Infusion of Technology in the Classroom: Implementing an Instructional Technology Matrix to Help Teachers

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ABSTRACT

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Teachers have become acquainted with integrating technology (IT) and embedding it in lesson plans. However, the workshops given have typically focussed on hardware and software functions, rather than lesson planning. This research examined the use of an instructional technology matrix (ITM) to create lesson plans by applying Jonassen and Tessmer's constructivist taxonomy and ASSURE model with the hypothesis that an ITM would enhance teachers' abilities to use and create IT lessons. A workshop was given to undergraduate students in Education who were enrolled in an ITC summer class. A pre and post-questionnaire measuring their IT use and perceptions were given. As an end product of the workshop, the participants were invited to produce a lesson plan integrating the ITM. Further, two independent evaluators were asked to evaluate if the ITM was suited to teachers' needs in most educational reform plans. The research deals with two questions: (a) Is there a difference between the teacher's approach and the reform's project-oriented approach? (b) Could the elaboration of an instructional technology matrix for teachers (ITM), demonstrating the use of different level of cognitive learning, become an influential factor in IT lesson planning? Comments regarding the results of the ITM workshop as well as suggestions for further research are discussed. The research concludes that not enough classes and workshops are given to train efficient and effective teachers to use ITC in an educational environment and the ITM did not have a significant impact on their attitudes toward lesson planning.

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Chapter 1: Initial Problem

Between 1996 and 2001, the *Direction des ressources didactiques* (DRD), a department of the *Ministère de l'Éducation, du Loisir et du Sport* (MELS), a Quebec provincial minister, provided more than 250 million dollars to implement hardware, software and learning workshops in its school boards. Between 2001 and 2004, twenty-one million dollars were allocated to renew obsolete hardware. During the last four years, 5.5 million dollars has annually been put into its *Réseau pour le développement des compétences par l'intégration des technologies* (RECIT) to improve teachers' technology use (Demers, 2004). Bates (2000) points out for every dollar spent on IT (integrating technology) infrastructure, ten are spent on support and applications. Even if Quebec schools are hooked up to the World Wide Web, the teachers are not. As Wang (2004) states, "despite the increased availability and support for classroom computer use, relatively few teachers have fully integrated computers into their teaching (Becker, 2000; Marcinkiewicz, 1996)". Guité (2004) demonstrates that more than 95% of future teachers have not used IT and will not be using it on a daily basis in their classroom. Teachers who wish to push and try out IT are often discouraged; the main financial priority has been given to hardware, whereas acquiring skills to use IT represents a small percentage (Young, 2004).

Over the years, teachers have become acquainted with integrating technology and embedding it in lesson plans. The technology training workshops typically focus on hardware and software functions, rather than lesson planning. As an English second language elementary teacher, I have observed homeroom teachers to be very linear in their IT lessons planning. Teachers complain about not receiving proper training and when they do, the training doesn't satisfy their needs. Teachers need adequate time and increased funding for technology integration; when those requirements are met, they must, as professional practitioners, take the responsibility to use and implement IT in their classroom environment (Kadel, 2005; Lachance 2004; Guité 2005). Still, without proper support and access to a community of practitioners, teachers are rapidly hitting the glass ceiling. Their autonomy through trial and error or by self-learning has reached a limit as well as their openness to change (Chartrand, 2005; Kadel, 2005). As a result, teachers limit themselves to drill and practice, commercial software, internet searching and keyboarding. Such activities are the foundations of appreciating the potential of computers, but these practices do not develop higher order thinking skills nor do they adapt to a higher more difficult level of mental challenge (Guité 2005; Young, 2004). It does not allow the students to develop greater learning competencies; instead of using IT as a tool to exploit students' cognitive functions, it has been regarded as a school subject (Jonassen, 2004, p. 693-719; Wang, 2004). The duality between instructivism and constructivism grows, as efforts to implementing IT continue. Teaching elementary homeroom teachers about the benefits of constructivist strategies (constructivism) while using IT may be an effective means to increase the proper use of IT.

Chapter 2: Literature Review

2.1 Constructivism versus instructivism: a growing duality of the initial problem

Another aspect of teachers having problems integrating IT in their lesson plans is the disparity between instructivism - ''learners are told about the world and are expected to replicate its content and structure in their thinking" (Jonassen, 1991; Tam, 2000) and constructivism - "knowledge and truth are constructed by people and do not exist outside the human mind" (Duffy and Jonassen, 1991; Tam, 2000). Whether it is due to their teaching style or previous experiences, many teachers embrace instructivism in their classrooms while using ITC. With the growing access to IT and new reforms, some teachers are turning to a constructivist approach.

Instructivism is teacher-centered, where the teacher presents knowledge to the student. The teacher, perceived as the expert, transmits acquired knowledge as facts, one-dimensional meaning to be memorized in a sequential manner with repetitiveness, by the student. The teacher provides the content and manages it; instructivism is a passive and stand-alone form of learning based on rigid content (Masuyama, 2005; Teaching and Learning Theories, 1999).

Constructivism is learner-centered, where the student discovers and constructs knowledge. The students process and manage the information on their own; as a result, their own thinking is developed and reflected based on their judgements (Jonassen, 2004, p. 693-719). Compared to instructivism, the teacher's role radically changes from a subject matter expert to a facilitator or coach to build the students knowledge from his pre-acquired experience and with the help of his learning community (peers, teachers, parents, etc.). Constructivists believe that learning occurs in a context, which becomes part of the student's knowledge associated with learning. Throughout active engagement, the teacher creates authentic and meaningful realistic problems that will serve as models and guides to the students' evolving knowledge transfer (Tam, 2000). As Sahin (2003) states, successful use of technology in the classroom will correlate with the teacher's ability to integrate ITC in their lesson plan. On the other hand, constructivism has been criticized for its difficulty to evaluate, its lack of cost-efficiency, its requirement that technology be used for its implementation, its absence of specific learning objectives (Dick, 1992) and that it ignores the gap between students' pre-acquired knowledge and the lesson. However, these points can be addressed by a teacher who is creative and innovative enough to assess and evaluate the students' learning progress (Tam, 2000).

In a constructivism environment, cognitive tools add a plus-value to reflective thinking and meaningful learning. Cognitive tools refer to technology that enhances the learner's cognitive process during critical thinking, problem-solving and challenging learning; it supports an authentic learning environment and the teacher's role of a guide (Jonassen, 1998). These tools are easy to learn and applicable to different subjects. Cognitive tools force the learners to design and articulate their own knowledge. One advantage of cognitive tools in IT is that the computer will execute the simple task while the learner performs the complex ones: it is the learner who will provide the intelligence and commands to the computer, not the other way around (Jonassen, 1998, Jonassen, 2004, p. 693-719). Some lesson plans have already used such principles without being known to the teacher. By using a word processor to type a letter fault-free, the teacher allows students to focus on vocabulary and sentence structure. With a spreadsheet, students learn how to use mathematical concepts to solve an authentic problem, such as managing money earned from a lemonade stand.

While an instructivist perspective is tempting to use in a classroom for its rigidity, allowing a comfort zone to teachers and students, a constructivist perspective can strike fear with its no right or wrong solution (Tam, 2000). What they should be looking for are evidence of critical thinking and higher order thinking skills. Many teachers are asking themselves how they can properly evaluate a student when standards are different for each student. Even if there is not an ideal learning theory, teachers cannot perceive one learning theory to be a cure-all to all IT designing problems; they should be encouraged to use the advantages of both.

2.2 Jonassen and Tessmer's Taxonomy

Every teacher is aware of Taylor's strategic framework of computers in education: a) tutor: a drill and practice, b) tool: computer has programs (i.e. calculator) to allow the learner to focus on high order tasks and c) tutee: the computer is programmed by the learner (Taylor, 1980). Early versions of software programs being used by teachers were drill and practice oriented. Today some teachers are still using the same software, not exploiting its pedagogical value. Some teachers mistakenly believe the computer to be the center of their lesson instead of the learning goals of the subject content. In a constructivist learning environment, learning is determined by "the learner's existing knowledge, the social context, and the problem to be solved" (Tam, 2000). Jonassen states that software programs have not yet fulfilled its promises because they are based on a traditional instructivist's pedagogy.

As a hierarchical network structure, taxonomy organizes a set of scheme and concepts (Taxonomy: Wikipedia, the free encyclopedia, 2005; Jonassen, 1999, p. 25-32). What is interesting about Jonassen and Tessmer's learning outcome taxonomy is that it adds " cognitive, metacognitive, and motivational learning outcomes that are not included in the currently used taxonomies of learning outcomes" (Jonassen, 1999, p. 25-32). As Teemu Leinonen (2005) states, the teachers' restlessness to constantly think may block their learning; this is where a taxonomy enters the picture to allow the teachers to think and use their advanced skills on what will be taught throughout the lesson. For its rich credentials, Jonassen and Tessmer's taxonomy is relevant to teachers who wish to integrate ITC in their lessons. The taxonomy used to plan lessons integrating ITC has two functions: allow students to have higher thinking activities while being exposed by ITC and let the teacher focus on the true goal and nature of the lesson; the student must be central to the process (Tam, 2000). The learning outcomes taxonomy (LOT) answers Tam's (2000) criticisms: "The absence of specific learning objectives and outcomes has earned the criticism for constructivism as 'inefficient and ineffective' (Dick, 1992). Furthermore, its lack of concern for the entry behaviors of students is being criticized for ignoring the gap between what a student must know or be able to do before beginning instruction" (Tam, 2000).

In order to develop training and tests that are congruent with our objectives, the teacher needs to do a task analysis. To classify a task, Jonassen and Tessmer suggest a taxonomy learning outcomes, which "contains classes of overt performance or covert cognitive states that characterize those tasks" (Jonassen, 1999, p. 25-32). A learning outcome can either be cognitive, motor or psychosocial. The task must be labelled with learning outcomes in order to create a training that matches it. One should be careful not to mix up learning outcomes and learning objectives, which is a specific performance demanded by the teacher (example: reinvest pre-acquired knowledge in an authentic situation). Their learning outcome taxonomy has separated the learning outcomes into different classes: structural knowledge, ill-structured problems, ampliative skills, self-knowledge, and executive control strategies, which are also known as metacognitive strategies and motivation.

After proceeding with task analysis, they suggest the following steps. The teacher should identify the purpose for classifying tasks, and then identify the taxonomic assumptions and purposes. Questions to ask: does it match the philosophy behind the teacher's lesson plan? The teacher should choose a taxonomy based on its purpose and content; consequently, this particular taxonomy was specifically designed for high order thinking skills. They should test the taxonomy's usability, in order to understand it, because some tasks might not fit the taxonomy.

