# Investigating Perception Changes in Teachers Attending ICT Curricula through Self-Efficacy

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***Abstract*—This paper introduces the construct of Self-Efficacy as a method to measure the impact that ICT-enhanced teacher training has on teachers. Firstly, Self-Efficacy and its related sub-constructs, Computer Self-Efficacy and Teacher Self-Efficacy, are presented. Secondly, three research settings where the construct have been tested are introduced: two related to BET K-12 (Brazilian Elearning Teacher training in K-12) project and one related to MELISSA (Measuring ELearning Impact in primary Schools in South African disadvantaged areas). Finally, results of the three experiments are presented and discussed.**

***Index Terms*— Self-Efficacy, eLearning, ICT4D, teacher training**

## I. Introduction

This paper addresses the issue of measuring the impact that ICT-enhanced teacher training curricula have on teachers. In particular, the paper addresses curricula introducing ICT into teaching practices as:

- a subject of study, to improve the digital literacy of primary school teachers;
- an educational strategy to deliver various teacher training modules, thus providing teachers with a direct experience of eLearning;
- an educational tool to be integrated – in a sustainable way – into the classroom, to bridge the digital divide, and to equip learners to become active players in the knowledge society, hence improving their future employability level.

And furthermore, it focuses on a particular context: teachers working in disadvantaged and underprivileged schools.

The paper first focuses on the approach chosen by the authors, Self-Efficacy, to investigate the impact that ICT-enhanced teacher training curricula have on teachers and set the main hypotheses (par. II). The paper continues presenting the two cases in which the self-efficacy construct has been tested: the BET K-12 Project – Brazilian Elearning Teacher training in K-12 carried on in Salvador de Bahia, Brazil (par. IV); and the MELISSA Project – Measuring ELearning Impact in primary Schools in South African disadvantaged areas, carried out in Cape Town, South Africa (par. VI).

Both projects are presented following this structure: an overview of the educational system (par. III and V), an overview of the delivered curriculum (par. IV and VI), a description of the sample and of the taken measurement actions (par. IV.C and VI.C), and a presentation of the results (par. IV.D and VI.D). Finally, the paper draws conclusions around the results obtained until March 2010.

## II. Self-Efficacy

### A. Theoretical Framework

Bandura defines Self-Efficacy as "people's judgment of their capabilities to organize and execute courses of action required to attain designated types of performances" [1]. The author goes on to identify four sources of influence of Self-Efficacy: mastery experiences, vicarious experiences, social persuasion and emotional states. Mastery experiences are effective ways in creating a greater sense of Self-Efficacy. They represent, in fact, the memories of past successful situations which people can reflect on in facing (similar) situations in future. Positive mastery experiences enforce Self-Efficacy, while negative mastery experiences weaken it. Vicarious experiences instead come from the observation of models: seeing people similar to oneself who earnest overcome difficult situations persuades the watcher to have the same skills too, whereas seeing someone who fails despite any efforts weakens one's sense of Self-Efficacy. Besides, it is possible to improve Self-Efficacy every time people are verbally persuaded to have good skills to achieve; this is the case of social persuasion. Though, with less intensity than with the mastery experiences, the way we are judged can exert a strong influence on our self-belief. The fourth source of Self-Efficacy is represented by the emotional state(s). People consider very often that one's skills are strictly related to the way they feel in a particular moment, so that a state of stress or tension is considered as an indication of failure. People with a high sense of Self-Efficacy use these kinds of emotional states to improve their performance, whereas people with a low sense of Self-Efficacy consider them restrictive and debilitating for the activities they are engaged in [2].

This concept has been applied to two specific contexts: the use of ICT (Computer Self-Efficacy – CSE) and teaching activity (Teacher Self-Efficacy – TSE). CSE represents "an individual perception of his or her ability to use computers in the accomplishment of a task" [3], while TSE can be defined as "a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" [4].

### B. Methodology

In order to measure quantitatively ICT impact on personal and professional efficacy, a questionnaire was designed that covered, thematically, Computer Self-Efficacy and Teacher Self-Efficacy. The Computer Self-Efficacy questionnaire was based on a tool proposed by Compeau and Higgins [5]. This questionnaire contains 10 items that refer to the use of a piece of software in a given educational context; for each item a Likert scale (1 to 10 points) is provided, where 1 is "not at all confident" and 10 is "totally confident". The 10 items will be repeated for all the technologies presented in the curriculum.

