse to water but the only water that gets into his stomach is what he drinks". What he meant is that learning depends less on what teachers or instructional designers plan or want to have happen in learning situations than on what the learners them-selves actually do.

Here, educational designers are talking about placing the locus of control for what is taught and learnt and how this should be done be transferred to the learner. Though this sounds good and modern, just replace the teaching and learning with diagnosing a disease and prescribing a medicine for. The patient then would be responsible for determining what is wrong with her or him and would then be responsible for prescribing the proper cure. Why does this sound so stupid when the same thing about education seems to be acceptable? But what does science say? Merrill (1983) advocated giving the locus to the learner, but concluded that high school students generally do not or cannot make good use of the possibilities of student-control. Carrier (1984) determined that students do not have well-fitting strategies or do not know how to use them when it is their job to administer the learning environment. And Snow (1980) found is his many studies about aptitude treatment interactions found that the use of learner-control only strengthened the effects of individual differences. Finally, again Clark can be cited here in his discussion of the mathemathantic effects of preferred verses prescribed learning approaches.

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