2.3 ASSURE model

The ASSURE model was developed by Heinrich and Molenda in 1999. It is an instructional guide "for planning and conducting lessons that integrate media and technology while focusing on the learner's needs" (ASSURE). Using a constructivism perspective, the ASSURE model works well with Jonassen and Tessmer's learning outcome taxonomy. ASSURE model has six procedures: 1) analyze learners, 2) state objectives, 3) select methods, media and materials, 4) utilize media and materials, 5) require learner participation and 6) evaluate and revise (Muller, 2005; Carpe 2003; Bradshaw, 2004).

In the first procedure, analyze learners, the teacher defines the general characteristics of the class: age, cultural, ethnic and socioeconomic factors. Afterwards, they enter competencies by assessing their technical vocabulary and preacquired knowledge and skills. The learners' analysis must also include their learning styles, such as their cognitive processing. As Tam (2000) states, while different learners may arrive at different answers, it is not a matter of "anything goes" (Spiro et al. 1991). Learners must be able to justify their position to establish its viability (Cognition and Technology Group, 1991). That is why it is important to assess their learning styles because it is their foundation to master the learning goals.

In the second procedure, the teacher states objectives includes a description of the learner instruction and objectives. Most teachers, when they are stating their objectives, tend to mix up their content and ITC, to the point of forgetting their original lesson plan idea. An objective must include their learning outcomes (cognitive, affective, psychomotor, etc.), expectations and needs for appropriate material. Wang (2004) states that preservice teachers who used specific goals, with and without vicarious experiences, significantly increased their judgments of self-efficacy for technology integration than those who were not assigned any goals.

The third procedure, selecting methods, media and materials, the teacher plans how to implement the media and material chosen and how will it help them meet their objectives. As Jonassen (2004, 693-719) argues, "rather than reading textbooks and solving workbook problems, students must define and constantly refine the nature of a problem they have identified, reconstruct their knowledge to solve that problem and represent their solution in hypermedia" (Lehrer, 1993). By selecting a specific media, teachers mold their lesson plans to fit into a specific learning outcome. As Lancy (1990) states "computers were effective in developing high-order thinking skills, including defining problems, judging information, solving the problems, and drawing appropriate conclusions. The computer can serve in the process of information gathering, inquiry and collaboration, and not merely as a vestige of direct instruction with its reliance on integrating technology in the existing curriculum" (Rice & Wilson, 1999). "Technology tools that aid in case-based learning include various types of simulation and strategy software/CD ROMs, video discs, multimedia/hypermedia, and telecommunication (e-mail and Internet)" (Tam, 2000). It is also an effective way to reconfirm awareness and the students' interest.

The fourth procedure, utilize methods, media and materials, the teacher plans the procedures to implement media and material. For each media used in the third procedure - selecting methods, media and materials – describe in detail how to implement them into the lesson plan to help the students meet the objectives. A few steps are suggested by Bradshaw (2004), to reinforce Lehrer's (1993) statement as reported by Jonassen (2004, p. 693-719): " Rather than reading textbooks and solving workbook problems, students must define and constantly refine the nature of a problem they have identified, reconstruct their knowledge to solve that problem, and represent their solution in hypermedia ". The steps are to preview the material, prepare the material, prepare the environment, prepare the learners and provide the experience. Technology is more reliable than in the 1990's, but teachers forget to prepare a backup plan, in case the first one does not work. Also, teachers need to test before the students are starting the lesson plan. Some results encountered in the test might not be what it is expected by the teacher. That is why previewing the material will save time.

In the fifth procedure, require learner participation, the teacher questions about how the students will be actively involved in the lesson. As Jonassen (2004) states, the students' involvement and engagement while using ITC provide an opportunity for learners to manipulate the information. The students are active learners in the process and not passive ones.

The last procedure of the ASSURE model is to evaluate and revise, which is one of the most important procedures. The teacher evaluates student performance – did they meet the lesson's objectives? They evaluate media components in order to determine media effectiveness. They evaluate instructor performance where the teacher will evaluate his own performance or the instructor to see how effective he was.

2.4 The Diffusion of Technology

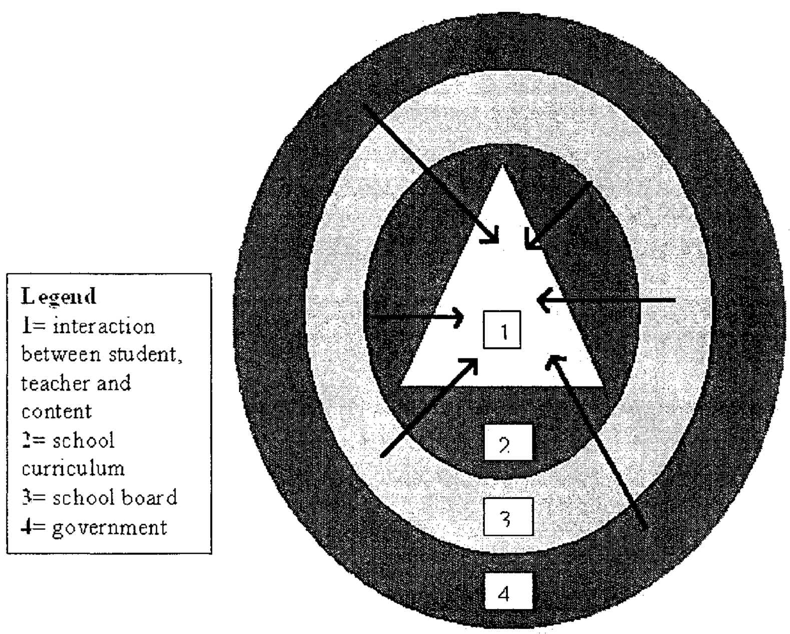

Figure 1 - Diffusion of Technology

In Figure 1, the spheres have an influence on teacher planning. Diffusion is expressed by the arrows. Technology is diffused by the government (education program), the school board (demographic and socio-economic situation) and the school (school curriculum/orientation). Rogers (1995) defines diffusion theory as an attempt "by which an innovation is communicated through a channel over a specified time period among members of a social system... Diffusion theory relates to the communication process where participants create and share information with the goal of reaching a greater mutual understanding. The channel may take several forms, ranging from mass communication to interpersonal communication" (Stithem Kalkowski, 2000). Since the education program has been implemented, the MELS's goal was to diffuse technology as a mean to gain additional knowledge and reinforce the constructivist perspective. But with many barriers, such as time, knowledge and resources, teachers did not diffuse technology properly. Instead, it is seen as an additional tool that cannot be properly used by themselves and students; ITC creates something that cannot be appropriated and manipulated. When a teacher creates a lesson plan that involves ITC, the goals are taken from the curriculum, called broad areas of learning, for example, to use information and communication technologies. There are no specific goals to guide the teacher or class needs. Therefore diffusion is negatively tagged and the whole process is inverted; the goals are not specific to a class needs.

The creative process in figure 1 of an ITC lesson plan relies solely on the teacher. In my teaching experience, most teachers try planning by themselves or team-teaching. Before the matrix was created, teachers without proper support and access to a community of practitioners were rapidly pushed to their limits. Restrained support, due to a lack of availability, is either provided by a technological committee composed of teachers who are tech-savvy or computer technicians who do not possess the necessary pedagogical requirements. There is a lack of teacher training, preparation and computers (Education Indicators in Canada: Report of the Pan-Canadian Education Indicators

Program 1999, 2000). The learning curve is a steep one. As a result, teacher's autonomy reaches a limit, by trial and error or self-learning, as well as their openness to technological changes (Chartrand, 2005; Kadel, 2005).

Hardware and software are also an issue in the diffusion of technology. School principals buy software and hardware without considering the teachers' needs and long term effects and a proper needs assessment. Quantity is still more important than quality. In the late 1990's, the Quebec government's policy was to close their computer ratio gap demanded by the United Nations Educational Scientific and Cultural Organisation (UNESCO). Some teachers feel obliged to buy software, by fear of losing their opportunity. They end up buying software that is not effective and properly evaluated. Again, diffusion is not possible without sharing information as a mutual understanding.

The creative process and the hardware/software issue creates a top-down approach where the external spheres such as the government, school board and school, in no particular order, guide the teacher's lesson planning, which is illustrated by the arrows in the diffusion of technology. The interaction and knowledge sharing among spheres is inexistent, since the teachers are accountable of the school principal and other external sphere that are government-based. A unique mean flows between the spheres (Governance, 2006).

The teacher does not possess an effective matrix, a pattern that allows the teacher to learn in a guided environment and to return constructive feedback. There is an absence of paradigm shift. It creates lesson plans that are low level in cognitive skills and does not match the original goal of the lesson plan. What they look for are evidence of critical thinking and higher order thinking skills. "The absence of specific learning objectives and outcomes has earned the criticism for constructivism as 'inefficient and ineffective' (Dick, 1992). Furthermore, its lack of concern for the entry behaviours of students is being criticized for ignoring the gap between what a student must know or be able to do before beginning instruction" (Tam, 2000).

2.5 The Instructional Technology Matrix (ITM) and its infusion

Whereas diffusion is a passive process to laggards and late majority teachers, infusion on the other hand is the continuum into which teachers not familiar with ITC seize the opportunity to use and appropriate ITC to move in Rogers' Adopter Categorization bell curve: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%) (Chapman, 2003). Infusion is gained by teachers who find a project with realistic ITC learning goals, for themselves and the students. Consequently, barriers such as time and knowledge are progressively removed while they are using technology (Houseman, 1997). Infusion has a greater influence on late majority and laggards when there is a community of practice at hand, which can be represented in a collaboration and support model. The role of a community of practice will play a great role in the improvement process and technology adoption. As Nicolls (2005) reports "A variety of studies indicate that peer collaboration and/or faculty mentoring are essential components in the quest to encourage all faculty members to adopt technology into their teaching methods" (Baldwin, 1998; McKenzie, 1999; Padgett

& Conceicao-Runlee, 2000; Quinlan & Akerlind, 2000; Sandholtz, 2001; Windschitl & Sahl, 2002). Several studies and articles emphasize that this strategy is conducive to building the critical mass needed to implement a paradigm shift (Hartman & Truman-Davis, 2001; Lan, 2001; Padgett & Conceicao-Runlee, 2000). It has proven to be an effective method in increasing faculty knowledge of alternative approaches and facilitating faculty responsibility as being "primary innovators and initiators of change in academe" (Camblin & Steger, 2000, p.1)". Connecting this to the ITM, the matrix infuses technology by breaking down some barriers.