For Teacher Self-Efficacy, the educator's Sense of Efficacy Scale proposed by Tschannen-Moran and Wolfolk Hoy [6] has been adopted. In this scale, 12 items (divided into 3 categories with 4 items each: "student engagement", "instructional strategies" and "classroom management") refer to different aspects of the teaching activity; for each question a Likert scale (1 to 9 points) is provided, where 1 is "nothing" and 9 is "a great deal". Research participants (teachers) were required to answer these questions by indicating how much they felt able to accomplish given teaching activities.

### C. Hypotheses of research

The hypotheses tested in the two projects are:

H1: the increase of technological skills promoted by the attendance of the proposed curriculum causes an increase in CSE;

H2: the increase of CSE influences an increase in TSE.

## III. The Brazilian Educational Context

In Brazil, Federal Government Law 4019/2004 mandates teachers to obtain a university degree in order to keep on teaching. Even if the first foreseen deadline – year 2012 – has been postponed, this law has promoted an important and positive mobilization among teachers, which resulted in a significant growth in the demand of updating-courses, especially for in-service teachers who do not own the required university degree and need preparatory courses for the Vestibular (Pre-Vestibular courses), i.e. the exam for accessing university. These courses usually last no longer than 12 months and are promoted either by public and private universities or private institutions. The latter are starting to test the use of ICTs in delivering teacher training curricula [7], [8], [9], [10], [11]. However, attending these courses and passing the Vestibular is still a big problem for teachers of disadvantaged schools, mostly ascribed to their poor (and unequal) backgrounds. In addition, these teachers are excluded from the teacher training programs sponsored by the Federal Government, as these are only for public school teachers.

Even if the goal of Brazilian government is the improvement of teachers' preparation and, as a consequence, an enhanced quality of the national schooling system, other problems may arise, such as the closure of disadvantaged schools for the lack of graduate teachers. For this reason, the training of teachers, particularly of those who live in disadvantaged areas, is still a crucial issue for the Brazilian education authorities. Hence the government decision to embark on online training programs.

The BET K-12 – Brazilian eLearning Teacher Training in K-12 – project aimed to help primary teachers in community schools in a disadvantaged region of Salvador (State of Bahia, Brazil) to obtain university degrees by training them in the use of ICTs. The goal here was for teachers to become more equipped in living and working in the knowledge society.

As a matter of fact, being able to access information, and hence knowledge, is one of the most important issues and challenges of development, both at the personal level – where it means education and employability – and at the social one – where it could mean growth and welfare. To access, produce, and share information (and knowledge) one has to master the technologies through which information and knowledge are "exchanged" – the so-called "technologies of the word" [12]. Nowadays, who cannot master ICTs – the most recent technologies of the word – risks to be excluded from the social life of his/her community or society by the so-called digital divide; this term is used to refer to "the inequalities that exist in Internet access based on income, age, education, race/ethnicity, and [...] between rural and metropolitan areas, through such factors as pricing and infrastructure" [13].

Before describing the details of the project, a brief presentation of the Brazilian School System is needed. The Brazilian School system is divided into two main branches: Educação Bàsica (Basic Education), which encompasses Educação Infantil (Pre-school), Ensino Fundamental (Primary Education) and Ensino Médio / Profissionalizante (High / Technical School); and Educaçao Superior (Higher Education). Higher Education extends from 4 to a maximum of 6 years of studies at university level and can be followed by 18 months of postgraduate course or by a Mestrado of a minimum of 2 years. The highest superior education degree is the doctorate, which lasts at least 4 years. The Brazilian School System is summarized in the figure below:

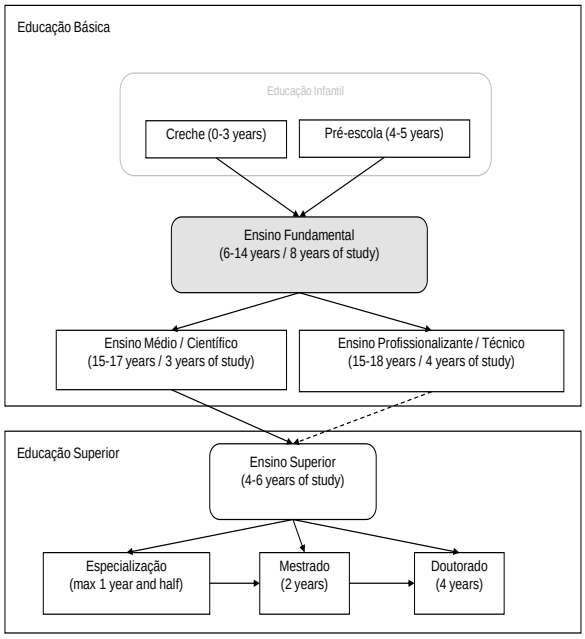


Fig. 1. The Brazilian school system [14]

