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## Assessment of a Socio-constructivist Model for Teacher Training: A Case Study

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**Abstract**
This article assesses a socio-constructivist model for training K-12 teachers in Brazil, in the use of Informatics in education. The method applied combines both face-to-face exchanges and a WEB-based distance approach made possible by Internet technology. The characteristics of such training and its main objectives are analyzed according to the collected data presented. A descriptive single case study research methodology is applied. The main conclusions reached by this research—based on the use of a systemic framework—are presented, mainly those addressing the importance of care and coherence for

knowledge creation in a socio-constructivist training model developed with the help of the Internet. Comparisons between this model and the traditional one are also presented.

## Introduction

In 1997, the Brazilian Ministry of Education and Culture (MEC) defined and launched a national public policy for the use of Informatics in Brazilian K-12 public schools, by means of a broad-based Program involving all 27 Brazilian States, known as PROINFO. While the Federal Government is in charge of investing in equipment and teacher training, the Brazilian states have autonomy to implement their Projects of Informatics in Education, as they think fit.

PROINFO, The National Program of Informatics in Education, aims to initiate the public educational system into the process of using state-of-art technology in the classroom, as well as to train human resources to develop their work adequately. In order to accomplish this target, PROINFO along with the acquisition and deployment of the necessary equipment, has stressed the need for training the teachers, using partnerships with universities, as training agents. Hence, together with state and municipal governments, NTEs (*Núcleos de Tecnologia Educacional*) were created to work as hubs of teacher training. NTEs are decentralized structures to promote the dissemination of Informatics within the pedagogical practice in public schools in each state. In these hubs, there are multipliers (teacher trainers) with qualifications (more than 360 course hours) in Informatics in Education given by a university involved in the program.

The greatest hurdle to the introduction of Informatics into the educational system has been the development of qualified human resources to keep abreast of the rapid transformations inherent to this area, along with the ever-present need to improve the quality of public education.

Taking part in this project, Rio Grande do Sul State, the southernmost Brazilian State, near the border with Argentina and Uruguay, has created 12 NTEs across the state in which 57 multipliers (teacher trainers) are already working. In Rio Grande do Sul, the State Commission in charge of implementing PROINFO across the state invited the Federal University of Rio Grande do Sul – UFRGS (www.ufrgs.br) to be its partner in this endeavor. Thus, the university developed the first training program for 57 multipliers, based on a face-to-face approach. Due to the success of this course, the State asked UFRGS to stage a second course in order to train more multipliers.

Research has been undertaken by the LEC (Cognitive Studies Laboratory) of UFRGS (www.psico.ufrgs.br/lec/) in the ongoing use of instructional technology and its role in the development of innovative educational practices. Consequently, new training methodology was developed by LEC to train the multipliers, combining face-to-face tuition with Web-based Instruction in order to be used for distance training.

This second training program started in July 1999 and ended in October 1999, involving 29 teachers from Rio do Grande do Sul State, who are expected to work as multipliers in the NTEs across the state.

## Impetus for Telematics-Based Training

The impetus for a new training model for teacher training was based on the outcome of

research developed by UFRGS in the realm of Informatics in Education. This has already been translated into theoretical models leading to new methodologies to orient changes in classroom practice (Projeto Educadi— http://educadi.psico.ufrgs.br/cursos/index.html), combined with the university's experience in the application of these models during the first specialization course on Informatics in Education given to the NTE multipliers of the PROINFO Program. Hence, it was concluded that it would be possible to develop and implement a second course, based on both a face-to-face approach and Internet-based distance training, the theoretical background of which was based on the development of interdisciplinary projects using Telematics.

The great challenge is to make the teachers of the public system aware of the need for incorporating new information technology in their daily practice in the classroom. The use of the technology demanded by the course facilitates the creation of learning and practice communities (Wenger & Snyder, 2000) involving both students and experts, as well as the exploration of the computer environment by both students and teachers, leading to enhanced socio-cognitive development and a shared, collective pooling of knowledge.

It was expected from the positive results of the first course, that this second course would permit the elimination of learning verticality and that each teacher and student of the course, would develop his/her own learning using a shared construction model, leading to the accomplishment of autonomous knowledge. Hence, the course was geared to stress the development of projects by small groups, addressing three aspects ( www.psico.ufrgs.br/mec-nte2/):

1. the student, seeking new technological resources in order to create knowledge leading to problem-solving related to all knowledge areas addressed in the course;

2. the teacher interacting with other teachers and with students within computerized environments in the public educational system, trying to grasp the established socio-cognitive relationships, as well as the participative, albeit autonomous knowledge-creation process;

3. the tutor in charge of training new human resources in his/her place, attempting to understand the interdependency relationships and, at the same time, the autonomous networks created by his/her peers, as the verticality of the system is eliminated and actual cooperative and truthful relationships based on reciprocity are developed.

## Operational Training Targets

The training under scrutiny here had the following operational targets: (www.psico.ufrgs.br/mec-nte2/)

- To train the teacher trainers involved in PROINFO, through a course on Informatics in Education lasting more than 360 hours (a *lato-sensu* graduate course, in Brazil), in order to qualify them to be multipliers at the NTEs throughout Rio do Grande do Sul State;
- To develop this 440-hour course in such a way that 320 hours of it are based on a face-to-face approach in Porto Alegre (Rio Grande do Sul State Capital), the remaining 120 hours to be dedicated to a distance training model, through the Internet;
- To take advantage of the 120 hours allocated to Distance Training, implementing the proposal presented in the Rio Grande do Sul State Project on Informatics in Education, in the schools assisted by each NTE, the teachers of which are attending the course.