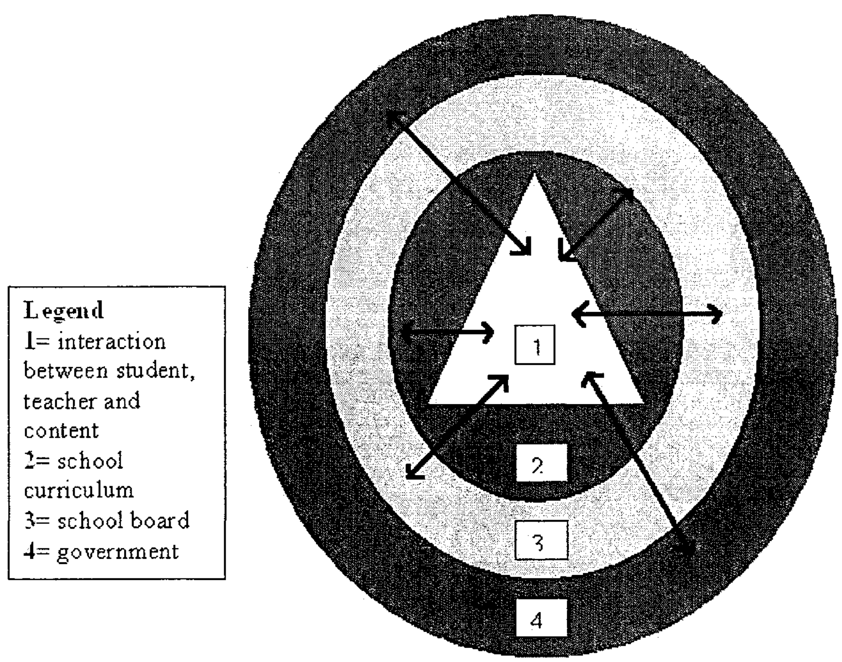

Figure 2 - Infusion of the Instructional Technology Matrix

The instructional technology matrix (ITM) for teachers is a concept that I have thought of while I was demonstrating to a teacher how to use the computer lab. I wanted to create a mechanism that helps teachers into their lesson plan design process. My requirements are: easy to use, not time-consuming, goal-content oriented and relevant to a teacher's pedagogical context. As illustrated in figure 2, the ITM is governed by external spheres: the government, school board and school. The ITM will have a direct influence on the teacher's content and scholarly relationship with the student. It is a mechanism to insert levels of thought processes to guide teachers in getting their content related efficiently and effectively to their initial goals. Finally, the ITM is a guidance tool, something the teachers, who are mostly beginners in using ITC, can rely on. Regardless of the content, it will generate a questioning process that will develop and criticize the pertinence of each step, making the teacher independent, so that they may become the subject matter expert related to the discipline. From that point of view, it gives a sense of empowerment, where the trial and error is replaced a by secured matrix.

The instructional technology matrix is based on constructivism, using Jonassen and Tessmer's taxonomy to demonstrate the various possibilities of computer tools: knowledge, comprehension, application, analysis, synthesis and evaluation. It is used in a project to reinvest pre-acquired knowledge and to elevate into high-order thinking skills.

The ITM also uses the ASSURE model (analyze learners, state objectives, select instructional methods, utilize media and materials, require learner participation and evaluate and revise), "an instructional systems design process that was modified to be used by teachers in the regular classroom. The ISD process is one in which teachers and trainers can use to design and develop the most appropriate learning environment for their students. Teachers can use this process in writing lesson plans and in improving teaching and learning. The ASSURE model incorporates Robert Gagne's events of instruction to assure effective use of media in instruction'' (Heinich, Molenda, Russell, Smaldino, 1999).

The ITM's main focus is the goal achievement the teacher wants to obtain. The teacher uses the curriculum and students' needs in their needs assessment. By focusing on a specific goal, the teacher will focus his effort on specific tasks. The teacher will formatively evaluate in order to reinvest into a new ITC lesson planning. He will question the lesson plan's usefulness and focus on the original goal. A learning curve can be adapted to the teacher's level of IT knowledge. Eventually the ITM will allow an exchange of ideas within a learning community, when there will be acceptance of such a concept. It has the advantage of being integrated among spheres; its interaction is bottom-up, where the teacher communicates and shares its needs with colleagues and administration. Still, teachers must have access to some minimal requirements. Software and hardware are not always adapted. But after a few lesson plans, resulted in stand-alone experience, teachers can specifically target their needs. Consequently, the software is not imposed by technician; it is based on the needs of the teachers.

Chapter 3: Methodology

The purpose of this research is to find a mechanism to encourage ITC in lesson planning, that is suitable to teachers, regardless of the content and ITC knowledge level. Guha (2001), points out that "in the teachers' workshop, the integration of computer with subject matter in classroom is the least well-addressed issue". The ITM would serve as a foundation for IT learning skills: "professional development needs to focus on how a change in ever teaching methods can be supported and be encouraged" (Guha, 2001). According to Amy S. C. Leh (2002) in her article "Action Research on the Changing Roles of the Instructors and the Learners" the goal of a workshop should be transferring knowledge: "Although the computer applications they learned in her classes might be obsolete one day, the learning skills, she hoped, might be transferred and applied to new learning experiences". Bober (2004) adds "the idea is to recognize that competence is generic and applies in many situations; there is more opportunity to apply generic competence than any specific skill".

My experience as a teacher and as a member of an IT school committee stimulated my interest in IT usage, particularly regarding the implementation of the education reform: Why does the reform use a project-oriented approach, but the lesson plans have a behavioral approach? Could the elaboration of an instructional technology matrix for teachers (ITM), demonstrating the use of different levels of cognitive learning, become an influential factor in IT lesson planning? This leads me to the hypothesis that an ITM would enhance teachers' abilities to use and create IT lessons.

3.1 Research Questions

The research deals with two questions:

1. Is there a difference between the teacher's approach and the reform's project-oriented approach?
2. Could the elaboration of an instructional technology matrix for teachers (ITM), demonstrating the use of different level of cognitive learning become an influential factor in IT lesson planning?

3.2 Research Objectives

The research focuses on the use of an ITM and its effects on the teachers IT planning process and use of computers. Researchers (Reiser, 2002; Guha 2001; Mandell, Sorge, and Russell, 2004) have pointed out that content integration to ITC is the next logical step after measuring the teachers' abilities to manage with hardware and their barriers – internal and external (Ertmer, 1999).

The objective of the ITM is to benefit the teachers by thoroughly addressing the application and integration issues in IT. Teachers are often using behavioural or a low cognitive approach, which leads to drill and practice. Consequently, there is no openness in the process, since everything is mapped for the learner. The learner can only compile his new knowledge. Nanjappa and Grant (2003) points out "increasing the skill levels of teachers with regard to computers and providing additional opportunities for teachers to integrate technology into lessons may encourage the use of constructivist behaviors…Yet, many teachers feel uncomfortable with the lack of a well-defined content and the shift of locus of control to the learners (Brush & Saye, 2000; Duffy and

Cunningham, 1996)".

A second benefit of the ITM is saving time, gaining knowledge and using efficiently the available tools the MELS has given over the years.

3.3 Research Design

This research is used to explore the value of the ITM in an educational setting. The project was done in an undergraduate class. The class used PCs with Microsoft Office suite and other multimedia software. The workshop was given during class as a part of a portfolio project. A brief overview of constructivism and Jonassen and Tessmer's taxonomy was explained, emphasizing on the role of constructivism and merging ITC with content. Notes were given, which included an overview of the Instructional Technology Matrix, as well as a summary after the workshop. As the second part of the workshop, the students had time to plan a basic IT lesson, which demanded a high level of cognitive abilities. They were encouraged to help colleagues throughout the process and contact me if necessary.

To validate the ITM approach, data were gathered from one questionnaire before the workshop to measure demographic and technology familiarity, and a post-questionnaire for workshop feedback; in addition, the instructor's evaluations of their end products were used. Finally, it was proposed that two independent observers evaluate the success of the workshop, including how well the students fit their content into the ITM.

Results of the data collection were used to refine both the ITM and the workshop for future use. Threats to validity such as incomplete questionnaires and neglected answers were partially addressed by on-site observation.

3.4 Population

Due to logistic constraints, this research was completed with undergraduate students enrolled in an ITC class, "Integrating Computer in Elementary Class". A majority of students who took part of this class were in Early Childhood and Elementary Education Specialization undergraduate degrees.

A sample was selected based on voluntary participation. An announcement was made during the first class of the semester. Their grade was not affected if they did not take part in the research.

3.5 Instrumentation

Pre and post questionnaires were built based on the Technology Implementation Questionnaire of the Centre for the Study of Learning and Performance (2000). It was hard to create a questionnaire that was originally intended for elementary teachers that have greater experience with children than undergraduate students.

The pre-questionnaire was divided into 3 sections: demographic, perception of students using ITC in the classroom and perception of teachers using ITC in the classroom. The sections perception of students using ITC in the classroom (questions 6 to 13) as well as a part of perception of teachers using ITC in the classroom (questions 17 to 20) used a five-point rating scale, with this respond range: strongly agree, agree, no opinion, disagree and strongly disagree.

The post-questionnaire has 3 sections that use the same five-point rating scale as the pre-questionnaire: the workshop, my perception, future considerations. The overall section is a qualitative one. It measures the appreciation and experience of using the ITM.

Finally, there is the Independent Evaluator's Grid: Instructional Technology Matrix, which is used by two independent evaluators to measure and evaluate if the students properly used the ITM and follow its steps in the lesson plan creation process. The independent evaluator used a five-point rating scale: strongly agree, agree, no opinion, disagree and strongly disagree.

3.6 Data analysis

The data analysis method used in this research is quantitative. After receiving the survey results, the database file was organized and coded. I've analyzed the raw data by computing the basic descriptive statistics for all items on the questionnaire, such as frequencies, means and mode. Twenty-six students enlisted in the class. Twenty-four students answered the pre-questionnaire, with a return rate of 92.3 percent and twelve students the post-questionnaire, a return rate of 46.2 percent. Twenty-four students handed in their lesson plan, a return rate of 92.3 percent.

Chapter 4: Findings

This research was designed to identify and assess factors that influence teachers to adopt computer technology methods in their lesson planning. The purpose of this chapter is to present the findings of the pre and post-questionnaire, which was used to evaluate the use of the ITM, throughout subjects' lesson plan creation and address the research questions. To answer the research question "Is there a difference between the teacher's approach and the reform's project-oriented approach?", the pre-questionnaire results are regrouped. For the second question, "Could the elaboration of an instructional technology matrix for teachers (ITM), demonstrating the use of different level of cognitive learning become an influential factor in IT lesson planning?", the pre and post-questionnaire results were used together.

4.1 Population

Due to logistic constraints, the sample group was selected based on voluntary participation from an undergraduate summer class. An announcement was made during the first class of the semester. The students were advised that their participation had no bearing on their course grade. All 26 undergraduate students in the class agreed to participate by signing the consent form to participate in research form. The students were enrolled in an ITC class, "Integrating Computer in Elementary Class". A majority of students who took part of this class are in Early Childhood and Elementary Education Specialization undergraduate degrees.