In this system, an important distinction has to be made between public and private institutions. Public institutions can be managed at a federal, state or municipal level, and are free of charge. Private schools are mostly linked to religious institutions, notably to Catholic ones, and are not free of charge, but offer quite often scholarships for disadvantaged students.

In general, at the level of Educação Basica the preparation offered by public schools is lower than the one offered by private schools. At the level of higher education, on the contrary, public universities are free of charge and usually better than private ones. This means that students aim to attend public universities, but the number of available places is not enough. Therefore, passing the entrance exam (Vestibular) is a goal that only few people can achieve; usually those who have attended a quality basic school, which very often means a private school, have more chances. On the contrary, those who have attended public basic schools may end up having an inadequate preparation to pass the Vestibular. So, underprivileged people may not be able to attend public universities because they have not the knowledge and the competencies to pass the Vestibular, and do not have enough money to afford private universities fees.

In some regions, particularly suburbs or rural areas, there are other kinds of educational institutions: so-called community schools. These were created to compensate for the general lack of public schools and are managed (and funded) by associations of citizens. Often located in tiny and uncomfortable buildings, these schools allow underprivileged children a chance at basic education. This despite the oft low quality of teaching, due to inadequate or ineffectual educator training.

## IV. BET K-12 Project

BET K-12 was active between 2005 and 2008, and aimed at introducing and assessing the use of ICT in the training of in-service primary school teachers working in community schools in the area of Salvador. The project was grounded on a previous collaboration between the NewMinE Lab (Università della Svizzera italiana, Lugano, Switzerland) and a Brazilian NGO (CEAP – Centro de Estudo e Assesoria Pedagogica), which brought to the development of some eLearning courses for community school teachers. The collaboration started in 2004 and was funded by a private foundation.

CEAP offers in-service training for primary school teachers and supports them in the challenging goal of passing the *Vestibular* exam, i.e. the exam to access the university.

### A. BET K-12 Curriculum

The curriculum is composed of three modules: Computer Literacy, ICTs in Educational Context, Communication Theories. The curriculum has been developed in Moodle with a series of multimedia materials and activities to engage the trainees and introduce them in an unknown environment.

*Digital Literacy (July 2005 to October 2006 - March 2008 to May 2008)*

The first module was delivered completely in person and lasted 20 hours. The contents of the course have been designed adapting the ECDL (European Computer Driving License) program to the context. The main themes were: basic concepts of information technologies, MS Office, the World Wide Web, and Moodle as a Learning Management System.

*ICTs in Educational Context (November 2006 to July 2007 - June 2008 to October 2008)*

The course lasted 20 hours and was organized in three main sections: (1) Qualitative Analysis of Websites; (2) How to Learn Online; and (3) How to Teach Online.

This course was offered on Moodle in a blended modality and it was designed through multimedia stories which gave a file rouge to the module. Participants worked in groups during the first 2 sections of the course; afterwards they developed an individual project consisting in a lesson using technologies in their school. Every week each participant had to do a short activity, such as writing comments in the course journal, or participating in a forum or answering a test. These activities were developed to help participants to keep the pace with the course. Furthermore, at the end of each section a self-assessment quiz was provided. Four lessons were planned face to face; however, since this was their first eLearning experience, teachers could use the CEAP informatics lab, in case they did not have any other place to access the internet (online activities were, however, very limited, due to well known access problems), and/or they wanted to be tutored by CEAP staff. [15]

*Communication Theory (August to December 2008)*

The course – also delivered through Moodle in a blended modality – lasted 60 hours, and was divided into three sections of 20 hours each: (1) Logic and Argumentation; (2) Language; and (3) Text Production.

This course was provided in order to offer a wider and better interpretation of the role ICTs play in the knowledge society, moving from knowing-how to knowing-why, hence offering a more scientific understanding of the nature and role of the technologies of the word.