**Course Description**

*Course Methodology*. The methodology of the course is divided into three main themes: face-to-face; mediated interaction and distance based instruction, as explained below:

- face-to-face: at this stage there are thematic workshops and seminars to plan and develop the interdisciplinary and diversified projects.
- mediated interaction: at this stage the simultaneous use of Internet services is intensified, namely: electronic mail, discussion lists, forums, real-time communication (IRC, Chat, MOOs, CuSeeMe etc.) and, concurrently a database for storing products like reports addressing the progress of each participant, texts, and on-going assessment portfolios is created, all of which are generated by the students during the course. Hence, the student activity records and data collection of their production are stored. This material is published in a site located in the Internet server of the course, along with the teachers and students' home pages.
- distance-based instruction: at this final stage an interdisciplinary project is developed by groups of students, who are already on-site at their NTEs, by giving training to other teachers and receiving orientation through the Internet regarding their dissertation

*Course Structure*. The course is divided into two stages, as presented below:

- *First Stage – Face-to-Face (320 hours)*

  The first stage is compounded of two modules (*Module 1 and 2*) over eight weeks, consisting of 40 hours per week. A section known as *Autonomous Production Time – APT*, (8 hours per week incorporated in the 40-hour week) is programmed into this stage.

- *Autonomous Production Time – TPA* (64 hours/activity)

  This time is to be used by the students in activities such as individual or collective studies, interviews with experts whose expertise is addressed in the project being developed, experiments with teachers and pupils in the classrooms, tracking of schools which are using ICT to develop pedagogical projects, finding solutions to challenges in the Informatics arena, information-searching on the Internet, data and information exchange through the Internet, instrumental software training, to name but a few.

  All the communications, discussions and reflections, as well as daily and final reports, are made available in a common area for the entire group under training, so as to permit interaction and exchange among the participants.

- *Module 1* (132 hours/activity)

  Structured into thematic workshops to be developed according to the group interests and the problems encountered by them. Each group (of 3 members) takes part in the thematic workshops, which are developed on a project basis approach.

  The first project (40 hours/activity) focuses on problem-solving in order to establish relationships between the different subjects of the curriculum. In this project the teachers are considered pupils addressing the basic level curriculum, formulating and solving problems, elaborating reports and evaluating their experiences.

The second project (80 hours/activity) addresses the understanding and analysis of the socio-cognitive and emotional relationships between teachers and students, and evaluates their ongoing knowledge acquisition in ICT-based learning environments.

The third project lasts 12 hours on a face-to-face basis with 120 hours of distance learning. The face-to-face stage focuses on the elaboration of the teacher-training project for use of ICT in the classroom. This project is developed by each one of the NTEs involved. The second stage is developed on a distance-learning basis, focusing on implementation of the project.

- *Module 2* (124 hours/activity)

  Consists of three Basic Seminars: "New Information and Communication Technologies for Learning Environments"; "Theoretical Basis for Learning in Computerized Environments"; and "Methodologies of Educational Interaction and Intervention in Computerized Learning Environments".

- *Second Stage – Distance-Based (120 hours)*

  This stage is held in the students' original NTEs. Each NTE (group of 6 students) develops an integrated project, lasting one and a half-months, being both theoretical and practical, based on their experiences with the students on the course and on their experience with the students of the schools belonging to each NTE. Geared towards motivating the students of the Basic Level to build relevant knowledge in computerized environments, the teachers involved in this experience are supported in the cooperative construction of relevant knowledge in order to assist the students in the computerized environment. They are also assisted in the construction of sharing methodology for interaction and intervention. They are encouraged to use the available ICT as enablers in this process. In this stage, the mentors of the course assist the students of the course on a distance-basis approach, via the Internet.

## Research Design

Assessment generally has at least one of the following three purposes: to improve, to inform, and/or to verify. The aims of this assessment are to provide information that can be used to determine whether or not intended outcomes are being achieved and how the project can be improved. In addition, the assessment process was structured to inform decision-makers about relevant issues that affect the project. (Rogers & Sando, 1996)

In this assessment process, it is important to distinguish between "formative" and "summative" assessment. Formative assessment is the collection of data and feedback of results on an ongoing basis. Formative assessment is designed to provide information for the purpose of improving the project or process being assessed. (Rogers & Sando, 1996). Summative assessment is designed to produce information that can be used to make decisions about the overall success of the project or process. Hence, this is a summative assessment.

### Methodology

The research methodology used in this article was the single case studyone. Case study is particularly suitable to answering "how" and "why"questions and are well suited to generating

and building theory in an area where little data or theory exists (Yin, 1994). It also enables the researcher to use "controlled opportunism" to respond flexibly to new discoveries made while collecting new data (Eisenhardt, 1994). Yin's tactics (construct validity; internal validity; external validity; and reliability) were carefully considered in this research.

In particular, construct validity was dealt with in the study through the use of multiple sources of evidence, the establishment of a chain of evidence, and having the members of the group reviewing the draft case study report. Internal validity issue is not necessary for descriptive case studies (Yin, 1994) and external validity in the findings is taken into account, mainly by applying replication logic. Finally, the reliability of the results was taken for granted by using a case study protocol and developing a case study database.

To conduct this research, some actions were undertaken and a theoretical framework was used. Several steps were conducted, in order to develop a working methodology to be applied in this research task. These steps are listed below:

- The project is presented in detail as conceived by its creators.
- The *modus-operandi* of the Program, i.e., its structure, is presented, so as to make clear how the outcomes are intended to be accomplished.
- Data to be analyzed are collected from different sources. In this case the following data were collected:
    - Data and Information about training, available on an Internet site at the following URL: (www.psico.ufrgs.br/mec-nte2);
    - The rationale of the project taken from academic papers developed to depict the program itself (Nevado *et al.,* 1999);
    - Student portfolios and projects deployed on the Internet also made available – although in a reserved area – through permission granted by the training coordinators;
- Analysis of the outcomes of the project obtained from the application and consolidation of questionnaires and interviews with both the students and teachers involved;
- Classroom observations and video-recordings, to analyze whether the teachers trained in a constructivist environment are applying this approach to train their students – the other teachers of the public education system;
- Comparison between the forecast and actual accomplished objectives so as to evaluate the program;
- Analysis of the cost-effectiveness of the Program;
- Conclusions and analysis of the strengths and weaknesses of the training program.

## Theoretical Framework

The questionnaire and direct observation of the training, mainly the WEB-Based Instruction stage were drawn primarily from the paper: "Effective Dimensions of Interactive Learning on the World Wide Web", Reeves & Reeves (1997). This model has applications in research, implementation and assessment of Web-based Instruction Programs such as this project.