4.2 Data collection

After the survey results were received, the database file was incorporated into a spreadsheet to organize and code the data. The researcher began analyzing the raw data by computing descriptive statistics, such as mean, mode, frequencies and correlations. The data analysis method used in this study is quantitative. Of the 26 pre-questionnaires, 24 were completed, a return rate of 92.3 percent. Of the 24 post-questionnaires, 12 were completed, with a return rate of 46.2 percent. Of the 26 lesson plans, 24 participants handed in their lesson plan, a return rate of 92.3 percent.

4.3 Non-Respondent Follow-Up

Follow up contacts were made to persuade non-respondents to complete the survey. Two weekly emails were sent to the non-respondents with an electronic copy of the pre-questionnaire attached to the message. None of the participants responded.

4.4 Demographic Data on the Sample

Questions 1 to 5 in the pre-questionnaire provide a demographic profile of the undergraduate students.

Table 1- Student status

	N	%
A) Full-time	21	87.5
B) Part-time	2	8.3
C) Independent	0	0
D) Continuing education	0	0
E) Other	1	4.2
Total	24	100

In Table 1, a total of 87.5 percent of students are enrolled in Arts and Science and 12.5 percent of the group in Fine Arts. From this sample, 83.3 percent are in Early Childhood and Elementary Education, one student in Child Studies (4.2 percent), another in Art Education (4.2 percent) and two students in Art Education Specialization. In that sample, 87.5 percent were enrolled full-time. When the students were asked to indicate their student status, the following answers were given.

Table 2 - Year in program

	N	%
Year 1	6	25
Year 2	5	20.8
Year 3	7	29.2
Year 4	4	16.7
Did not answer	2	8.3
Total	24	100

In regards to teaching experience, 75 percent of students had a basic overview of lesson planning. It is not until their fourth year of their undergraduate studies that they are allowed to substitute in classes and take a full teaching position. The results indicate inexperience with manipulating content in a classroom and knowing students' needs.

On question 5 in the pre-questionnaire, 91.7 percent were females and 8.3 percent males. It is a rather high ratio that does not reflect gender distribution of the educational world. However, this ratio demonstrates a possible future of gender distribution in elementary-secondary education. In Education Indicators in Canada (2000), the number of male full-time elementary-secondary educators was falling. This trend will likely continue in the future, as more females are replacing newly retired teachers: "While the proportion of female staff has been growing in recent years at all levels, women are in the majority only at the elementary–secondary level, accounting for 63% of full-time educators in 1996-97'' (Education Indicators in Canada: Report of the Pan-Canadian Education Indicators Program 1999, 2000). The gender distribution also raises the debate over gender abilities since males constitute a great majority, roughly two-thirds, who use and play with technology toys and gadgets at a younger age. Perhaps as a results, male teachers are more inclined to use and appropriate technology in their classroom. (Cassell, J., & Jenkins, H., 2000).

4.5 ITC Knowledge Data on the Sample

Questions 14, 15 and 16 measure the participants' knowledge and frequency of computer usage. All of the sample can perform basic functions in a limited number of computer applications. In the group, 70.8 percent can perform general functions in a range of computer applications. Since the diffusion of computers, teachers appear to have benefited from technology integration in the curriculum (Table 3).

Table 3 - Amount of training received on using computer technology

	N	*%*
A) None	2	8.3
B) A full day or less	0	0
C) More than a full day and less than a one-semester course	3	12.5
D) A one-semester course	8	33.3
E) More than a one-semester course	11	45.8
Total	24	100

However, 20.8 percent had less than one semester course, approximately 45 hours, dedicated to teaching children how to use ITC in their learning, and integrating it into their daily practice. The standardization of ITC knowledge varies across universities (Lowerison, Gretchen. "EDUC 301 - ." E-mail to Patrick Lefebvre. 28 2005; Cours PPA2100A, 2006; plan_final_aut05.pdf, 2005.). Some emphasize learning software, whereas others the philosophy of using ITC in the classroom. Some students may not have an opportunity to learn pedagogical strategies. A transition from the previous school curriculum to the new one is rather difficult when proper training isn't available to the teachers, especially for teachers who do not feel comfortable around technology.

Table 4- Hours per week using a computer

	N	*%*
A) None	0	0
B) Less than one hour	0	0
C) 1h00 to 5h00 hours	7	29.2
D) 5h00 to 10h00 hours	6	25
E) 10h00 or more	9	37.5
Did not answer	2	8.3
Total	24	100

Table 4 shows the sample varies in the amount of use of a computer: 62.5 percent use a computer 5 hours or more. Different barriers as Ertmer (1999) explained may cause teachers to limit their computer usage: time, computer knowledge, interest, access to a computer, etc.

4.6 Potential of ITC in the Class Curriculum

The sample reveals a high positive appreciation of ITC use by students. As future teachers, reported in question 6 of the pre-questionnaire, 75 percent believe ITC will encourage contact among students. The entire sample agreed that computer technology is useful to students, and 95.8 percent agreed that it encourages active learning. Active learning is defined as the students being cognitively engaged in the lesson. In these results the participants acknowledge the potential of ITC, either because it eases their teaching tasks, such as grading, creating activities and a positive relationship the students have with technology. The responses hint at an understanding of the potential to give differentiated experiences for all the students. Only 58 percent of the sample believed ITC encourages active participation. Active participation is defined as students being engaged with other students in the learning process: peer consultation, teamwork, etc. As Jonassen (1999) states, having a high cognitive commitment will increase time on task, which is supported by a 0.67 correlation of question 11 (Computers help students to learn the material in a meaningful way) and question 12 (Computers make it easier for students to work in groups with other students) of the pre-questionnaire. Active participation in a group allows an exchange of ideas and cognitive strategies.

In Table 5, questions 18 (Learning about ICT applications will enhance my ability to prepare for working with students), 19 (Learning about ICT applications will enhance the options I have for working with students) and 20 (Learning about ICT applications will permit me to be more effective in my presentations to students) show interesting correlations. The results show that the undergraduate students believe in various possibilities ITC has to offer to students as an engaging tool.

Table 5 - Correlations of ITC enhancement for teachers

	Question 18	***Question 19***	***Question 20***
Question 18	1.00		
Question 19	0.52	1.00	
Question 20	0.59	0.77	1.00

A comparison of pre and post-questions were done to analyze if the ITM has changed their initial perception. The results are how they agree with the questions. The questions are: question 18 - Learning about ICT applications will enhance my ability to prepare for working with students (pre-questionnaire) and question 7E - My use of the Instructional Technology Matrix (ITM) will enhance my ability to prepare for working with students (post-questionnaire); question 19 - Learning about ICT applications will enhance the options I have for working with students, and question (pre-questionnaire) 7F - My use of the Instructional Technology Matrix (ITM) will enhance the options I have for working with students (post-questionnaire); and question 20 - Learning about ICT applications will permit me to be more effective in my presentations to students (pre-questionnaire), and question 7G - My use of the Instructional Technology Matrix (ITM) will permit me to be more effective in my presentations to students (post-questionnaire). Results show a reduction of the abilities of the participants to work with students, when using the ITM. There is also a slight reduction of the participants' perception of their options for working with students. Finally, a light increase of the participants' perception toward their effectiveness in their presentations to students.

Table 6 – Comparison of learning about ITC and using the ITM

Questions, Pre-Questionnaire	***Results (%) that agree***	***Questions, Post-Questionnaire***	***Results (%) that agree***
18	95.8	7E	75.0
19	87.5	7F	80.3
20	87.5	7G	91.7

4.7 The effect of the Instructional Technology Matrix on Lesson Planning

After the sample created their lesson plan, using the ITM, a post-questionnaire was distributed to measure how they integrated their content into it. In addition, two independent evaluators measured the effect of the ITM on the lesson plan, by completing a grid after the work was submitted (see Appendix K). Both evaluators agreed that the ITM influenced the participants' lesson plans. In the post-questionnaire, a series of questions asked participants how they perceived the different steps of the ITM: 58.3 percent agree they were easy to follow. The two independent evaluators agreed, except for the "analyze learners" and "evaluation and revision' parts", where they found that only 58 and 51 percent respectively had understood the ASSURE model.

For teachers, it is important to have that easiness, because it removes a second-order barrier related to methodology (Ertmer, 1999). Even so, analyzing and evaluating their learners is an important part of the task. The two independent evaluators agreed at 86 percent that the sample related their content efficiently and effectively to their initial objectives, with the ITM as a framework.

Table 7- Understanding the objectives of the lesson plan, using ITM

	N	%
Strongly Disagree	0	0
Disagree	2	16.7
No Opinion	2	16.7
Agree	6	50.0
Strongly Agree	2	16.7
Total	12	100

To be certain that the workshop and the notes given were clear to the sample, two questions were asked in the post-questionnaire. In Table 7, 66.7 percent understand the objectives of the lesson plan, using the ITM. Focusing on the objectives' importance permits the sample to appropriate the right vocabulary and feel comfortable with it; 75 percent of the sample found the workshop notes and presentation of the ITM useful in creating their lesson plans. Some revealed that they did not completely master learning theories applied in an educational content. Also, 66.7 percent found the workshop engaging, which is encouraging. Teachers told me that previous ITC experiences led them to complain about uni-dimensional and non-participative instruction. The workshop is a good step toward making the participants aware and engaged in their learning.

Table 8- Frequencies: ITM encourages contact among students

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	25
Agree	5	41.7
Strongly Agree	4	33.3
Total	12	100

A section of the post-questionnaire included questions to measure communication and active learning among teachers and students in a hypothetical situation. According to 75 percent of the sample (Table 8), the ITM encourages contact among students. This will allow students to foster their organization skills and use knowledge strategies based on communities of practice.

For the ITM's impact on the students' interaction, the questions used are question 6 (pre-questionnaire) - ITC will encourage contact among students (pre-questionnaire), and question 7A (post-questionnaire) - My use of the Instructional Technology Matrix (ITM) will encourage contact among students. Table 9 shows the results are the same in the pre and post-questions.

Table 9 - ITM's impact on the students' interaction

Questions, Pre-Questionnaire	***Results (%) that agree***	***Questions, Post-Questionnaire***	***Results (%) that agree***
6	75.0	7A	75.0

For the student time on task, the questions used are question 8 (pre-questionnaire) - ITC will increase student time on task, and question 7D (post-questionnaire) - My use of the Instructional Technology Matrix (ITM) will increase student time on task. Table 10 shows the participants believe the ITM will lead to an increase of time on task.

Table 10 – Student time on task

Questions, Pre-Questionnaire	***Results (%) that agree***	***Questions, Post-Questionnaire***	***Results (%) that agree***
8	58.3	7D	75.0

Engagement isn't the only aspect to a good lesson plan; active learning is another important aspect, as 83.4 percent of the sample reported (Table 11). As Young (2003) states, a community of practice creates the social fabric of learning, by exposing difficulty and encouraging the sharing of ideas, and careful listening. The ITM reinforces this social fabric of learning by providing a common framework and domain of knowledge.