The structure of this course parallels the medieval Trivium, i.e. the three “roads” forming the foundation of ancient liberal arts (grammar, logic, rhetoric). Each section of the course presented its topics in a rich multimedia way: for instance, in the first section the main topics (Knowledge and Truth; The Elements of Thought: Concepts and Propositions; Reasoning; Argumentation) were presented by means of audio files containing simple fairy tales; teachers were required first to listen to the whole fairy tale, then to a commented version of it, where the main theoretical concepts were presented and explained. In the second section, the framework of a story contained different animations and interactive presentations where the main topics (Speech; Sign; Language; Text) were presented. In addition to these multimedia contents, each section provided online activities to be accomplished either in group or individually, self-evaluation tests and text files where all the contents of the section were presented in a more detailed and structured way.

The choice of presenting rich multimedia contents was made in order to satisfy the demands of teachers, who, in spite of possible technical difficulties due to low bandwidth, requested to have as less written/printable materials as possible in order to be allowed to know and exploit the multimedia features of ICTs. [16]

### B. BET K-12 Measurement Actions

In order to test the abovementioned hypotheses (par. II.C), four data collections have been made with the first round of teachers and three with the second round.

In the first round, 44 primary school teachers attended the BET K-12 curriculum, 43 of which were women. In the group there were teachers who did not pass the Vestibular exam yet, teachers who were enrolled in a university and teachers who had already completed their university curriculum. During the second round, 35 teachers attended a 9-month curriculum focused on ICTs in educational contexts. In this round, an experimental research setting was applied: 30 teachers with the same characteristics as the experimental sample have been involved in the project to be the control group.

### C. Characteristics of the sample

*First Round*

The average age of the group was about 37 years, 12 teachers were over 45; the large majority of the group started teaching before 30, only 8 of them after 35 years. As concerns the teachers' possibilities of accessing ICTs, the percentage of teachers using computers at the university was 32%. Moreover, 55% owned a computer and 45% of the sample could connect to the internet at home. 100% used the computer more than once a week. Another relevant datum is that 39% of teachers frequented LAN Houses (Brazilian internet cafes). Finally, the percentage of teachers surfing the internet more than once a week was 91%.

*Second round*

The sample consisted of 34 women and one man, with an average age of 35 years. 51% had already used a computer before the beginning of the course – 17% of these in an internet café, and the rest owned computers at their home. Only 15% of the sample had already accessed the internet before; the majority of them (57%) at friends' homes. Main computer activities included writing/word processing (29%) and searching for information (29%). On average, they accessed a computer two to three times a week. The majority of the sample possesses a television (94%), a DVD player (86%), a radio (80%), and a CD player (66%).

### D. BET K-12 Results

*First round*

The first round of BET K-12 confirmed both hypotheses H1 and H2, as indicated by the graph and table below. They represent the means of CSE and TSE during the four measurements, and the increase of the statistical regression, respectively.

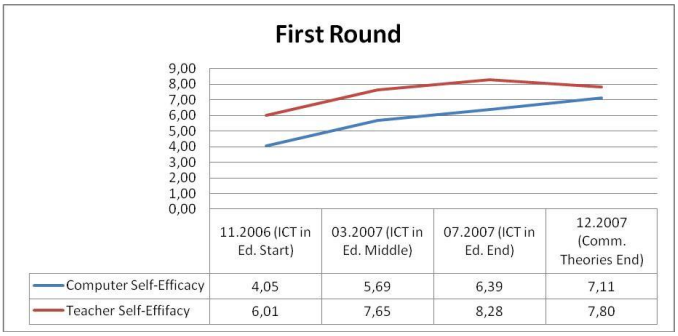


Fig. 2. Computer and Teacher Self-Efficacy change over time (data are normalized to a 10 grade scale)

| TSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 11.2006 | | 03.2007 | | 07.2007 | | 12.2007 | |
| | β | $R^2$ | β | $R^2$ | β | $R^2$ | β | $R^2$ |
| CSE | 0.19** | 0.16 | 0.23* | 0.11 | 0.28** | 0.26 | 0.31** | 0.31 |
| * $\alpha < 0.10$; ** $\alpha < 0.05$; *** $\alpha < 0.001$ | | | | | | | | |

Fig. 3. Teacher and Computer Self-Efficacy regression's coefficients during the course – First Round – EG

*Second Round*

Concerning the experimental group:

- H1 was confirmed, even though Computer Self-Efficacy decreases in the last measurement this tendency can be due to the fact that once a teacher learns to use a new tool, after nine months the novelty is no longer perceived. It is also important to consider the size of the sample (9 out of 35) in the last data collection, which can be a bias in the comparison of the results and reduce the significance.
- H2 was not confirmed, as indicated by the graph, showing the means of the two variables, and by the statistical regressions (Fig. 3) which do not represent a consistent correlation between the two variables in the four measurements.

