Computer Literacy : Insufficient for Digital Age Literacy Learners

Ronald Noel BEYERS, Nicoli Amanda KOORBANALLY
Young Engineers and Scientists of Africa, 223 Water Road, Port Elizabeth, 6070, South Africa
Tel: +27 (0)83 310 8843, Fax: +27(0)41 581 0224, Email: ron@yesa.org.za
*2*CSIR Meraka Institute, PO Box 395, Pretoria, 0001
Tel: +27 12 8414532 Fax: + 27 12 841 4570, Email: nkoorbanally@csir.co.za

Abstract: South Africa, and similar economies, cannot afford to lose another generation in the current schooling system, by failing to adequately equip youth to take advantage of life in a modern knowledge economy. This paper adopts a more philosophical approach initially to comprehending such issues as the digital divide, and makes a clear distinction between computer literacy and digital literacy. These perspectives form the basis for the Young Engineers and Scientists of Africa (YESA) initiative which was incubated within the CSIR's Meraka Institute to initiate and nurture a pipeline of human capital in science, technology, engineering, mathematics and innovation (STEMI). The emphasis is on the acquisition of 21st century skills through innovative and stimulating school based programs. e-Skills are embedded in all activities and are regarded as essential to equipping learners with the right knowledge, skills, attitudes and values to draw benefit from life in a modern technological world. Failure to address the development of e-skills within the education system as well as the broader society will leave individuals on the wrong side of the digital divide as they cannot compete in a global economy.

Keywords: Digital Literacy, Digital Divide, Human Capital Development, Young Engineers and Scientists of Africa, Skills Development.

1. Introduction

The consequences of a lack of a culture of innovation in South Africa are severe, as there is a direct correlation to a country's economic performance. Using the South African example, in the 1960s South Africa represented 6% of the world's GDP. Today that figure is less than 0,5%, but year-on-year South Africa's economy has never shrunk. South Africa has simply been out-innovated by other nations who had seen the signs, identified the trends, and acted accordingly. Today half of America's economic growth comes from products that barely existed a decade ago! The degree to which this happens has become a key measure of national success. Innovation has become the economic religion of the 21st Century, but it's no longer enough to differentiate one from 'the bunch'. Radical innovation is a necessity to thrive today. South Africa has not yet adopted this religion en masse, but there are exceptions. It's about real people who took risks. These are people who set themselves outrageous goals, at almost impossible odds [1].

The same scenario has played itself out in the educational sector. One of the primary functions of an education system is to convey and ensure a mastery of a set of knowledge, skills, attitudes and values that a particular society regards as desirable. During the formative years an individual will also be exposed to a cultural framework, which will supplement his or her survival strategies for the rest of their life in a given society. One of the problems that many societies are facing especially where there is a transition from an industrial and manufacturing based economy to a knowledge society, is the rate of change. The reform processes in education, as portrayed through the curriculum, are seldom able to keep pace with the change resulting in students exiting the formal education system inadequately prepared for a world that has moved forward light years. To address this problem it is proposed that curriculum changes need to be visionary and project the activities within the classroom to intersect with the future needs of society as portrayed in Figure 1 [2].

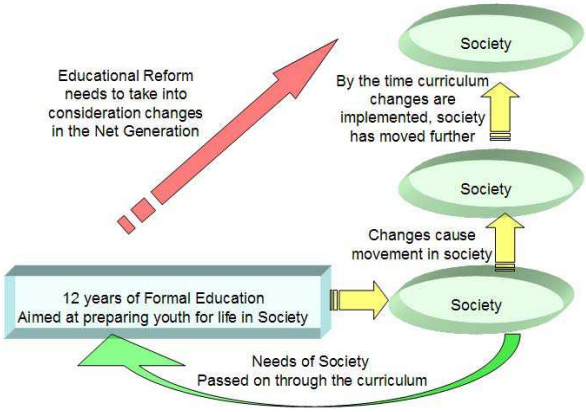

***Figure 1*: The education system, society and the curriculum [2]**

Given the slow uptake of technology in schools, the high unemployment rates and unequal distribution of wealth in South Africa, there is little chance of teleporting the majority of learners to the right side of the digital divide. In terms of human capital development (HCD) in the e-skills department, the consequences are that the feeder stock emerging from the current education system will not be adequately equipped to firstly cope with life in a rapidly evolving technological world, and secondly will not be able to contribute meaningfully to the economy of the country. This digital divide simply reinforces social and economic exclusion to a burgeoning population of learners emerging

from an education system that is failing to prepare them for life in a modern technological world.