Table 11 - ITM encourages active learning amongst students

	N	**%**
Strongly Disagree	0	0
Disagree	0	0
No Opinion	2	16.7
Agree	5	41.7
Strongly Agree	5	41.7
Total	12	100

The ITM is used with the participants' lesson planning, question 17 (pre-questionnaire) - Learning about ICT applications will encourage communication between myself and other teachers regarding instructional technology issues, and question 7B (post-questionnaire) - My use of the Instructional Technology Matrix (ITM) will encourage communication between myself and other teachers regarding instructional technology issues. The result (Table 11) remains the same after the participants tried the ITM.

Table 12 - Communication between participants and other teachers regarding instructional technology issues

Questions Pre-Questionnaire	***Results (%) that agree***	***Questions Post-Questionnaire***	***Results (%) that agree***
17	58.3	7B	58.3

In the final section of the post-questionnaire, the sample was asked to evaluate how the ITM will affect their lesson planning options: 83.3 percent believed it will enhance their option to work with students, and 91.7 percent believed the ITM will make them gain in effectiveness when teaching. However, the independent evaluators believed only 65 percent of the sample demonstrated an effective use of media in instruction, showing that while progress occurred, there is still room for improvement.

Chapter 5: Summary, Discussion, Conclusion and Recommendations

Teachers have become accustomed to integrating technology in lesson plans, as required in the new educational program. The workshops given by the school board or the ITC committee in schools have typically focussed on hardware and software functions, rather than lesson planning. As a result, teachers complain about the training not satisfying their needs. Their autonomy has reached a limit, by trial and error or self-learning; they limit themselves to basic computer functions and practices, with a low level of cognitive involvement for the students. This does not allow the students to develop greater learning competencies; instead of IT becoming a tool to exploit students' cognitive functions, it has been regarded as a school subject (Jonassen, 2004, p. 693-719; Wang, 2004). The importance of the current research lies within its initial focus: teaching elementary homeroom teachers about the benefits of constructivist strategies (constructivism) was seen as an effective means to promote the proper use of IT. Culpepper (2005) reports on the problem of change within school settings: "Without teacher's willingness to learn new skills to incorporate computer tools in their teaching practices their use will be superficial or nonexistent".

Having faced this problem within my teaching experience, I decided to create an Instructional Technology Matrix (ITM) that would help teachers. The purpose of this study is to evaluate the efficiency and effectiveness of the ITM in an educational setting. The goal of the ITM is to help teachers in their lesson plan design process. It must be easy to use, not time-consuming, content oriented and relevant to a teacher's pedagogical context. The theoretical framework used to support the ITM is Jonassen and Tessmer's

Learning Outcomes Taxonomy, which adds " cognitive, metacognitive, and motivational learning outcomes that are not included in the currently used taxonomies of learning outcomes" (Jonassen, 1999, p. 25-32). There are three types of learning outcomes: cognitive, motor or psychosocial. Another theoretical framework used is the ASSURE model, created by Heinrich and Molenda, to plan and conduct lessons that integrate media and technology while focusing on the learner's needs. Based on a constructivist perspective, the ASSURE model will guide the teachers, using specific steps to create a lesson plan in an educational environment.

Due to logistic constraints, a population of future teachers was selected to measure the effectiveness of the ITM. A sample of undergraduate students from an ITC class "Integrating Computer in Elementary Class" was selected to examine the research questions. Though they are not yet certified teachers, their experience with technology was similar to an elementary or secondary school environment. The participants were instructed on the ITM. Afterwards, the participants created their lesson plans by using the ITM. They also completed a questionnaire before and after the ITM instruction and the lesson-plan exercise. Data collection began 3 classes after the summer class began. I presented myself to the classroom, explaining the purpose of the research with detailed instructions. The ITC class met twice a week. The workshop lasted three classes, over a two-week span.

Since the literature did not reveal a survey that would be appropriate for use in this study, a survey instrument was developed based on the Technology Implementation

Questionnaire of the Centre for the Study of Learning and Performance (2000). Some questions were modified to fit the level of teaching experience, which was close to none. To analyze the raw data, basic descriptive statistics for all items on the questionnaire was used, such as frequencies, means, modes and chi-square.

5.1 Findings: The Teacher's Approach in Lesson Planning

The research examined two research questions. The first research question: Is there a difference between the teacher's approach and the reform's project-oriented approach? The research found almost all of the participants aiming to be elementary teachers are females with a 91.7 percent. A larger proportion of the sample is in Early Childhood and Elementary Education. Young female teachers, as represented by the participants in the research, have greater social computing than their older female peers (Tech-Savvy: Educating Girls in the Computer Age, 2000). Their attitude in becoming power users and appropriating ITC stimulate their use. No participants in the sample had teaching experience. Many of the participants had contact with a school throughout their small obligatory internships from their undergraduate program. As computer users, 62.5 percent use it more than 5 hours per week. Few participants had ITC classes to help them become more efficient computer users. According to Sheingold and Hadley (1990), teachers need five to six years working with technology to develop expertise (Chapman, 2003).

A transition from the previous school curriculum to the new one is rather difficult when proper training isn't available to the teachers, especially for those who do not feel comfortable around technology or it is obsolete when it comes to a project-oriented approach. A project-oriented approach requires teachers to be comfortable embedding their content with technology. It also has to be meaningful in a way to promote high cognitive skills and commitment. That is not always the case because undergraduate training and attitude do not focus on integrating content, but on mastering the content itself. Few undergraduate participants have integrated technology in their classrooms, during their internships, to promote ITC. Comparing the technology available at their homes with the hardware and software available in schools, some teachers might not find it relevant to focus time and energy on technology that might not work as well as their personal teaching approach, where they have total control of the learning process.

The participants' attitude toward their students' interaction stayed the same after using the ITM, at 75.0 percent. This suggests a lack of proper training in the bachelor programs. Laberge (2006) writes in a blog entry that while the number of computers augment in quantity and quality, for the last ten years, the *Ministère de l'Éducation des Loisirs et du Sport* (MELS) has been pushing for a decentralization, while relaxing on the control of the quality. With few classes available to student teachers, my research concludes that not enough classes and workshops are given to train efficient and effective teachers to use ITC in an educational environment. Solutions such as undergraduate classes integrating technology in their classes, workshops after graduation or mentoring programs are a step in the proper direction.

5.2 Instructional Technology Matrix: An Influential Factor in Lesson Planning

The second research question: Could the elaboration of an instructional technology matrix (ITM) for teachers, demonstrating the use of different level of cognitive learning, become an influential factor in IT lesson planning? Teacher's previous experiences led to complaints about ITC being one-dimensional and non-participative for them The participants in this study believe ITC promotes positive behaviours and attitudes, that students will feel more involved in their contact among peers and engage in active learning. According to the Education Development Center (Brumfield, 2006), students, especially the power users, play an important role in the classroom. Power users will have a positive effect on the teacher's learning and use of technology. This positive attitude promotes openness and tolerance of technology. The participants in this study may not be comfortable integrating technology into their content, but they believe the benefits it will bring to student learning. However, only 58 percent of the sample believes ITC encourages active participation, where students are engaged with their peers. They do believe that it will increase student time on task, with an increase from 58.3 percent to 75.0 percent. Such results also relate to the first research question, indicating a project-oriented approach is not sufficiently understood to be effectively used in a lesson plan.

As far as teacher involvement goes, technology cannot be properly implemented in a lesson plan without answering some essential questions. Both independent evaluators agreed that the ITM influenced the participants' lesson plan. Further, 91.7 percent of participants felt effective when employing the ITM to create lesson plans, as in

Dusick and Yildrim's study (2000), which found access to computers was positively correlated with technological competency and computer use in the classroom.

Results regarding the easiness of following the ITM steps and engaging in a community of practice with other colleagues support a positive response to the second research question, as does the sample's appreciation of the ITM workshop, which is regarded as clear and engaging by 66.7 percent of the participants for both post-the relevant questions. The sample was asked to evaluate how the ITM will affect their lesson planning options: 83.3 percent believed it will enhance their option to work with students, and 91.7 percent believed the ITM will make them gain in effectiveness when teaching.

Results show that the instructional technology matrix did not have a significant impact on their attitudes toward lesson planning. Some factors such the type of students, content and learning objectives will play a greater role in the process. Some participants reported in the post-questionnaire that the ITM did not have a significant effect on their attitude toward technology. However, power users may have a significant impact, by demonstrating their skills to lower level users, including the teachers (Brumfield, 2006). Teaching is in a transition, where the students are resources more than receptors of information (Richardson, 2006). The question remains: is the actual learning environment adapted to integrating ITC in the content, with the facility that it is expected by the administrators?

5.3 Future Directions in Research

The results of this research indicate that more research is needed concerning participants, community of practice and implementing the ITM on a larger sample. Based on this research, the following directions are recommended for future research:

1. Create a sample with teachers in different career stage: permanent, non-permanent, experienced, non-experienced.
2. Focus question on using the ITM while in a community of practice. How did the various types of support – power users, colleagues, etc. - influence their use of ITM?
3. Control the variable software, in order to isolate the factors that influence their choice to use a project oriented approach.
4. Have observations of ITM-ed lesson plan situations with elementary or secondary students in schools.

5.4 Summary

The findings of this research suggest that most teachers are not power users when it comes to technology. Most of them have been introduced to technology by requirements of educational reform. With so many things to think about, and barriers and constraints to overcome, technology may be the last thing on a teacher's mind to create educational learning situations. It is only fair to give them a hand by creating a tool, like the ITM, to support their own learning curve. For teachers and undergraduate students, technology has a huge role to play. It's not access that they fear, but how to infuse technology into teaching. Although teachers are eager to train themselves, universities and school administrators need to encourage and support computer technology in their instruction. Finally, without a community of practice that includes teachers and students, computer technology would be pointless in an educational setting. A community of practice will integrate technology and teachers together, to promote interesting learning situations in educational settings.

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Concordia
UNIVERSITY

Summary Protocol Form

For faculty and staff research, and student research which is not funded by a faculty member's grant and not part of regular course requirements, submit to the University Human Research Ethics Committee (UHREC), c/o the Office of Research, GM 1000

- ***For student research (with the exception noted above), submit to the relevant departmental ethics review committee.***

If using the MS Word form, please tab between fields (do not use the enter key) and click on check boxes.