The proposed model includes ten dimensions of interactive learning on the World Wide Web: (1) pedagogical philosophy, (2) learning theory, (3) goal orientation, (4) task orientation, (5) source of motivation, (6) teacher role, (7) metacognitive support, (8) collaborative learning, (9) cultural sensitivity, and (10) structural flexibility.

Each of the ten dimensions in this model is presented as a two-ended continuum with

contrasting values at either end. Needless to say, the world is rarely dichotomous and there is more complexity involved in learning than any of these dimensions represent. However, the individual dimensions themselves are not as important as the interplay among the ten dimensions that represent the instructional designs of various WBI sites.

1. Pedagogical Philosophy (Instructivist <=> Constructivist)

   The debate between instructivist and constructivist approaches to teaching and learning continues through education and training (Kafai & Resnick, 1996). Instructivists stress the importance of objectives that exit apart from the learner. Little emphasis is placed on learners per se, who are viewed as passive recipients of instructions or treated as empty vessels to be filled with learning. By contrast, constructivists emphasize the primacy of the learner's intentions, experience and cognitive strategies. According to constructivists, learners construct different cognitive structures based upon their previous knowledge and what they experience in different learning environments. It is paramount for constructivists that learning environments be as rich and diverse as possible. Instead of an empty vessel, the learner is regarded as an individual replete with pre-existing motivations, experiences, aptitudes and knowledge. Tasks to be accomplished and problems to be solved must have personal relevance to the learner. The constructivists believe that what we know is constructed – both individually and socially – based on prior experience.

2. Learning Theory (Behavioral <=> Cognitive)

   According to behaviorists, the critical factor in learning is observable behavior, and instruction involves shaping desirable behaviors through the arrangement of stimuli, responses, feedback, and reinforcement. A stimulus is provided (e.g. a short presentation of content), then a response is elicited, often via a question. Feedback is given as to the accuracy of the response, and positive reinforcement is given for accurate responses. Inaccurate responses result in a repetition of the original stimulus, and the cycle begins again. Cognitive psychologists place more emphasis on internal mental states than on behavior. A cognitive taxonomy of internal learning states includes simple propositions, schema, rules, skills, mental models and so forth. They claim that a variety of strategies – including memorization, direct instruction, deduction, drill and practice, and induction, are required in any learning environment, depending upon the type of knowledge to be created by the learner.

3. Goal Orientation (Sharp <=> Broad)

   The goals for education and training can range from sharply focused ones to general higher-order ones. Hence, the goal orientation of WBI systems varies in degree of focus from sharp to broad (Cole, 1992).

4. Task Orientation (Academic <=> Authentic)

   The context of learning is enormously important to adults (Merriam, 1993). An academic design would depend heavily on having the learners carry out traditional academic exercises. By contrast, an authentic design would engage the adults in practical activities such as preparing job applications, thereby situating practice and feedback within realistic scenarios. If knowledge, skills, and attitudes are learned in a practical context, they will be used in that and similar contexts.

5. Source of Motivation (Extrinsic <=> Intrinsic)

   Motivation is a primary factor in any theory or model of learning (Amabile, 1997). Every new educational technology promises to be intrinsically motivating. This dimension ranges from extrinsic (i.e., outside the learning environment) to intrinsic (i.e., integral to the learning environment). Intrinsically, motivation instruction is elusive regardless of the delivery systems.

6. Teacher Role (Didactic <=> Facilitative)

   The teacher role continuum ranges from didactic to facilitative. In the former role, the teacher presents information and asks learners to memorize information and recall it later in tests. The latter role assigns cognitive responsibility to the learners, as they should be responsible for recognizing and judging patterns of information, organizing data, constructing alternative perspectives, and presenting new knowledge in meaningful ways, wherein the teachers are mentors and tutors of this process.

7. Metacognitive Support (Unsupported <=> Integrated)

   Metacognition refers to a learner's awareness of objectives, ability to plan and evaluate learning strategies, and capacity to monitor progress and adjust learning behavior to accommodate needs (Flavell, 1979). The metacognitive support dimension is unsupported at one end of the continuum and integrated at the other. Recapitulation of the students' strategies at any point in the problem-solving process, as well as construction of Web-based portfolios are examples of how support for reflection and metacognition might be provided in WBI.

8. Collaborative Learning Strategies (Unsupported <=> Integral)

   The Collaborative Learning dimension ranges from a complete lack of support for collaboration to the inclusion of collaborative learning as an integral feature. Cooperative and collaborative learning refers to instructional methods in which learners work together in pairs or small groups to accomplish shared goals.

9. Cultural Sensitivity (Insensitive <=> Respectful)

   All instructional systems have cultural implications. In an insensitive approach the training is developed regardless of the culture and diversity of the learners it is intended to address. On the other hand, a respectful approach should be based on the diversity in the populations where the system will be used so that the overall learning environment is enhanced. It is unlikely that WBI Training can be designed to adapt to every cultural norm, but sites should be designed to be as culturally sensitive as possible.

10. Structural Flexibility (Fixed <=> Open)

   "Fixed" systems, still dominant in education, are usually limited to specific places, e.g., a classroom or laboratory, at specific times, e.g., 50 minutes class period. Independent of time and/or location constraints, the learner can use "Open" systems. The World Wide Web provides opportunities for more asynchronous (open) learning, although some Web-based learning tools are temporally fixed (synchronous), such as chats, video-conferences, MOOs and MUDs.

The research aims to have Table 1 completed by the learners so as to evaluate the program's outcomes.