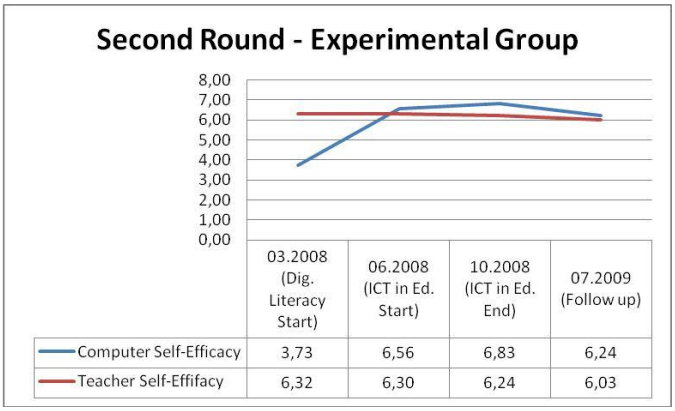


Fig. 4. Teacher and Computer Self-Efficacy during the course – EG (data are normalized to a 10 grade scale)

| TSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 03.2008 | | 06.2008 | | 10.2008 | | 07.2009 | |
| | β | $R^2$ | β | $R^2$ | β | $R^2$ | β | $R^2$ |
| CSE | -0.04* | 0.00 | 0.49*** | 0.11 | 0.25* | 0.12 | 0.66** | 0.94 |
| * $\alpha < 0.10$; ** $\alpha < 0.05$; *** $\alpha < 0.001$ | | | | | | | | |

Fig. 5. Teacher and Computer Self-Efficacy regression's coefficients during the course – Second Round - EG

Furthermore, the control group results, as shown in the following figure, highlight that:

- H1 was confirmed: the attendance of an ICT course is a factor that can increase CSE.
- H2 was not confirmed. The growth of TSE values is not *only* caused by the single increase of CSE, but also by other external factors, since it increased during the course, even if these teachers did not attend the course.

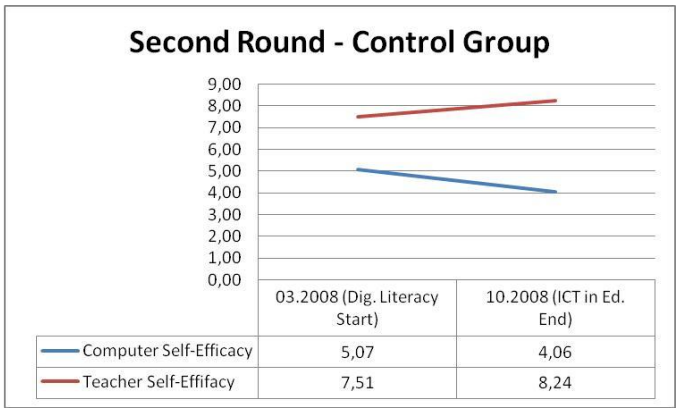


Fig. 6. Teacher and Computer Self-Efficacy during the course – CG (data are normalized to a 10 grade scale)

To summarize: during BET K-12 self-efficacy was first measured in a semi-experimental context, and the hypotheses were verified. Therefore, the researchers decided to apply an experimental setting, but in this case the hypotheses were not verified. Two reasons for this can be suggested:

- During the second round, a different curriculum was delivered: both the Communication Theories module and the two initial modules were cut. During the first round, the delivery of the first two modules lasted 24 months, whilst in the second only 7 months.
- The fourth measurement (i.e. the follow up) counted only 9 answers, too few to produce a consistent result.

For all the above mentioned reasons, the researchers decided to further investigate the matter, to properly understand if:

- Self-efficacy is a construct which can be adopted to explain changes in teachers' attitudes toward technologies;
- If ICT-based courses can really affect teachers' perceptions of being good or better educators.