Date: February 6, 2005

What type of review do you recommend that this form receive? Expedited or Full

Part One: Basic Information

1. Names of Researchers:

Principal Investigator: Patrick Alain Lefebvre

Department/Program: Master of Educational Technology Programmed

Office address:

Telephone number: 514-380-8899 E-mail address: plefebvre3@gmail.com

Names and details for all other researchers involved (co-investigators, collaborators, research associates, research assistants, supervisors):

- Supervisor: Dr. Dennis Dicks

A) Title of Research Project:

Infusion of technology in the Classroom: Implementing an Instructional Technology Matrix to Help Teachers

B) Granting Agency or Contractor (if any):

N/A

4. Brief Description of Research:

For funded research, please include one-page summary; otherwise, include a brief overall description. Include a statement of the benefits likely to be derived from project. You can address these questions by including the summary page from the grant proposal.

- I propose to do a study of the use of an ITM in ITC undergraduate class, and its effects on the teachers IT planning process and use of computers. Researchers (Reiser, 2002; Guha 2001; Mandell, Sorge, and Russell, 2004) have pointed out that it is the next logical step after measuring the teachers' abilities to manage with hardware and their barriers – internal and external (Ertmer, 1999).

The objective of the instructional technology matrix for teachers (ITM) is to benefit the teachers by thoroughly addressing the application and integration issues in IT. Teachers are often using behavioral or a low cognitive approach, which leads to drill and practice. Consequently, there is no openness in the process, since everything is mapped for the learner. The learner can only compile/compress his new knowledge. Nanjappa and Grant (2003) points out "increasing the skill levels of teachers with regard to computers and providing additional opportunities for teachers to integrate technology into lessons may encourage the use of constructivist behaviors…Yet, many teachers feel uncomfortable with the lack of a well-defined content and the shift of locus of control to the learners (Brush & Saye, 2000; Duffy and Cunningham, 1996)".

The project will be done in an undergraduate class. The class will use Microsoft and other multimedia software. The workshop will be given during their classes as a part of a portfolio project. A brief overview of constructivism and Jonassen and Tessmer's taxonomy will be explained. Notes will be given, as well as a summary after the workshop. As the second part of the workshop, the undergraduate students will have time to plan a basic IT lesson, demanding a high level of cognitive abilities, according to their grade. They are encouraged to seek help from colleagues throughout the process and contact me if necessary.

To validate the ITM approach, I will gather data from one survey before the workshop to measure demographic and technology familiarity, a questionnaire for workshop feedback and will use instructor evaluations of their end products. Finally, it is proposed that an independent observer evaluate the success of the workshop, including how well did the students fit their content into the ITM.

A second benefit of the ITM is saving time, gain knowledge and use efficiently the available tools the MEQ has given over the years.

5. Scholarly Review of Proposed Research:

Complete the Scholarly Review Form (SRF) if you are conducting non-funded or contract bio-medical research or any other non-funded or contract research involving more than minimal levels of risk.

- N/A

Part Two: Research Participants

1. Sample of Persons to be studied:

- This will be done with undergraduate students enrolled in a ITC class, "Integrating Computer in Elementary Class". Students who will take part of this class are in Early Childhood and Elementary Education Specialization undergraduate degrees.

2. Method of Recruitment of Participants:

- Sample will be selected based on voluntary participation. An announcement will be made during the first class of the semester. There is a possibility of fifty undergraduate students participating.

3. Treatment of Participants in the Course of the Research:

A brief summary of procedure, as well an account of the training of researchers/assistants.

- I will be in constant communication with the students either on-site, by email or phone. Guidance and critique will be given to each teacher. Here is a rough outline of the schedule proposed.

- Class 1- week 1: Submission of questionnaire 1 as a needs assessment and workshop outline with notes given to the participating teachers.
- Class 2 to 3 – week 1 and 2: Scheduling of workshops. Workshops will begin.
- Class 4 – week 2: End of workshops. Handing in of end product. Post-questionnaire regarding their comments on the workshop will be given.

Part Three: Ethical Concerns

Indicate briefly how research plan deals with the following potential ethical concerns:

1. Informed Consent:

Written consent form or written draft of oral protocols must be attached; see instructions and sample.

▸ See attached.

2. Deception:

The researcher must both describe the nature of any deception and provide a rationale regarding why it must be used to address the research question – i.e., is it absolutely necessary for the design? Deception may include the following: deliberate presentation of false information; suppression of material information; selection of information designed to mislead; and selective disclosure.

▸ All the people involved are well aware of the content of the workshops and objectives. Further the research methods are presented in the consent form and letters/invitations sent. No deception is included in the research.

3. Freedom to Discontinue:

▸ Every participant will have opportunities to discontinue in the following instances:

F) During initial recruitment

G) Consent form

H) Survey and questionnaire documents

If the participation wishes to express a verbal or written withdraw, it will be possible.

4. Assessment of Risks to Subjects' Physical Wellbeing, Psychological Welfare, and/or Reputation:

This includes low-level risk or any form of discomfort resulting from the research procedure and how it will be dealt with. When it is called for, you should indicate arrangements that have been made to ascertain that subjects are in "healthy" enough condition to undergo the intended research procedures. You should be able to indicate clearly the kinds of risks that may be involved and the action to be taken if someone is unexpectedly put at risk as part of the research efforts.

▸ The researchers have evaluated that the level of risk in this action research is low. There is a potential risk of participants feeling uncomfortable disclosing personal information on their IT level and knowledge of certain teaching concepts. To reduce the discomfort level, the researcher will ask consent of the participants and code all feedback for anonymity.

Another risk relates to their confidentiality. To reduce the discomfort level, pseudonyms will be used to protect their personal and professional identities.

5. Protecting and/or Addressing Participant "At Risk" Situations:

▸ The professor of the class will not be informed whether students are participating or not.

6. Post-Research Explanation and/or Debriefing:

▸ After the research, an information session will be given to present results and data collection. If there is a huge interest, the researcher will ask the professor to present its research.

7. Confidentiality of Results:

▸ No identity of the students will be revealed by name or reference to the level being taught. Coding will be used to protect confidentiality.

8. Other Comments:

Bearing in mind the ethical guidelines of your academic and/or professional association, please comment on any other ethical concerns which may arise in the course of this research (e.g., responsibility to subjects beyond the purposes of this study).

▸ N/A

Signature of Principal Investigator: ______________________________

Date: June 29, 2005

Consent Form to Participate in Research

Concordia University

This is to state that I agree to participate in a program of research being conducted by Patrick Lefebvre of the Education Department (Educational Technology) of Concordia University.

I have been informed that the purpose of the research is to implement an Instructional Technology Matrix that will augment the use of ITC in the classroom curriculum, based on the use of a constructivist approach.

The project will be done in as part of the course Integrating Computer in Elementary Class (EDUC 301). The subjects will be invited to a workshop of an hour with the intention of producing a 45-minute lesson integrating ITC, in a school subject chosen by the participant. After this workshop, the researcher will offer you the necessary support to create this lesson plan.

There will be no risk involved in the research. Do not hesitate to ask explanations during the project.

CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences.
- I understand that my participation in this study is confidential.
- I understand that the data from this study may be published.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT.
I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print)

____

SIGNATURE

____

WITNESS SIGNATURE

____

DATE

____

If at any time you have questions about your rights as a research participant, please contact
Adela Reid, Research Ethics and Compliance Officer, Concordia University, at 514.848.2424, x.7481 or by email at Adela.Reid@Concordia.ca

Questionnaire Integrating Technology in Classroom Curriculum

I would like to test out my instructional technology matrix (ITM), a concept that I have thought of while I was demonstrating to a teacher how to use the computer lab. I would like to use the ITM as a tool to allow teachers, regardless of their experience, subject matter and level of IT knowledge to create lesson plans.

With the results, I plan to improve the matrix and help teachers include computer technology into their classroom curriculum.

All information provided will be kept confidential. Participating to this questionnaire is voluntary. You can withdraw of the process any time if you do not feel comfortable. However, your personal experience and opinions are essential to the exploration of using ITC in a classroom curriculum.

If you wish to obtain a copy, the results of the research will be available upon written request.

After you have completed your questionnaire, please send your questionnaire via FirstClass or at plefebvre3@gmail.com

I will be greatly honored if you take the time to fill out this questionnaire. Thank you for your precious input!

Patrick Lefebvre
Graduate student, Master Educational Technology
Concordia University
plefebvre3@gmail.com or via FirstClass

1- Which faculty are you currently enrolled in?
   a) Arts & Science
   b) John Molson School of Business
   c) Engineering/Computer Science
   d) Fine Arts
   e) Other (i.e. individualized programme)

2- Which program are you enrolled in?

a) Early Childhood and Elementary Education
b) Child Studies
c) Art Education Major
d) Art Education Specialization
e) Other

3- Please indicate your student status.

a) Full-time
b) Part-time
c) Independent
d) Continuing education
e) Other

4- Year in the program: ________

5- Gender:

a) Female
b) Male

Perception of students using ITC in the classroom

Choose the option that reflects your opinion by putting an X or √ in the appropriate column.

Questions	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
6- ITC will encourage contact among students.					
7- ITC will encourage active learning amongst my students.					
8- ITC will increase student time on task.					
9- Computer technology is useful for students.					
10- Students enjoy working with a computer.					
11- Computers help students to learn the material in a meaningful way.					
12- Computers make it easier for students to work in groups with other students.					
13- The use of computers will improve the quality of the student's work.					

Perception of teachers using ITC in the classroom

14- What kind of computer user are you? Circle the level that best corresponds to you.

a) I have no experience with computer technologies.
b) I require help regularly to use computer technologies.
c) I can perform basic functions in a limited number of computer applications.
d) I can perform general functions in a number of computer applications.
e) I am an expert in using computer technologies

15- Total amount of training you have received to date on using computer technology?

a) None
b) A full day or less
c) More than a full day and less than a one-semester course
d) A one-semester course
e) More than a one-semester course

16- How many hours per week, do you use a computer?

a) None
b) Less than one hour
c) 1h00 to 5h00 hours
d) 5h00 to 10h00 hours
e) 10h00 or more

Choose the option that describes how ICT will affect you by putting an X or √ in the appropriate column.

Learning about ICT applications will…

Questions	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
17- Encourage communication between myself and other teachers regarding instructional technology issues.					
18- Enhance my ability to prepare for working with students.					
19- Enhance the options I have for working with students.					
20- Permit me to be more effective in my presentations to students.					

Additional comments/ concerns

<u>Thank you for your input!</u>

Patrick Lefebvre
Graduate student, Educational Technology
Concordia University
plefebvre3@gmail.com or via FirstClass

Participant Instructional Technology Matrix Post-Questionnaire

I would appreciate your opinion regarding your use of the Instructional Technology Matrix (ITM) as a part of your teaching skills with ITC.

The instructional technology matrix (ITM) is a concept that I have thought of while I was demonstrating to a teacher how to use the computer lab. I would like to use the ITM as a tool to allow teachers, regardless of their experience, subject matter and level of IT knowledge to create lesson plans.