**Table 1**
**WBI Assessment Parameters**

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHILOSOPHY | Instructivist | | | | | | | | | | | | Constructivist |
| LEARNING THEORY | Behavioral | | | | | | | | | | | | Cognitive |
| GOAL ORIENTATION | Sharply Focused | | | | | | | | | | | | General |
| TASK ORIENTATION | Academic | | | | | | | | | | | | Authentic |
| MOTIVATION | Extrinsic | | | | | | | | | | | | Intrinsic |
| TEACHER ROLE | Didactic | | | | | | | | | | | | Facilitative |
| METACOGNITIVE SUPPORT | Unsupported | | | | | | | | | | | | Integrated |
| COLLABORATION | Unsupported | | | | | | | | | | | | Integral |
| CULTURAL SENSITIVITY | Insensitive | | | | | | | | | | | | Respectful |
| FLEXIBILITY | Fixed | | | | | | | | | | | | Open |

## Data Survey and Analysis

**Theoretical Model of Training applied by the LEC**

The LEC (Cognitive Studies Laboratory) has published several papers addressing a socio-constructivist approach to train teachers using Information and Communication Technologies as enablers. According to LEC (Nevado *et al.*, 1999) the answer to the question: "If new practices are recommended to the teachers under training, why do the trainers themselves not apply this approach in their own classes?" lies at the foundation of a theoretical frame of reference upon which this practice is based.

So, to design a new pedagogical model for computerized environments it is necessary to create a theoretical framework which leads the teachers to understand more fully the affective and socio-cognitive processes that are developed when students are interacting with Information and Communication Technologies. This theoretical approach is even more necessary considering that the digital media increases the interactive processes among the players involved (teachers, students, experts, community). This model can assist in developing interactive models for teacher training.

According to Costa et al. (1997), the central idea of the theory, the basis of the model, is presented below in Figure 1.
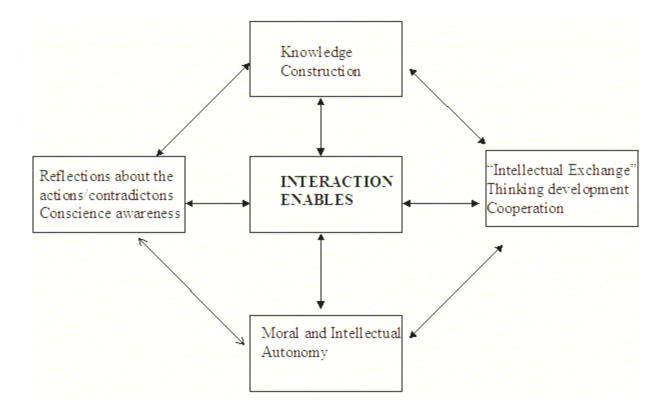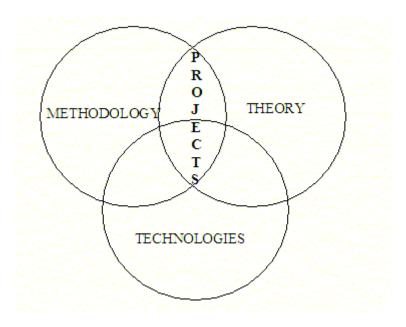
**Figure 1. Theoretical Framework for Teacher Training**

**Teacher Training Course Design**

As already stated, the design of the course is based on two different but complementary moments: (1) face-to-face and (2) distance-basis, having as its rationale an interactive and problem-solving methodology and leading to a central axis relying on the development of interdisciplinary projects using telematic tools as enablers.

The following Figure 2 presents, in brief, the basic structure of the course, showing how the theoretical and methodological studies and the technology used are articulated around the Projects in practice.

**Figure 2. Basic Structure of the Training**

As can be seen, the training is heavily constructivist-based and student-centered, aiming to develop interdisciplinary skills in the trainees (multipliers), so that they can use this expertise in their classrooms to train other teachers. Hence, the main target of this paper is to know whether the training - albeit developed according to this constructivist paradigm - was successful in developing a new classroom practice, which was observed when the trainees were back to their NTEs to continue the training of their peers.

**Web-Based Structure of the Training**

The LEC (Cognitive Studies Laboratory) of the Federal University of Rio Grande do Sul did not use any kind of off-the-shelf software package in order to develop the course. As real constructivists, they preferred not be restricted to a hermetic, instructionist and behavioristic system, but rather to build their own Web-environment during the training.

Since the beginning of the training, technology-mediated activities were developed via Internet services such as e-mail, discussion lists, newsgroups, real time communication (IRC, MOOs, CuSeeMe etc.) and spaces to store the practical and theoretical records of the groups, as well as contributions from the group.

A virtual environment was created in www.psico.ufrgs.br/mec-nte2, aiming to permit exchanges among the students and between them and other communities. The site has a public area and a protected zone reserved only for the participants of the course.

In the public space, all the navigators have the following resources at their disposal:

- Support and Interactive resources, such as information about the course, a library offering articles and research papers, links to interesting sites, IRC, FAQs, a Guest Book and News about the Project;
- Learning Projects of the Groups of Multipliers that offer partial considerations resulting from the analytical work addressing the developed processes and data obtained to date;
- Individual portfolios that encompass student home pages, student diaries (relating their reflections about the student-teacher processes developed both in individual and collective moments); their theoretical output and a space to store collaborative and cooperative contributions.

In the reserved area, one can find:

- Group portfolios that keep texts and articles generated by discussions developed in a collective way, texts under production by the group, enabled by the theoretical skill that has been developed through the discussions undertaken in the listserv of the site;
- Orientation for the dissertations to be developed by the NTEs' groups. In this space, methodological suggestions of the tutors, reports about the implementation of the NTEs in each region and records of the exchanges between tutors and students are made available;
- The Cyber Café—a meeting point to foment informal exchanges, jokes, invitations etc.

On the course site, the students can upload their information through forms previously developed as templates. This information is immediately converted to HTML code and stored on the site. In this manner, their reflections, experiences, reports, critics, data to be used in

shared projects and so forth can be easily deployed in the Web.