The objectives of this paper include:

- Differentiating between Computer Literacy and Digital Literacy
- Towards a definition of e-skills
- Introducing the Young Engineers and Scientists of Africa (YESA) programme as a national delivery vehicle to initiate and nurture a STEMI pipeline which also promotes e-skills development at school level.

2. Towards a definition of e-skills

The term 'digital divide' caters for the clear demarcation of those who have access to technology and those who do not but it does not portray a future for learners and users beyond access. An alternative philosophical approach to the concept of the Digital Divide is to rather view the situation as a Technological Ladder as represented diagrammatically in Figure 2 in order to convey further development beyond access as proposed by Beyers [3].

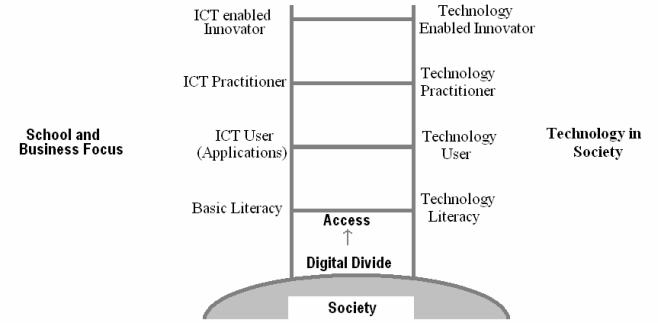

***Figure 2. A Schematic Representation of the Concept of a Technological Ladder*[3]**

The importance of the Digital Divide is not diminished in this model but it is seen as the initial step to be overcome through the provision of access. The concept of a Technological Ladder implies the need to continue to provide ICT developmental targets further up the ladder for the learners to aspire to. Unfortunately many learners in the current education system will either remain on the first rung or even slip off as they are often not provided with additional support or access time to develop their newly acquired skills.

Once basic literacy has been achieved, users need to be exposed to a variety of packages in order to become competent users. Beyond that is the mastery of the tools where ICT constitutes the main part of their future professions. The ultimate goal is the utilization of the power of ICTs to conceptualize and realize their creative talents in the form of innovations (and ultimately patents). By providing challenges for ICT and other technology users they need to be afforded the necessary support and vision of what can be achieved rather than be left as casual users of products [3].

As ICTs have become such an important element in the working lives of many European citizens, so has the demand for ICT-related skills, both in terms of the "ICT practitioners (or professionals)" who design, build and maintain products and systems, and of the "ICT users". Consequently, concerns about the supply of these skills has become of considerable interest to policy makers – a smoothly operating ICT job market is felt likely to increase effective ICT use and so to increase industrial efficiency and economic gains [4].

The term "e-skills" is often used as the encompassing concept of all skills related to ICT activities and is most often interpreted more directly as (synonymous with) ICT skills.

The European e-Skills Forum (2004) discussion on e-skills has resulted in definitions for three different types of skill. ***ICT user skills***: the capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not ICT. ***ICT practitioner skills***: the capabilities required for researching, developing and designing, managing, the producing, consulting, marketing and selling, the integrating, installing and administrating, the maintaining, supporting and service of ICT systems. ***e-Business skills***: the capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses [4].

To this has to be added the issues of various deficiencies raised by the European e-Skills Forum (2004): ***Shortage***: a quantitative lack of skilled people in the labour market; ***Gap***: a competence shortfall between current and needed competence levels of (employed) personnel; ***Mismatch:*** a difference between the competence of the trainee or graduate and Employers' expected competence needs [4].

In a more simplified view the terms e-Skills and ICT Skills are used interchangeably. There is currently no universally adopted definition of e-skills; however, the definition is characterized according to the various areas of ICT competencies. According to the report of the study on the ICT skills conducted by the Department of Communications, the ICT skills have been categorized into three areas as follows:

- ICT skills needed for modern life outside the workplace: digital literacy/e-literacy
- ICT skills in the work place to respond to changes in business processes and industry structures: e-skills
- Technical skills for the ICT specialists needed in ICT and related jobs user industries [5].