With the results, I plan to improve the matrix and help teachers include computer technology into their classroom curriculum.

All information provided will be kept confidential. Participating to this questionnaire is voluntary. You can withdraw of the process any time if you do not feel comfortable. However, your personal experience and opinions are essential to the exploration of using ITC in a classroom curriculum.

If you wish to obtain a copy, the results of the research will be available upon written request.

Please take a few minutes and complete this survey. Return it to Patrick Lefebvre via FirstClass or at plefebvre3@gmail.com

Patrick Lefebvre
Graduate student, Educational Technology
Concordia University

Instructions: Choose the option that reflects your opinion by putting and X or √ in the appropriate column.

Questions	Strongly Agree	Agree	No Opinion	Disagree	Str on gly Dis agr ee
The Workshop					
1- I feel my ITC experience had a significant and positive impact on my ability to teach.					
2- The steps of the ITM were easy to follow.					
3- I understood the objective of the lesson plan.					
4- The theory and class notes helped me create my lesson.					
5- I would rate my participation in this workshop as engaging.					

My Perception					
6- In general, I have increased my use of instructional technology in terms of:					
6a) Material Preparation					
6b) Making Presentations					
6c) Integrating content with ITC.					

Future Considerations					
7- My use of the Instructional Technology Matrix (ITM) will:					
7a) Encourage contact among students.					
7b) Encourage communication between myself and other teachers regarding instructional technology issues.					
7c) Encourage active learning amongst my students.					
7d) Increase student time on task.					
7e) Enhance my ability to prepare for working with students.					
7f) Enhance the options I have for working with students.					
7g) Permit me to be more effective in my presentations to students.					

Overall

8- After this workshop, do you have a better understanding of integrating content with ITC?

9- What are the strong points of the workshop?

10- What are the weak points of the workshop?

11- What new goals or skills would you like to attain with respect to instructional technology?

Additional comments/ concerns

Thank you for your input!

Patrick Lefebvre
Graduate student, Educational Technology
Concordia University
plefebvre3@gmail.com or via FirstClass

Instructional Technology Matrix: Notes

THE PROBLEM

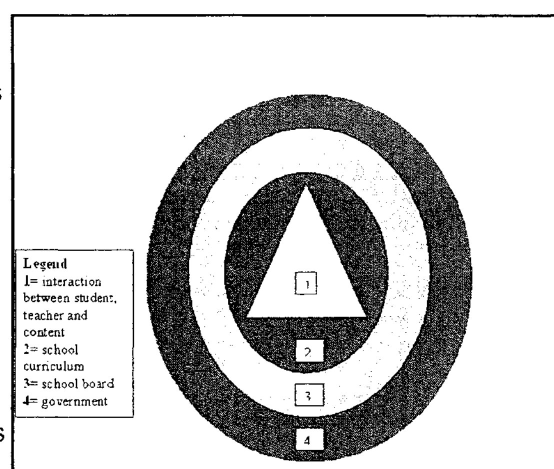
Over the years, teachers have become acquainted with integrating technology (IT) and embedding it in lesson plans. However, the workshops given have typically focussed on hardware and software functions, rather than lesson planning.

As an English second language elementary teacher, I have observed homeroom teachers to be very linear in their planning IT lessons. Teachers complain about not receiving proper training and that when they do, the training doesn't meet their needs. Consequently, they limit themselves to drill and practice, commercial software, internet searching and word typing. Such activities are the foundations of appreciating the potential of computers. But it does not allow the students to develop greater learning competencies.

Teaching elementary homeroom teachers about the benefits of constructivist strategies (constructivism) while using IT may be an effective means to increase the use proper use of IT.

DEFINITION OF THE ITM

As illustrate in Figure 1, the ITM is governed by the external spheres: school curriculum, school board, the government. The ITM will have a direct influence on the teacher's content and scholarly relationship with the student. By inserting the ITM before the other spheres, the teachers will be given a tool to: appropriate IT, which includes the benefits and disadvantages and reinforce the initial statement made by the spheres.



The instructional technology matrix is based on constructivism, using Jonassen and Tessmer's taxonomy to demonstrate the various possibilities of computer tools: knowledge, comprehension, application, analysis, synthesis and evaluation.

The instructional technology matrix also uses the ASSURE model (analyze learners, state objectives, select instructional methods, utilize media and materials, require learner participation and evaluate and revise), "an instructional systems design process that was modified to be used by teachers in the regular classroom. The ISD process is one in which teachers and trainers can use to design and develop the most appropriate learning environment for their students. Teachers can use this process in writing lesson plans and in improving teaching and learning. The ASSURE model incorporates Robert Gagne's events of instruction to assure effective use of media in instruction" (Heinich, Molenda, Russell, Smaldino, 1999).

The instructional matrix for teachers is a mechanism to insert the levels of thought/processes to guide teachers in getting their content related efficiently and effectively to their initial objectives and to focus on the content. Finally, the instructional technology matrix is guidance. Regardless of the content, it will develop a questioning that will develop and criticize the pertinence of each step.

JONASSEN AND TESSMER'S LEARNING-OUTCOMES TAXONOMY

Taxonomy is a hierarchical classification scheme that organizes objects or phenomena into categories.

A *learning-outcome taxonomy* is used to classify different types of learned capabilities, each of which can be labelled as a learning outcome. (Jonassen, Tessmer, Hannum, 1999).

This taxonomy adds cognitive, metacognitive, and motivational learning outcomes that are not included in the currently used taxonomies of learning outcomes.

CLASS OF LEARNING OUTCOMES	***LEARNING OUTCOME***
Declarative Knowledge: Students can recall, recognise and paraphrase declarative knowledge, albeit unstructured or inadequately structured knowledge.	Cued propositional information
	Propositional information
	Acquiring bodies of information
Structural knowledge (declarative)	Information networking
Structural knowledge (conceptual)	Semantic mapping/conceptual networking
Structural knowledge: Students demonstrate that they have acquired a range of diverse and interrelated semantic networks in relation to tasks.	Structural mental models
Cognitive component/structural knowledge	Forming concepts
Cognitive component skill	Reasoning from concepts
	Using procedures
	Applying rules
	Applying principles
	Complex procedures (convergent, well-structured, problem solving)
Situated problem solving: Students can successfully transfer knowledge of concepts and problems to authentic and diverse contexts.	Identifying/defining problem space
	Decomposing problem (integrating cognitive components)
	Identifying/defining problem space
	Decomposing problem (integrating cognitive components)
	Hypothesizing solutions

CLASS OF LEARNING OUTCOMES	*LEARNING OUTCOME*
	Evaluating solutions
Knowledge complexes	Mental modeling
Ampliative skill: Students can use rules of logic and imagination to draw conclusions, explain implications and imagine a range of plausible possibilities.	Generating new interpretations
	Constructing/applying arguments
	Analogizing
	Inferencing
Self knowledge: Students demonstrate their ability to control internal and external learning problem solving processes.	Articulating content (prior knowledge)
	Articulating sociocultural knowledge
Self knowledge (metacognition)	Articulating personal strategies (strategic knowledge)
Reflective self knowledge	Articulating cognitive prejudices or weaknesses
Executive control: Students demonstrate their ability to control internal and external learning problem solving processes.	Assessing task difficulty
	Goal setting
	Allocating cognitive resources
	Assessing prior knowledge
	Assessing progress/error checking
Motivation (disposition): Students demonstrate the willful manipulation of task attention, effort, and enthusiasm. They consistently display willingness, persistence and effort.	Exerting effort
	Persisting on task (tenacity)
	Engaging intentionally (willingness)
Attitude: Students demonstrate a healthy attitude towards tasks. They make choices in keeping with appropriate behaviour.	Making choices

Source for definitions: http://www.aare.edu.au/01pap/ste01110.htm

ASSURE MODEL

The ASSURE model was designed to be used by teachers and instructors to develop a proper learning environment for students.

Analyze learners: know who your target audience is: general characteristics, learning styles, etc.
State objectives: what will the students get out of the lesson?
Select instructional methods, media, and materials: what will best suit the lesson plan?
Utilize media and materials: create your lesson plan. Don't forget to test it AND get a plan B.
Require learner participation : students must be actively involved in the learning situation.
Evaluate and revise: reflect upon the lesson: did it meet the objectives?, were the expectations too high or low?, did I assess properly?, what should I do next time to improve it?, etc.

For more information, go to
http://www.unca.edu/education/edtech/techcourse/assure.htm

Independent Evaluator's Grid:

Instructional Technology Matrix

The lesson will:

	Strongly agree	*Agree*	*No opinion*	*Disagree*	*Strongly disagree*
1) Have a direct influence on the teacher's content					
2) Allow a good relationship with the student					
3) Allow the teacher to become comfortable using IT in the classroom.					
4) Demonstrate the various possibilities of computer tools such as:					
a) Comprehension					
b) Knowledge					
c) Application					
d) Analysis					
e) Synthesis					
f) Evaluation					

5) Use the ASSURE model					
a) Analyze learners					
b) State objectives					
c) Select instructional methods					
d) Utilize media and materials					
e) Require learner participation					
f) Evaluate and revise.					
6) Assure effective use of media in instruction.					
7) Guide the teacher in relating their content related efficiently and effectively to their initial objectives.					
8) Encourage the use of instructional technology in the classroom.					

Pre-questionnaire Results

1- Which faculty are you currently enrolled in?

	N	%
A) Arts & Science	21	87.5
B) John Molson School of Business	0	0
C) Engineering/Computer Science	0	0
D) Fine Arts	3	12.5
E) Other (i.e. individualized programme)	0	0
Total	24	100

2- Which program are you enrolled in?

	N	%
A) Early Childhood and Elementary Education	20	8333
B) Child Studies	1	4.17
C) Art Education Major	1	4.17
D) Art Education Specialization	2	8.33
E) Other	0	0
Total	24	100

3- Please indicate your student status.

	N	%
A) Full-time	21	87.5
B) Part-time	2	8.33
C) Independent	0	0
D) Continuing education	0	0
E) Other	1	4.17
Total	24	100

4- Year in the program:

	N	%
1	6	25
2	5	20.83
3	7	29.17
4	4	16.67
Did not answer	2	8.33
Total	24	100

5- Gender:

	N	%
Female	22	91.67
Male	2	8.33
Total	24	100

6- ITC will encourage contact among students.

	N	%
Strongly Disagree	0	0
Disagree	2	8.33
No Opinion	4	16.67
Agree	13	54.17
Strongly Agree	5	20.83
Total	24	100

7- ITC will encourage active learning amongst my students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	1	4.17
Agree	11	45.83
Strongly Agree	12	50
Total	24	100

8- ITC will increase time on task.