**Questionnaires**

Two types of questionnaires were used on the multipliers. The first, a quantitative questionnaire, followed the Theoretical Framework presented in the Research Design. The second, a qualitative one, is presented in the Annex. All of them were sent by Internet to the teachers and collected when the researchers were in Rio Grande do Sul State observing the multipliers training other teachers. All the 29 trained teachers fulfilled the quantitative questionnaire. The consolidated results led to the following table and exhibit:

**Table 2**
**Teacher Assessment**

| ITEM | AVG. RATING |
|---|---|
| PHILOSOPHY | 9.92 |
| LEARNING THEORY | 9.92 |
| GOAL ORIENTATION | 9.67 |
| TASK ORIENTATION | 9.83 |
| MOTIVATION | 9.08 |
| TEACHER ROLE | 9.92 |
| METACOGNITIVE SUPPORT | 9.5 |
| COLLABORATION | 9.75 |
| CULTURAL SENSITIVITY | 9.75 |
| FLEXIBILITY | 9.83 |

**Figure 3. Teacher Assessment**

As can be seen, the socio-constructivist approach was largely understood and accepted by the teachers. The grades are very high though a small observation needs to be made concerning the motivation issue. The "source of motivation" ranges from extrinsic (i.e., outside the learning environment) to intrinsic (i.e., integral to the learning environment). Intrinsic motivation of instruction is elusive regardless of the delivery system, but some proponents seem convinced that WBI systems motivate learners automatically, simply because of the integration of music, voice, graphics, text, animation, video, and a user-friendly interface. Multimedia studies indicate that learners soon tire of these media elements (Reeves, 1993), as the results above show, and it should be obvious that motivational aspects must be consciously designed into WBI as rigorously as any other pedagogical dimension.

During our visit to Rio Grande do Sul, the questionnaire presented in the Annex was also applied to the 29 teachers and the following results were obtained:

**Before the course**:

Most of the teachers defined their pedagogical posture as "traditional", here understood as instructivist and teacher-centered, which they said was the way they were trained to be. Some

of them tried to change their posture without success, as stated below:

- "Before the course, I define my posture as both traditional (developed by practice) and innovative/constructivist (developed just in discourse). As with most of my peers my teacher-centered approach is the result of my academic training in college. This posture could be classified as a content-based one, taking the social reality for granted"
- "Although I have tried to develop new pedagogical praxis, my posture was traditional, teacher-centered and heavily based on knowledge transmission. I did not believe social constructivism could be applied successfully".

**After the course:**

Most of the teachers are conscious of the need to change their pedagogical practice, however they are realistic enough to say that they have not yet changed. As they said:

- "I cannot say I have changed my pedagogical posture. Though I can say that I have reflected about my posture and am comfortable saying 'I don't know', 'I may be wrong', statements which I would hardly have dared say a short while ago".
- "After the course, I believe I have not made a radical transformation, as it will take time to put this into practice. But I do feel myself in a process of transformation as I realize that some of my postures must be changed, and I am frequently aware of the need to create constructivist situations for the students. Unfortunately, most of them are rarely implemented".

**Course Strengths and Weaknesses**

According to our survey the most cited Strengths and Weaknesses of the course were as follows. **Strengths:** The trainers' sincerity and humility; the respect shown to the students and their opinions; their knowledge and their absolute coherence between practice and speech. **Weaknesses:** The course duration which was very intensive as well as some classes given by "technical experts" who did not follow the constructivist approach of the course.

**Classroom Observation and Interviews**

During the visit to Rio Grande do Sul State, we had a chance to interview the multipliers and also to observe their practice in training other teachers. Speeches of the trained teachers conveyed to us the conclusion that they are truly aware of the need to change their pedagogical practice, and they see how to do that. They spoke very sincerely and the emotional component seemed to be very important for their forthcoming transformations. They explained that they suffered very much during the course, as they expected technical Cartesian training and became frustrated, as they wanted more technical skill development practice. Some teachers had already attended informatics courses on their own, and could not understand why these issues were not being addressed in the course. According to one of the teachers, they needed to be totally deconstructed to relearn from scratch. When asked about how they were deconstructed they pointed out two factors as the main enablers:

- Lack of Guidelines

  Although they waited for pre-established frameworks full of landmarks, the trainers spurred them to find their own way in the course. This generated a considerable degree

of frustration as they began to compete among themselves and sometimes they felt they were falling behind. These frustrations were greater among the women participants eliciting a profoundly emotional response. Some of them confessed that they almost quit the course in despair.

- The Error Treatment

  Another way they were deconstructed was having to deal with a new perspective of error. The trainers said most of time they did not know the right answers to the teachers' questions. This procedure confused them, and led the group to being obliged to live with "answers" such as: "I don't know", "Try yourself" and so forth.

We visited a training session in Gravataí, a town approximately one hour from Porto Alegre, the capital of Rio Grande do Sul State. There, some of the trained teachers were in the process of training some other teachers to use Informatics in their schools. Our observations showed that the teachers actually try to create a constructivist environment, conveying the students to look for the solutions themselves, in a workgroup and learning community created with the other students. At the moment of the visit the students were just beginning to create their own home pages on the Internet. They looked forward to having straight solutions and specific answers to their questions. The teachers were reluctant to give them the solutions, as they were more interested in getting the students to learn how to find their own solutions. This posture embarrassed some of the students, mainly the more Cartesian-oriented ones. Actually, it is a real battle, as the teachers have the impulse to present the solutions, rather than letting the students think for themselves. The teachers must be aware at all times of their former ways.

It became apparent that the gender influence must be taken into account. According to the multipliers, the men's reactions are very different from the women, as they control their emotions. This is an issue LEC wants to research deeper, so as to understand how it works. However what we could again see clearly is the effect of the emotional component in a socio-constructivist approach, even on the Web. This is an effect that cannot be disregarded and is better explained in the conclusions below.

## Conclusions

It is important, before addressing any manner of conclusions, to present the assessment frame developed by LEC for its own course.

*LEC's Course Assessment*. The qualitative assessment of the course, according to LEC's approach, was based on the following elements addressing the students:

- Regular construction and publishing of the individual and collective production on the course website;
- Creation and publication of multimedia documents;
- Contribution in the shared spaces on the site;
- Publishing, follow-up and discussion of the projects developed;
- Personal use of the website resources, both in a synchronous and asynchronous way.

A system (AccessWatch) was used to record interaction among the students and between students and teachers. Subsequently, the quality of the interaction was analyzed.