The further investigation is taking place in South Africa, within the framework of the MELISSA Project.

## V. South African Educational Context

*"Everyone has the right to a basic education, including adult basic education; and to further education, which the state, through reasonable measures, must make progressively available and accessible."* [17]

As an emerging nation, it has become pertinent for the South African government to invest heavily into its formal schooling system. As stipulated by the Bill of Rights above, education is a fundamental right, and should be accessible to all. This is not the case across the board, however. Many educational facilities lack appropriate resources, especially within rural, poor regions (notably in the Eastern Cape and KwaZulu-Natal). In fact, the Human Sciences Research Council has found the standard of education in South Africa to be "dismal", especially in comparison to poorer countries [18]. Although the state has vowed to eradicate the vestiges of apartheid, new challenges have arisen since the advent of democratic leadership in 1994.

That said, the national Department of Education (DOE) has explored innovative means of attracting (and retaining) learners and educators alike. This includes, for the most part, the introduction of modern curricula, coupled with the adoption of information and communication technologies (ICTs). In light of this, educational development in South Africa has had much impetus in the last decade. Hence the Department's continual emphasis on the importance of school safety, infrastructure, health promotion, gender equity, and sustainable partnerships [19].

Formal education in the country is structured around three primary levels (or "bands"): General Education and Training (GET), Further Education and Training (FET), and Higher Education (HE). GET encompasses the first year of primary school (Grade R, or the "reception year") up to Grade 9. This framework also hosts an Adult Basic Education and Training (ABET) qualification. The FET band comprises of learners in grades 10 to 12 (or Matric), and also includes career-oriented education and training offered in other FET institutions (technical, community, and private colleges) [20]. The band of Higher – or tertiary – education comprises of under- and postgraduate degrees, certificates, and diplomas, up to the level of the doctoral degree. Most HE institutions set individual requirements for academic qualification.

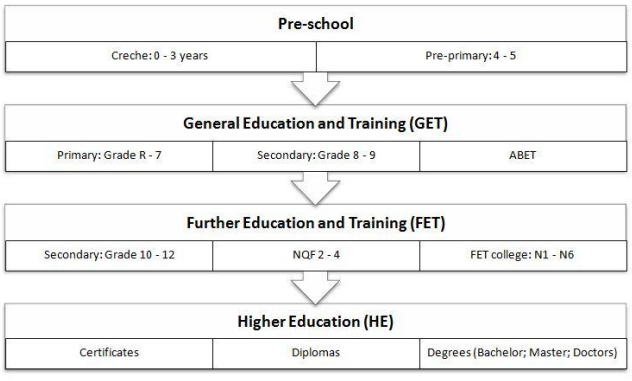


Fig. 7. South African Formal Education Framework (adapted from [20])

The three aforementioned bands are recognized by the National Qualifications Framework (NQF): a set of principles and guidelines by which records of learner achievement are registered to enable national recognition of acquired skills and knowledge [21]. The NQF forms the guiding body of South African qualifications, and facilitates a universal platform (or standard) of educational development. This framework is officially mandated by the South African Qualifications Authority (Saqa) Act 58 of 1995 [22].

In recent years, the DOE has outlined information and communication technologies (ICTs) as a key ingredient to modern education, especially with regards to computer-assisted teaching (see [23]). Hence a renewed interest in distance education and technological learning in the national B.Ed degree programme, stipulated as part of the NPFTED [24]. In fact, it has become useful to introduce sound (socio)technological structures within previously starved pedagogical setups. This may reduce teacher-student dependency, increase learning effectiveness, and improve overall education(al) provision [25]. Yet, a multitude of the country's educational environments function in unstable environments where elements of social disempowerment are rife. This affects the introduction, integration, and ultimate recognition of any technological endeavor.

Lacking or fractured technological undertakings may further the polarity between classes of rich and poor, teacher and student, and sustain the broader socio-political ills of "e-isolation" and "e-exclusion". These ills describe the general (or universal) inaccessibility of technology for the majority of South African communities. Moreover, while it is the belief that ICTs have the potential to enhance teaching (and learning) practices, there has been a shortage of research on educators' perceptions and use of the technology in disadvantaged schools in South Africa [26].