In summary any definition of e-skills needs to make provision for life in all sectors of a modern society while creating different levels for users to aspire to, based on the technological ladder approach while taking into consideration the needs of the employees as well.

3. Computer Literacy vs Digital Literacy

Prior to the 21st century, literate defined a person's ability to read and write, separating the educated from the uneducated. With the advent of a new millennium and the rapidity with which technology has changed society, the concept of literacy has assumed new meanings. Experts in the field suggest that the current generation of teenagers—sometimes referred to as the E-Generation—possess digital competencies to effectively navigate the multidimensional and fast-paced digital environment. For generations of adults who grew up in a world of books, travelling through cyberspace seems as treacherous and intimidating as speaking a new language [6].

In a developing country like South Africa there may well be digitally literate learners who are being led by a linear-thinking teacher who is confined to the two dimensional world of the text book. In the vast majority of schools in South Africa there is very little disposable income available for the luxury of computers, let alone technology plans to address the skills requirements of the learners. Where computer training takes place it is confined to the teaching of macros at a computer literacy level, with little or no relevance to the real world. In terms of the *technological ladder* [3], learners may be offered a position on the first rung which may be perceived as the end point of computer literacy rather than

the starting point to develop future opportunities. There are, however, many pockets of excellence in the education system in South Africa where technology is integrated into the curriculum addressing the ideals of the White Paper on e-Education [7] but these instances are few and far between. In many instances these pockets are also in the form of individual educators sufficiently motivated to create opportunities for their learners to operate at the level of ICT enabled innovators through the introduction of programmes like Formula One in Schools [8], Technology Olympiads [9], etc where technology is used merely as a tool.

It can be argued that computer literacy is largely confined to the development of psychomotor skills to operate macros of office packages and the transcription of information. An individual with these skills will not be equipped to take full advantage of a digital world which they are literally immersed in through the spaces they move through. Wireless communications may be transmitting mission critical information for a company through the classroom space and yet, individuals are still confined to learning the definitions of an input and out device to meet the minimum requirements of an examination that may move them closer to the front of the unemployment queue.

Being computer literate does not necessarily translate into being e-literate. Simply put, being able to type up a document does not necessarily mean that an individual can access information from the internet and other electronic sources, process it and generate new knowledge using a the appropriate technology available.

One has to bear in mind that education is dealing with the holistic child and not just the left side of the brain. In general, schools tend to favour left-brain modes of thinking, while downplaying the right-brain ones. Left-brain scholastic subjects focus on logical thinking, analysis, and accuracy [10]. There is a need to promote creativity and innovation at school level through the use of subjects like art developing the right-hand side of the brain. Academic subjects tend to cater for the more mentally adept left-brained individuals while the technical subjects catered for the development of pure psychomotor skills. The recent introduction of Technology Education into the South African National Curriculum up to Grade 9 can provide an opportunity for linking the capabilities of right-brained creative individuals and their hands if the subject is taught correctly. This is dependent on the background of the individual appointed to teach the subject [11].

4. Introduction to YESA

YESA was conceived to initiate and nurture a pipeline of human capital for the science, technology, engineering, mathematics and innovation (STEMI) sectors. The organization was incubated for three years within the African Advanced Institute for Information and Communication Technology commonly referred to as the Meraka Institute based at the Council for Scientific and Industrial Research (CSIR) in Pretoria.

YESA is suitably positioned to contribute to the following national initiatives : White Paper on Science and Technology ; Youth into Science Strategy ; White Paper on e-Education ; ICT R&D Strategy ; DST 10 Year Strategic Plan ; National System of Innovation ; Accelerated and Shared Growth Initiative for South Africa ; Millennium Development Goals ; Joint Initiative on Priority Skills Acquisition (Jipsa).

A number of school based interventions were researched and piloted during this period. It must be noted that the focus of the various interventions was on skills development while promoting creativity and innovation and not on the formal education process of information transfer. Each of the interventions were plotted on to a *skill grid* in order to identify their strategic importance as well as where gaps existed. This is represented in Figure 3.