All assessment was based on the process of knowledge creation, established by analysis of

student portfolios, project evolution, student reflections and student self-analysis developed throughout the course.

We can conclude that according to LEC's assessment factors, the training program was a success. The trained teachers are aware of the need to change their pedagogical practices, and they now know how to do that and are willing to deploy what they have learnt in their schools, as soon as possible.

**Theory vs. Practice**

The practical training given by the multipliers (trained teachers) to the other teachers in a cascade process complies with the way they were trained, i.e., they try to apply the socio-constructivist approach in the training, using Information Technology as a tool and enabler to give a new awareness to the teachers about how to spur the students to create their own knowledge.

At one point one of the multipliers – almost as a throwback to her old mental model – tried to help a student by giving her the correct way of solving a problem. This should be considered normal, as the multipliers themselves are still undergoing their own transformation process which takes time.

Care and empathy are used all the time, just in the same way as they were used in the multipliers' training. They understand the de-construction process the students are experiencing as they have been through the same process themselves.

Coherence is the key-word for the success of the training, and the students see this as the multipliers' discourse and practice lead the course to the same central objectives, namely to use the technology to create a new *modus-operandi* in the classroom, thereby enabling the students to create and socialize their knowledge.

Naturally, coherence is not the only issue in the transformation of pedagogical practice, as shown below, but it is paramount for the success of the training itself.

The use of the framework developed by Pettigrew & Whipp (1991) depicted below in Figure 4 can help us to better understand the role of coherence in the success of the training and, by extension, of teacher practice. This model can show us one of the possible ways to achieve a successful strategic change in the educational realm.
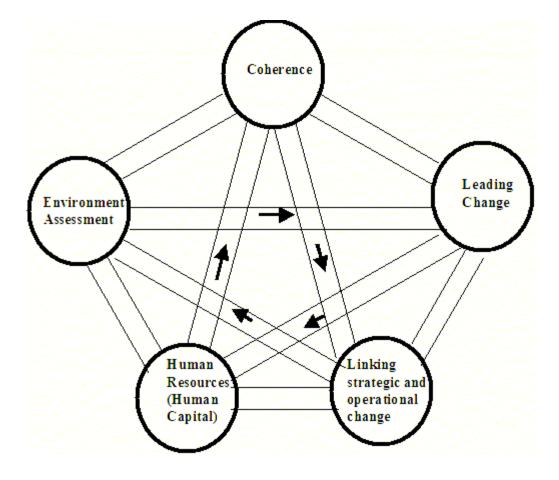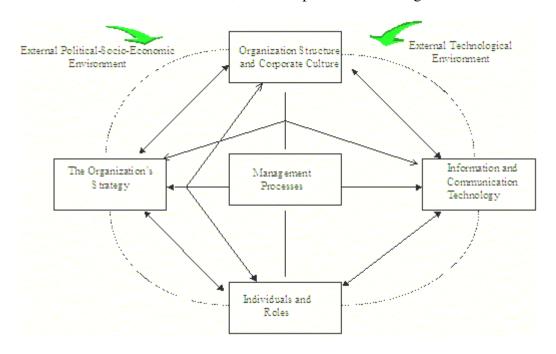
**Figure 4. The Role of Coherence in Strategic Change**

**Barriers to be overcome**

The greatest mistake one can make is to conclude that training itself is enough to change pedagogical practice in schools. According to the following Figure 5, developed by Morton (1996) and adapted by the researcher for the educational realm, several issues in the educational environment are interrelated, thus a deep and actual change affect all of them.

**Figure 5. Systemic Framework**

The diagram recognizes that organizations (in this case schools) can usefully be thought of a set of forces existing in a state of dynamic equilibrium. On the one hand there are its strategy (the mission it wishes to accomplish), and all the tasks that make up that mission. There are also its organization structure and, more importantly, the corporate culture that makes that structure become alive and vibrant. There are also people and the roles they are being asked to play. The fourth major set of forces are the information technologies. Holding all these four forces together are the management processes: the planning, the budgeting, and the control systems as well as the informal processes that represent the way the organization does its business. All these set of forces exist in an external environment which consists of the social, political, economic, and technical forces.

Analyzing the use of ICT in the schools after teacher training in a WBI constructivist environment, we can conclude that:

- Organization's Strategy – if the school principal is trained in the use of ICT to develop a new pedagogical practice, it will become easier for the school to adopt a new *praxis*. However, it is important to say that the schools' strategy must conform to the educational strategy developed by the state government as a whole;
- Organization Structure and Corporate Culture – regarding school's structure, this is perhaps the most difficult issue to be changed as the public authorities, themselves, have designed the school's organizational structure. As Chandler (1962) said: "Structure follows Strategy", so they are intimately linked. Hence, a radical change in the organizational design of the schools is essential in order to reach a new level of pedagogical practice, which is more open, constructivist and child-centered, otherwise new developed strategies will fail. Regarding corporate culture, the training gives the teachers new values, concepts and visions about education and the role ICT can play in the classroom. By consequence, it can lead to a (r)evolution in school practice, so as to break with the old *schemata* (mental models) and define a new vision and mission for the school.
- Information and Communication Technology – ICT can dramatically change the pedagogical procedures and processes applied by the schools, by reengineering and innovating old and outdated processes;
- Individuals and Roles - teachers trained in ICT can socialize the benefits of the new educational approach by explaining and demonstrating the use of ICT to their peers in the school, thus becoming catalysts in the transformation process. So, this is an issue the training can deal with successfully;
- Management Processes – as the management processes depend heavily on each school principal's way of guiding them, once again it is perceived the importance of having the headmasters trained in how to use ICT in a constructivist way;