Participative technological endeavors have, in light of the above, become imperative within local educational contexts. Such approaches incorporate the perspective of the end-user (students and teachers); co-creating and co-managing a technological intervention to a specified context [see 31]. The user is then a central participant and stakeholder in crafting technological involvement(s) in his or her community. With this context in mind, various (research) projects have been architected so as to compensate for the rise in technological exclusion in education, both globally and locally. One of these projects, MELISSA – or, Measuring eLearning Impact in Primary Schools in South African Disadvantaged Areas – will be introduced accordingly.

## VI. The MELISSA Project

### A. MELISSA Curriculum

Under the MELISSA project, more than 100 primary school teachers working in disadvantaged schools in the Western Cape Province are being trained on the effective and sustainable use of ICTs within teaching practices.

All the schools participating in the project are part of a governmental initiative, Khanya (www.khanya.co.za), which aims at setting up informatics labs in selected schools in the Western Cape Province.

The curriculum is composed of three modules: Digital Literacy, ICT in Educational Context, and Teaching and Learning in the Knowledge Society. In this curriculum, ICTs are introduced into teaching practices as:

- a subject of study, to improve the digital literacy of primary school teachers;
- an educational strategy, to deliver various teacher training modules, thus providing teachers with a direct experience of eLearning;
- an educational tool to be integrated – in a sustainable way – into classrooms, equipping learners to become active players in the knowledge society, hence improving their future employability level.

*Digital literacy*

The first module totals 20 hours and comprises MS Word, MS Power Point, MS Excel, Internet (browsing), and Moodle as an example of a Learning Management System (LMS). The main objectives of the module are: knowledge of various functions of the different programs, practical application through performing various tasks in the form of exercises.

*ICT in educational context*

The second module, ICT in Educational Context, aims at showing the uses of ICTs for teaching and learning, including the associated difficulties, such as educational resources on the Internet and Web 2.0 technologies. Another objective of the second module is to understand intellectual property, copyright, and fair use of internet resources.

*Teaching and learning in the Knowledge Society*

The third module lasts 10 hours and aims at having a general understanding of education's role in the Knowledge Society, and its relation to communication; in particular, through this module, teachers have the possibility to experience an online course from a student perspective in order to better understand how to use the ICT supports in teaching activities.

### B. MELISSA Measurement Actions

In the first round of the curriculum delivery (July 2009 – May 2010), 42 teachers working in a Cape Town township have been trained. The same curriculum, refined according to the feedback gained during the first round, will be delivered in a second round to other 68 teachers from July 2010 to June 2011.

MELISSA research is developed with an experimental setting, which has foreseen an experimental group composed by teachers who attend the curriculum and a second group of teachers with the same characteristics who do not attend it.

Four measurements are foreseen in order to investigate the project hypotheses; in particular both teachers of the experimental and belonging to the control group are requested to fill in a questionnaire at the beginning of each module and six months after the end of the (entire) course.

### C. Characteristics of the sample

The experimental group is composed of 42 teachers working in two disadvantaged primary schools in Cape Town (Rosemead and Zimasa), 85% of them are women. The majority of them are 31-40 years old with a college certificate as highest educational level. In average they have been teaching for 18 years. They use personal computers daily (46%), from schools (98%), in particular for writing texts. 56% possesses a PC at home, but the majority of this group (76%) does not have any internet connection. They access the internet two or three times per week from schools for searching information (72%) and for writing emails (52%).

68 teachers from four schools in disadvantaged areas in Cape Town (Vukukhanye, Blossom, Thembani and Moshesh) constitute the control group. 72% of them are women between 41 and 50 years. As teachers belonging to the experimental group, the majority of them have a college certificate as the highest educational level, and they have been teaching for an average of 16 years. They use PCs daily, from schools, in particular for writing (and preparing assignments). The majority of them do not possess a computer at home. This datum differs from teachers in the experimental group, as well as the datum regarding internet access: 21% of the control group teachers access the internet less than once a month. They mostly access it from their schools (87%) to search for information (89%).

### D. MELISSA First Results

The first survey was done in July 2009 (at the beginning of the first module), while the second one in January 2010 was conducted at the beginning of the second module. Performing a statistical t-Test of the means, a slight increase of CSE and a slight decrease of TSE values in the experimental group are not statistically significant at .05 level.