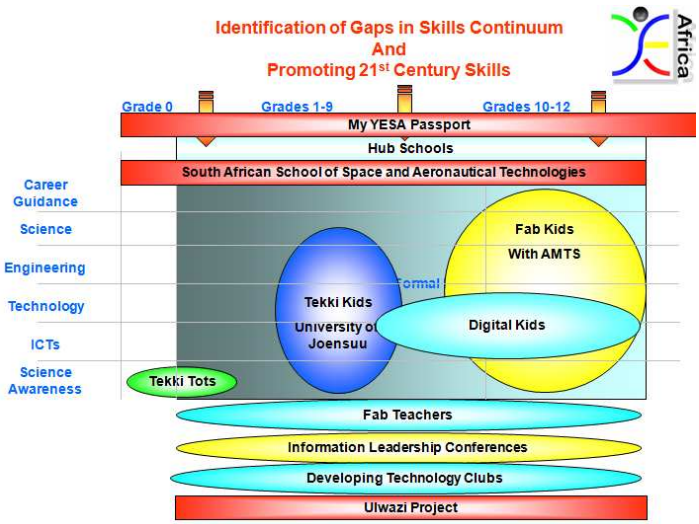

Figure 3. The YESA Skills Grid [11]

Due to the limitations of this paper a summary of some of the relevant projects will be highlighted to indicate their importance in developing the concepts of e-skills within South African schools:

- **TekkiTots** – promoting the love of science and technology by learning through playing with a variety of well defined activities
- **TekkiKids** – Introducing learners to Technology Clubs through the introduction of Lego to Grades four to seven learners. Advantaged learners were twinned with disadvantaged counterparts where the groups are introduced to the world of programming through the use of Lego
- **FabKids** – developing high productivity skills in a high-tech rapid-prototyping environment of a FabLab
- **Fab Teachers** – the principles of FabKids are applied to Fab Teachers with the only difference being that participants are exposed the pedagogy of the Design Process
- **Information Leadership Conferences** – encouraging teachers to become knowledge producers and to share best practices within such forums
- **Developing Technology Clubs** – Initiated through Digital Kids but expanded to include a host of additional relevant Science, Technology, Engineering, Mathematics and Innovation (STEMI) activities wherever possible
- **The Ulwazi Project** – creating virtual interactive classrooms using wireless broadband connections, interactive whiteboards, web cams and microphones and to digitally share teachers
- **My YESA Passport** – a system of tracking learner involvement in STEMI event, Olympiads and competitions while delivering additional service via the internet and mobile applications to include learners from deep rural communities
- **The South African School of Space and Aeronautical Technologies –** this is a concept to expose a significant number of learners to the wonders of space travel with the prospect of producing future Africanauts [11].

Three of these interventions need further elaboration within the context of the e-skills debate and the promotion of key 21st century skills. The **FabKids** involves learners being introduced into a high-tech environment of a Fabrication Laboratory or FabLab [12], an initiative supported by the Advanced Manufacturing Technology Strategy (AMTS) [13]. Learners are provided with a challenge and have to make use of computers, vinyl cutters, electronics, laser cutters and a variety of hand tools to conceptualize and produce a working

prototype within five to six hours. Given the rapid-prototyping capabilities of a FabLab it is conceivable that an environment of this nature can contribute significantly to learners participating in such events as the Technology Olympiad [9], Expo for Young Scientists[14] and other Federation of Engineering, Science, Technology, Olympiads and Competitions (FESTOC) related events. Is essence it is about creating opportunities for learners to make use of technology to solve human problem in a creative and innovative way while promoting STEMI careers. The research findings are published in Journal of Science and Technology [15].

The second project involves the establishment of **Digital Kids** through the adoption of a school as a YESA school with the formation of extramural technology club. *Computer literacy* is assumed in order to convey the principles of *Digital Literacy* through the use of open source software wherever possible. Participants are taught how to generate 2D and 3D graphics, animations, digital image and video editing, web page designs, an introduction to programming, etc. The focus of all training is on the development of materials for the classrooms so that the learners are able to take on the role of generating resources for teachers and integrating the multimedia into their own school work as well. The research findings have been submitted to Journal of Science and Technology for publication.

The third project involves the development of a national portal to track learner involvement in STEMI events, Olympiads and competitions from Grade one to PhD level. There is a perceived need to generate a system to track and identify learners with talent and to create the opportunity to lure more individuals into pursuing careers in STEMI to increase the feeder stock for the National System of Innovation (NSI). This project is termed **MY YESA Passport** which has the capabilities of providing learners in urban as well as deep rural communities with access to the portal as well as a content rich environment via mobile technologies using a MXit platform. A Journey Planner will encourage them to seek essential career information while creating opportunities to contribute to their STEMI curriculum vitae by participating in both formal FESTOC related events as well as informal *Lab Work* and *Field Work*. The portal will generate the necessary *virtual passports* and accompanying *stamps* as a permanent verifiable record of their STEMI journey from Grade 1. The research findings are published in International Network of Research Management Societies (INORMS) conference [11].