Now, we may depict the framework already presented in Exhibit 6, highlighting the "dark" nodes of the model as the ones which a socio-constructivist approach associated to the use of ICT are unable to change or influence in a deeper way. So, by consequence, these items need to be addressed through the use of other strategies rather than via teacher training. Figure 6 below depicts this idea and presents a holistic view of all the issues that must be changed.
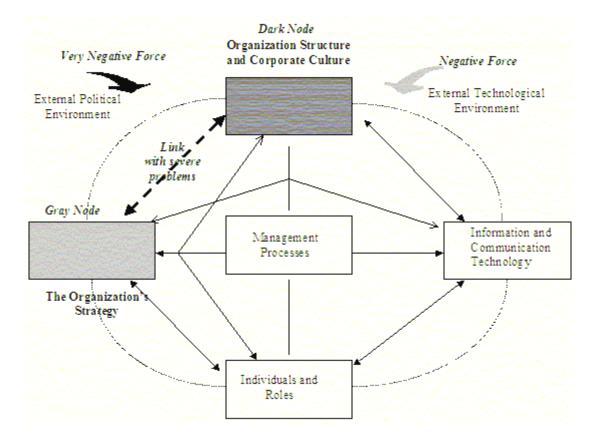
**Figure 6. The "Dark" Nodes of the Systemic Framework**

Regarding the "Environmental Scan" (Hax & Majluf, 1991) associated to the training, it can be concluded after several interviews with the persons in charge of the training that political discontinuity—quite common in Brazil—can jeopardize this educational endeavor. Besides, as technological innovations outdated very rapidly the hardware and software acquired by the Government, a constant influx of investments would be necessary. Unfortunately, severe financial constraints can accelerate the obsolescence process of the hardware and software purchased, as well as the obsolescence process of the skills developed by the teachers during the training (Argote *et al.*, 1998).

Regarding the "Internal Scrutiny" (Hax & Majluf, 1991) associated to the training, it can be concluded that Strategy and Structure associated with the schools' practice, hardly will be changed by the socio-constructivist training, as they are imposed in a top-down basis. These "dark nodes" will influence all the others dimensions of the model, mainly the Management Process. According to the teachers interviewed, a more participative approach is needed so as to allow the schools to influence for a better organizational structure and strategy.

**The Influence of Care in the Training Process**

We can thus see that care is fundamental in knowledge creation, as explained by von Krogh (1998). According to Maturana & Varela (1987), cognition is a creative act of conjuring up a microcosm. Because knowledge resides in our bodies and is closely tied to our senses and previous experience, we will naturally create a world in ways which are unique to ourselves.

In this study, care engenders trust in the learning process and also gives rise to active empathy, making it possible to assess and understand what the other person needs. Empathy is the

attempt to put yourself in another's shoes, understanding his/her particular situation, interests, skill level, history of success and failures, and future opportunities and problems. By means of active empathy, you proactively seek to understand the other person. Through active questioning and acute observation, you seek out instances where your efforts are needed. You practice dialogue rather than advocating only your own point of view. Care accomplishes precisely the sharing of positive and negative emotions through active empathy. In this study, for example, the relationship between the student and the teacher in learning the use of Informatics in the classroom is made easier when the teacher explains that he/she has had some of the same personal frustrations in learning a specific issue, and that speed in grasping the difficulty of this issue is not a gauge of the intellectual capacity of the student, but one of the inherent characteristics of a long learning process.

Hence, it can be concluded that the approach developed in this specific training for knowledge creation was based on von Krogh, (1998):

## Table 3
## Characteristics of Care in the Case Study Model

| PROCESS | LEVEL | CHARACTERISTICS |
|---|---|---|
| BESTOWING | INDIVIDUAL | Knowledge created in a supportive environment ("maximum leverage")<br>Strong intent to share knowledge on the future<br>Feedback from others<br>Integration of individuals into the team |
| INDWELLING | SOCIAL | "Equals" creating knowledge<br>Questioning and changing the basis for legimate knowledge<br>Sharing to help the team grow<br>Attempts to "look with" not "look at" other team members |

As there is care in training, there is mutual trust, active empathy, access to help among team members, lenient judgments towards participants in the team, and courage. In such a situation the student will *bestow* knowledge on others as well as receive active help from others (others bestowing knowledge on him/her). The environment is supportive, and the goal of the learning process shifts from obtaining "maximum grip" to reaching "maximum leverage" on others' knowledge. There is a mutual intent to help others to optimize their task performance, and, therefore, to share knowledge. The individual can experiment more freely in order to develop unconventional task solutions, and is emboldened in the pursuit of knowledge creation.

The individual is integrated into the team. Other students and teachers take an active interest in the learning process, and the individual is encouraged to make knowledge explicit while learning. When care runs high, colleagues show interest and support, and the individual member can spontaneously articulate his/her knowledge using unconventional language, metaphors, and analogies. Expressing personal difficulties in knowledge creation will be met with lenience from other team members and active feedback will be provided.

The process of mutual bestowing provides fertile ground for a distinct process of creating social knowledge in a team: *Indwelling*. Indwelling is of particular importance to the sharing of tacit knowledge and concept creation. Polanyi & Prosch (1975) suggested that dwelling in a concept can be understood as a dramatic shift of perspectives, changing the concept from

"looking at" to "looking with". In broader terms, indwelling is about commitment to an idea, to an experience, to a concept, or to a fellow human being. In developing shared tacit knowledge, the challenge for the teachers in knowledge creation is to dwell in the experiences, perspectives and concepts of other participants, or in other words, to change from self-commitment to commitment to others. In changing such deeper-level commitments, participants literally make changes in their perceptions. When care runs high, team members extend help to each other in finding new means of conveying and sharing personal beliefs. Trust and lenience make it easier to articulate emotional aspects of an experience, as was realized during this research.

Again, it is important to stress that the emotional component, here translated as care, was a vital force for the success of this socio-constructivist WBI training. Socio-constructivist training demands by its very nature high involvement of the teachers, both in the face-to-face stage and the distance-basis one. As the training aims to lead the students to reprogramming their minds by challenging their "temporary certainties", some physical as well as emotional support is necessary. The students are conveyed to an "un-learn" and "re-learn" process, and sometimes they offload their mental models without having acquired a new *schemata.* At this moment care is absolutely necessary (von Krogh, 1998) as they are emotionally deconstructed.