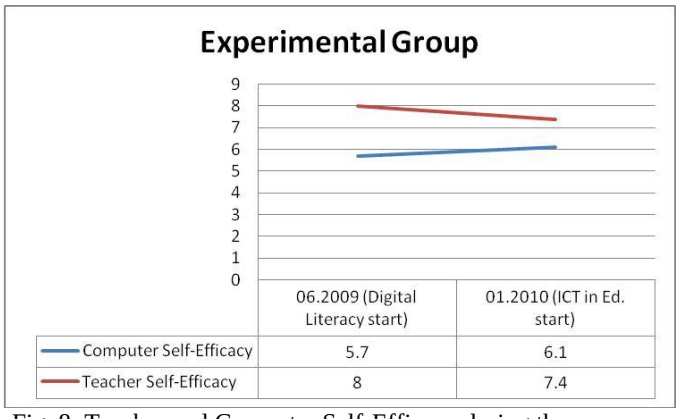


Fig. 8. Teacher and Computer Self-Efficacy during the course – EG (data are normalized to a 10 grade scale)

In the control group, teachers maintained the same level of CSE and of TSE, since performing a statistical t-Test of the means reveals that changes are not statistically significant the .05 level.

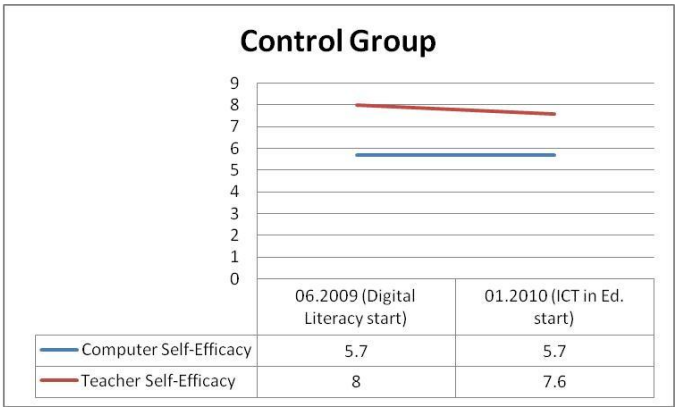


Fig. 9. Teacher and Computer Self-Efficacy during the course – CG (data are normalized to a 10 grade scale)

Results available through the first two surveys are not sufficient to validate the hypotheses. However, considering previous experience (par. IV), teachers may need more time to internalize what they have learned before significantly changing their CSE perception(s). In terms of both CSE and TSE, time is needed in order to identify some significant changes in teachers' perceptions. According to these observations, TSE may be significantly affected by CSE by the end of the entire curriculum.

## VII. Conclusion

This paper presented three research settings in which Self-Efficacy was/is being used to measure teachers' perceptions of using ICT in teaching practice(s), and studied the correlation between these two variables.

In the first setting (BET K-12 first round), both hypotheses were confirmed, while in the second (BET K-12 second round) only the first hypothesis was confirmed. This led the researchers to test the construct in another setting, the MELISSA project, which is currently active. So far, Computer and Teacher Self-Efficacy remained statistically unchanged both in the experimental and the control group; however, the research protocol foresees a longer span of time, in order to appreciate statistical changes in the two variables.

At this stage, it is important to note that, whilst a final conclusion on this research endeavor is premature, certain insights may be inferred. It is apparent that results across each setting have differed, somewhat significantly. This may be ascribed to differences in curriculum delivery, where modules have, to a major degree, alternated in content. Time and quantity are factors too, since one could dispute not enough (valuable) data has been gathered for a longitudinal scenario.

However, this observation does little to alleviate the challenge. It has to be assumed, in this regard, that the proposed methodology has not been applied to ultimate effect. Whether the construct of self-efficacy is an able measurement of personal attitudes is seemingly more evident than the practical adoption of the theory itself. The research setting is a complex one; filled to the brim with social, cultural, economic, environmental, and political dynamics. These may very well intersect, and eventually inscribe certain characteristics on any notion of personal or professional efficacy. These variables have contaminated, albeit naturally,

each research group. Additional explorations are required to work out exactly how to this is effected, and how to avoid it in future.

Ultimately, the idea of "perception change" is crucial to understand any impact of teaching interventions. For how better to evaluate success (or failure) than to measure the attitudes and self-views of beneficiaries or recipients. Yet in such examples it is pertinent that the relevant methodologies be strengthened, so as to incorporate elements of fluidity, or reasonable change, beyond the scientific laboratory.

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