It must be noted that the outcomes of three years of research at the Meraka Institute including the authors previous decade of experience in the classroom has been captured in a PhD thesis entitled, *Promoting Human Capital Development through ICT Creativity and Innovation* which was submitted for evaluation in May 2010 through the North West University.

Conclusions

InfoDev noted that the use of ICTs for Education in the South Asian countries can be viewed from two perspectives. Firstly, an *ICT for Development* approach where the use of technology is advocated to reach the unreached, provide support to those who do not have access to quality hard infrastructure, quality teachers and quality educational resources. This includes use of ICTs for various non formal education programs, adult literacy, informational and educational services for farmers, fisherman etc and creating telecentres where citizens can have access to services and information.

Secondly an *ICT for e-learning* paradigm as a response to the needs of the emerging ‘knowledge society’, where ways of learning and applying that knowledge are changing at a fast pace. It reflects the requirements of 21st Century teaching learning skills [16].

Given the less than optimal performance of the educational system in South Africa as measured in terms of the number of learners passing Grade 12 exit examinations especially in Mathematics and Science, coupled to the global shortage of scarce skills, especially in the ICT sector, there is an urgent need to address this problem. If the system does not change, the country will continue to produce certificated learners whose qualifications are of little or no use to society, who will have to be retrained before they can be of any economic benefit to any future employer. This also includes certification of computer literate individuals who are destined to uses these qualification as glorified tellers scanning items for customers at checkout counters. These qualifications do not ensure that individuals are moved out of the unemployment sector.

The outcomes of the various YESA interventions indicate that learners, no matter what their background, are able to draw benefit from and operate in high-tech environments. The emphasis is no longer on information transfer but rather on the use of technology as a tool to solve a given challenge. In simple terms, they are provided with opportunities to operate at different levels up the technological ladder all the way up to ICT innovators. As in the real world they are encouraged to find their niche and to do so as a team player with specific roles and responsibilities. Key 21st century skills such as collaboration, effective communication, high productivity and digital literacy form the foundation stones on all YESA initiatives. YESA Kids are also exposed to a range of additional soft and higher order thinking skills as they are provided with opportunities to unleash their creative and innovative talents.

Currently there is very little emphasis on e-learning in the South African education system as there is very little, if any, use of state of the art technology for advanced e-learning practices largely due to a lack of resources and a lack of qualified educators. YESA through the various interventions can play a significant role in the South African landscape based on the following key insights raised by the InfoDev survey:

- Creating an ICT for Education Ecosystem
- ICT Initiatives as a Platform for Innovation in Education
- Creating an aspiration for Information and Communication Technologies
- Mobile Technology for Education
- ICTs in Non formal Education
- Systemic Capacity Building

In order to enhance the good work being done by various players in the e-skills sector, there is a need to conduct an audit of such institutions, both quantifying and qualifying their impacts as part of a national database. At the same time it is suggested that this information is married with the skills sets needed from the different sectors in order to quantify the shortages. Based on this information, an educational cluster approach can be used to coordinate the training of sufficient individuals in association with the appropriate SETAS and other relevant authorities. Educational clusters may be seen as the amalgamation of a number of organizations in a regional sector who can draw benefit from mutual association and combining efforts to deliver more holistic solutions.

To achieve this, the country can ill afford the lowering of standards. On the contrary, there is a need to raise the standards if South African companies hope to compete in a global economy. The strategic importance of promoting the ICT skills needed for modern life outside the workplace should be inculcated through the education system at the curriculum interface. This will increase the chances of individuals developing ICT skills in the work place to respond to changes in business processes and industry structures while providing others with the technical skills for the ICT specialists needed in ICT and related

jobs user industries. In essence the call is to adopt a Technological Ladder as a framework to define the policies needed to bring about sustainable reform.

Can a country like South Africa afford to have yet another generation lost through an education system that does not cater for their basic social and academic needs. Every child has the right to become a productive citizen of the rainbow nation equipped with the right knowledge, skills, attitudes and values to cope with life in a technological world.