**Traditional vs. Socio-Constructivist Web-Based Training**

As a summary of our conclusions the following Table 4 is presented comparing some issues addressed in traditional teacher training and in a socio-constructivist program:

**Table 4**
**Traditional vs. Socio-Constructivist Approach**

|  | TRADITIONAL TRAINING | ANALYZED MODEL |
|---|---|---|
| General Characteristics | Knowledge Transmission | Knowledge Creation |
|  | Hierarchical | Team-based |
|  | Directive | Relational |
|  | Fixed Roles | Flexible roles |
| Objectives | Defined by the Teacher | Negotiated among the players |
| Contents | Fixed | Flexible and changeable |
|  | Mono-disciplinary | Interdisciplinary |
|  | Based on texts, books etc. | Based on Internet, the peers etc. |
| Methodology | Based on reproduction | Interactive and problem-based |
|  | Cartesian and Taylorist | Integrated |
| Evaluation | Based on command-control | Metacognitive-based |

**Final Recommendations**

As final recommendations that can improve the training analyzed above, we should highlight the following issues to be implemented:

- Mentoring Programs

Mentoring programs must motivate the trained teachers to share their knowledge with junior teachers and newcomers in the schools. Management can achieve this by defining two sets of responsibilities for each individual, namely to develop proportionally his/her ability to acquire expertise, in line with the responsibility to make his/her help accessible to those who need it as his/her expertise grows.

- Headmaster Training

    As stated above, the role of the headmaster in the creation of a "new school" is paramount, not just to motivate the teachers, but also to be fully involved in the other realms that hinder a true, radical transformation in the pedagogical practice, as presented in Figure 6. Hence, their participation and involvement in the training process is highly important for training targets to be fully accomplished.

- Social Events

    It is important to reunite the trained teachers in social events, where in a face-to-face basis they can share the experiences, improvements and obstacles they are facing. These moments are as important as opening and maintaining a newsgroup on the Internet the participants of which are already trained in this socio-constructivist approach.

All in all, this was a very innovative teacher training initiative which fully complied with the trainers' paradigms and pedagogical philosophies, seeking coherence at all times. Undoubtedly, as stated before, this alone will not change the outdated former teaching and learning *praxis*, but it is an updated and powerful enabler for instilling the necessary changes in the other remaining areas addressed in the whole educational process.

# References

Amabile, T. (1997) "Motivating Creativity in Organizations" *California Management Review*, Vol. 40, No. 1, Fall, pp. 39-58

Argote L. , Beckman S. L. & Epple D. (1998). "The Persistence and Transfer of Learning in Industrial Settings", In: *The Strategic Management of Intellectual Capital*, Klein D. (ed.), Butterworth-Heinemann.

Chandler, A. D. (1962) *Strategy and Structure: Chapters in the History of the Industrial Enterprise*, Cambridge, MA, MIT Press

Cole, P. (1992) "Constructivism Revisited: A Search for Common Ground", *Educational Technology*, 32 (2), pp. 27-34

Costa, I.T., Fagundes, L.C. & Nevado, R.A. (1997) "Projeto TecLec – Educação a Distância e a Formação Continuada de Professores em Sistemas de Comunidades de Aprendizagem", *Anais do VIII Simpósio Brasileiro de Informática na Educação (SBIE97),* São José dos Campos, Instituto Tecnológico da Aeronáutica

Flavell, J.H. (1979) "Metacognition and Cognitive Monitoring: A New Area of Psychological Inquiry", *American Psychologist*, 34, pp. 906-911

Hax, N. & Majluf N. (1991). *The Strategy Concept and Process: A Pragmatic Approach,*

Prentice-Hall, Englewood Cliffs, N.J., USA.

Kafai, Y. & Resnick, M. (Eds.) (1996) *Constructivism in Practice: Designing, Thinking and Learning in a Digital World.* Mahwah, NJ: Lawrence Erlbaum Associates

Lynch, R. (1997) *Corporate Strategy,* Financial Times, Pitman Publishing, pp. 778-779

Maturana, H.. & Varela, F.J. (1987) *The Tree of Knowledge,* New Science Library, Boston, MA

Morton. S. (1996 ) "How Information Technologies can Transform Organizations," in Rob Kling, Editor, *Computerization and Controversy* (San Diego: Academic Press) pp. 148-160

Merriam S.B. (Ed.) (1993) *An Update on Adult Learning Theory*. San Francisco: Jossey-Bass

Nevado, R.A, Magdalena, B.C. & Costa, I.B.T. (1999) "Formação de Professores Multiplicadores: nte2@projetos.cooperativos.ufrgs.br ". *Revista Informática na Educação: teoria e prática*. vol. 1, N.3 Curso de Pós-Graduação em Informática na Educação. October.

Nonaka, I. & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York.

Pascale, R.T. & Athos, A.G. (1982) *The Art of Japanese Management*, Simon & Schuster, New York, NY

Peters, T.J. & Waterman, R.H. (1982) *In Search of Excellence*, Harper & Row, New York, NY

Pettigrew, A. & Whipp, R. (1991) *Managing Change for Competitive Success*, Blackwell Publishers, Oxford, pp. 104.

Polanyi, M. & Prosch, H. (1975) *Meaning*, University of Chicago Press, Chicago, IL

Reeves, T. (1993) Research Support for Interactive Multimedia: Existing Foundations and Future Directions. In: C. Latchem, J. Williamson & L.Henderson-Lancett (Eds.), *Interactive Multimedia: Practice and Promise* (pp. 79-96). London: Kogan Page

Reeves, T. & Reeves, M. (1997) "Effective Dimensions of Interactive Learning on the World Wide Web", In: *Web-Based Instruction*, Khan B. (ed.), pp. 59-66

Rogers G.M. & Sando J.K. (1996) *Stepping Ahead: An Assessment Plan Development Guide*, Rose-Hulman Institute of Technology, pp.1

von Krogh. G. (1998) "Care in Knowledge Creation", *California Management Review*, Vol. 40, No. 3, Spring, pp. 133-153

Wenger E.C. & Snyder W.M. (2000) "Communities of Practice: The Organizational Frontier*", Harvard Business Review*, January-February, pp. 139-145

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