As the old saying goes, *"You think education is expensive, try ignorance"*. This applies to all forms of basic education starting with the 3Rs of Reading wRriting and aRithmetic. To this must be added e-literacy and a host of other e-skills for the individual to take full advantage of what technology has to offer in the modern world and to enable participation as fully fledged Net Generation [17] members. Failure to do so will merely widen the digital divide leaving those stranded on the wrong side or in the middle, with little prospect of benefiting from and participating in a global knowledge society.

'The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn'(Alvin Toffler).Thus the e learning paradigm sees technology as a platform for fundamental innovation in the way teaching-learning any where in the world is being undertaken. It focuses on creating more learner centric environments, replacing one way instructional model with collaborative learning models and knowledge creation and knowledge sharing [16].

YESA has been mandated by the Meraka Institute to initiate and nurture a pipeline for STEMI. In order to exercise this mandate, YESA is in the process of formalizing the national delivery vehicle as a not-for-profit company and seeks partners to massify the projects which will promote creativity and innovation, encourage the development of e-skills at a school level and track learners as part of a longitudinal study with the view to identifying individuals with talent on a national scale. These learning experiences are made available to influence the formulation of e-skills policies in order to have an impact on future e-skills strategies as they are based on real-world experience.

BLIOGRAPHY

[1] Grulke, W., *Lessons in Radical Innovation*. 2001, Benmore: @One Communications.

[2] Beyers, R.N., *A Five Dimensional Model for Educating the Net Generation.* Educational Technology & Society, 2009. **12**(4): p. 218-227.

[3] Beyers, R.N., *Creating a Sputnik Moment for Learners in Africa*, in *2nd South African International Aerospace Symposium*. 2008: Cape Town.

[4] Frinking, E., Ligtvoet, A., Lundin, P., Oortwijn, W. (2005) *The Supply and Demand of e-SKills in Europe*. 1-143.

[5] Presidential National Commission on Information Society & Development, *South Africa's efforts to address the e-Skills Challenge*. 2007

[6] Jones-Kavalier, B.R., Flannigan, S.L., *Connecting the Digital Dots: Literacy of the 21st Century*. Educause Quartely 2006. **29**(2).

[7] Department of Arts Culture Science And Technology, *White Paper on Science and Technology : Preparing for the 21st Century*, C. Department of Arts, Science And Technology, Editor. 1996, Government Press: Cape Town.

[8] Formula One in Schools. *Formula One Technology Challenge*. 2009 [cited 2010 17 February]; Available from: http://www.f1inschools.co.za/.

[9] SAIMechE Technology Olympiad. *Creating Tomorrows Engineers Today*. 2010 [cited 2010 17 February]; Available from: http://www.technologyolympiad.org.za/.

[10] Riedl, A. *The Psychology of Learning; an Overview*. 2002 [cited 2010 17 February]; Available from: http://www.lrz-muenchen.de/~riedlpublikationen/pdf/kuw3psychologylearning.pdf.

[11] Beyers, R.N., Blignaut, A.S., Hersleman, M., *The Young Engineers and Scientists of Africa - Initiating the SET Pipeline from Grade 1*. 2010, International Network of Research Management Societies (INORMS).

[12] FabLab. *Fabrication Laboratory*. 2010 [cited 2010 17 February]; Available from: http://fab.cba.mit.edu/.

[13] AMTS. *Advanced Manufacturing Technology Strategy* 2010 [cited 2010 17 February]; Available from: http://www.amts.co.za/main.htm.

[14] Eskom Expo for Young Scientists. *Eskom Expo for Young Scientists* 2010 [cited 2010 17 February]; Available from: http://www.exposcience.co.za/

[15] Beyers, R.N., *Nurturing Creativity and Innovation through FabKids — A Case Study* in *Journal of Science and Technology*. Accepted on 12 February 2010.

[16] InfoDev (2010) *Survey of Information and Communication Technologies for Education in India & South Asia : Draft Survey Insights*.

[17] Oblinger, D.G. and J.L. Oblinger, *Educating the net generation*, in *Chapter 2: Is it age or IT: First steps toward understanding the net generation*, D.G. Oblinger and J.L. Oblinger, Editors. 2005, Educause: Washington, D.C. p. 8.