	N	%
Strongly Disagree	0	0
Disagree	4	16.67
No Opinion	6	25
Agree	10	41.66
Strongly Agree	4	16.67
Total	24	100

9- Computer technology is useful for students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	0	0
Agree	8	33.33
Strongly Agree	16	66.67
Total	24	100

10- Students enjoy working with a computer.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	0	0
Agree	9	37.5
Strongly Agree	14	58.33
Did not answer	1	4.17
Total	24	100

11- Computers help students to learn the material in a meaningful way.

	N	*%*
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	12.5
Agree	13	54.17
Strongly Agree	8	33.33
Total	24	100

12 - Computers make it easier for students to work in groups with other students.

	N	*%*
Strongly Disagree	0	0
Disagree	2	8.33
No Opinion	5	20.83
Agree	10	41.67
Strongly Agree	7	29.17
Total	24	100

13 - The use of computers will improve the quality of the student's work.

	N	*%*
Strongly Disagree	0	0
Disagree	3	12.5
No Opinion	3	12.5
Agree	14	58.33
Strongly Agree	4	16.67
Total	24	100

14- What kind of computer user are you? Circle the level that best corresponds to you.

	N	%
C) I have no experience with computer technologies.	0	0
D) I require help regularly to use computer technologies.	0	0
E) I can perform basic functions in a limited number of computer applications.	7	29.17
F) I can perform general functions in a number of computer applications.	17	70.83
G) I am an expert in using computer technologies	0	0
Total	24	100

15- Total amount of training you have received to date on using computer technology?

	N	%
I) None	2	8.33
J) A full day or less	0	0
K) More than a full day and less than a one-semester course	3	12.5
L) A one-semester course	8	33.33
M) More than a one-semester course	11	45.83
Total	24	100

16- How many hours per week, do you use a computer?

	N	%
F) None	0	0
G) Less than one hour	0	0
H) 1h00 to 5h00 hours	7	29.17
I) 5h00 to 10h00 hours	6	25
J) 10h00 or more	9	37.5
Did not answer	2	8.33
Total	24	100

17- Learning about ICT applications will encourage communication between me and other teachers regarding instructional technology issues.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	2	8.33
Agree	13	54.17
Strongly Agree	9	37.5
Total	24	100

18- Learning about ICT applications will enhance my ability to prepare for working with students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	1	4.17
Agree	9	37.5
Strongly Agree	14	58.33
Total	24	100

19- Learning about ICT applications will enhance the options I have for working with students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	12.5
Agree	7	29.17
Strongly Agree	14	58.33
Total	24	100

20- Learning about ICT applications will permit me to be more effective in my presentations to students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	12.5
Agree	6	25
Strongly Agree	15	62.5
Total	24	100

Post-questionnaire Results

1- I feel my ITC experience had a significant and positive impact on my ability to teach.

	N	%
Strongly Disagree	0	0
Disagree	1	8.33
No Opinion	4	33.33
Agree	6	50
Strongly Agree	1	8.33
Total	12	100

2- The steps of the Instructional Technology Matrix (ITM) were easy to follow.

	N	%
Strongly Disagree	0	0
Disagree	2	16.67
No Opinion	3	25
Agree	5	41.66
Strongly Agree	2	16.67
Total	12	100

3- I understood the objective of the lesson plan.

	N	
Strongly Disagree	0	0
Disagree	2	16.67
No Opinion	2	16.67
Agree	6	50
Strongly Agree	2	16.67
Total	12	100

4- The theory and class notes helped me create my lesson.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	25
Agree	7	58.33
Strongly Agree	2	16.67
Total	12	100

5- I would rate my participation in this workshop as engaging.

	N	%
Strongly Disagree	0	0
Disagree	1	8.33
No Opinion	3	25
Agree	6	50
Strongly Agree	2	16.67
Total	12	100

6- A) In general, I have increased my use of instructional technology in terms of material preparation.

	N	%
Strongly Disagree	0	0
Disagree	2	16.67
No Opinion	2	16.67
Agree	6	50
Strongly Agree	1	8.33
Did not answer	1	8.33
Total	12	100

6- B) In general, I have increased my use of instructional technology in terms making presentations.

	N	%
Strongly Disagree	0	0
Disagree	1	8.33
No Opinion	3	25
Agree	7	58.33
Strongly Agree	0	0
Did not answer	1	8.33
Total	12	100

6- C) In general, I have increased my use of instructional technology in terms integrating content with ITC.

	N	%
Strongly Disagree	0	0
Disagree	1	8.33
No Opinion	3	25
Agree	6	50
Strongly Agree	1	8.33
Did not answer	1	8.33
Total	12	100

7- A) my use of the Instructional Technology Matrix (ITM) will encourage contact among students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	25
Agree	5	41.67
Strongly Agree	4	33.33
Total	12	100

7- B) My use of the Instructional Technology Matrix (ITM) will encourage communication between me and other teachers regarding instructional technology issues.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	5	41.67
Agree	5	41.67
Strongly Agree	2	16.67
Total	12	100

7- C) My use of the Instructional Technology Matrix (ITM) will encourage active learning amongst my students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	2	16.67
Agree	5	41.67
Strongly Agree	5	41.67
Total	12	100

7- D) My use of the Instructional Technology Matrix (ITM) will increase student time on task.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	25
Agree	5	41.67
Strongly Agree	4	33.33
Total	12	100

7- E) My use of the Instructional Technology Matrix (ITM) will enhance my ability to prepare for working with students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	3	25
Agree	7	58.33
Strongly Agree	2	16.67
Total	12	100

7- F) My use of the Instructional Technology Matrix (ITM) will enhance the options I have for working with students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	2	16.67
Agree	6	50
Strongly Agree	4	33.33
Total	12	100

7- G) My use of the Instructional Technology Matrix (ITM) will permit me to be more effective in my presentations to students.

	N	%
Strongly Disagree	0	0
Disagree	0	0
No Opinion	1	8.33
Agree	6	50
Strongly Agree	5	41.67
Total	12	100

Independent Evaluator 1 Results

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Total
1	8	5	1	2	0	30
2	11	5	7	1	0	24
3	6	9	5	4	0	24
4a	10	8	0	5	0	23
4b	10	8	0	5	0	23
4c	10	8	0	6	0	24
4d	6	9	3	6	0	24
4e	6	7	5	5	0	23
4f	5	2	9	7	0	23
5a	6	3	6	7	0	22
5b	8	11	2	2	0	23
5c	8	12	2	2	0	24
5d	10	12	1	1	0	24
5e	15	6	2	1	0	24
5f	2	8	6	7	0	23
6	4	13	3	3	0	23
7	7	13	0	3	0	23
8	5	9	6	3	0	23

Independent Evaluator 2 Results

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Total
1	8	4	2	0	0	14
2	8	5	1	0	0	14
3	3	7	2	0	0	12
4a	4	6	2	2	0	14
4b	4	6	2	2	0	14
4c	7	5	0	2	0	14
4d	6	3	2	3	0	14
4e	7	3	1	3	0	14
4f	6	1	4	3	0	14
5a	6	6	0	2	0	14
5b	8	4	2	0	0	14
5c	9	2	2	1	0	14
5d	8	5	1	0	0	14
5e	11	3	0	0	0	14
5f	9	0	2	3	0	14
6	6	1	7	0	0	14
7	5	7	2	0	0	14
8	6	7	1	0	0	14

Independent Evaluators: Compilation of Results

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Total
1	53.33%	30.00%	10.00%	6.67%	0.00%	100.00%
2	50.00%	26.32%	21.05%	2.63%	0.00%	100.00%
3	25.00%	44.44%	19.44%	11.11%	0.00%	100.00%
4a	37.84%	37.84%	5.41%	18.92%	0.00%	100.00%
4b	37.84%	37.84%	5.41%	18.92%	0.00%	100.00%
4c	44.74%	34.21%	0.00%	21.05%	0.00%	100.00%
4d	31.58%	31.58%	13.16%	23.68%	0.00%	100.00%
4e	35.14%	27.03%	16.22%	21.62%	0.00%	100.00%
4f	29.73%	8.11%	35.14%	27.03%	0.00%	100.00%
5a	33.33%	25.00%	16.67%	25.00%	0.00%	100.00%
5b	43.24%	40.54%	10.81%	5.41%	0.00%	100.00%
5c	44.74%	36.84%	10.53%	7.89%	0.00%	100.00%
5d	47.37%	44.74%	5.26%	2.63%	0.00%	100.00%
5e	68.42%	23.68%	5.26%	2.63%	0.00%	100.00%
5f	29.73%	21.62%	21.62%	27.03%	0.00%	100.00%
6	27.03%	37.84%	27.03%	8.11%	0.00%	100.00%
7	32.43%	54.05%	5.41%	8.11%	0.00%	100.00%
8	29.73%	43.24%	18.92%	8.11%	0.00%	100.00%

Jonassen and Tessmer's Learning Outcomes Taxonomy

CLASS OF LEARNING OUTCOMES	*LEARNING OUTCOME*
Declarative Knowledge: Students can recall, recognize and paraphrase declarative knowledge, albeit unstructured or inadequately structured knowledge.	Cued propositional information
	Propositional information
	Acquiring bodies of information
Structural knowledge (declarative)	Information networking
Structural knowledge (conceptual)	Semantic mapping/conceptual networking
Structural knowledge: Students demonstrate that they have acquired a range of diverse and interrelated semantic networks in relation to tasks.	Structural mental models
Cognitive component/structural knowledge	Forming concepts
Cognitive component skill	Reasoning from concepts
	Using procedures
	Applying rules
	Applying principles
	Complex procedures (convergent, well-structured, problem solving)
Situated problem solving: Students can successfully transfer knowledge of concepts and problems to authentic and diverse contexts.	Identifying/defining problem space
	Decomposing problem (integrating cognitive components)
	Identifying/defining problem space
	Decomposing problem (integrating cognitive components)
	Hypothesizing solutions
	Evaluating solutions
Knowledge complexes	Mental modeling

Ampliative skill: Students can use rules of logic and imagination to draw conclusions, explain implications and imagine a range of plausible possibilities.	Generating new interpretations
	Constructing/applying arguments
	Analogizing
	Inferencing
Self knowledge: Students demonstrate their ability to control internal and external learning problem solving processes.	Articulating content (prior knowledge)
	Articulating sociocultural knowledge
Self knowledge (metacognition)	Articulating personal strategies (strategic knowledge)
Reflective self knowledge	Articulating cognitive prejudices or weaknesses
Executive control: Students demonstrate their ability to control internal and external learning problem solving processes.	Assessing task difficulty
	Goal setting
	Allocating cognitive resources
	Assessing prior knowledge
	Assessing progress/error checking
Motivation (disposition): Students demonstrate the willful manipulation of task attention, effort, and enthusiasm. They consistently display willingness, persistence and effort.	Exerting effort
	Persisting on task (tenacity)
	Engaging intentionally (willingness)
Attitude: Students demonstrate a healthy attitude towards tasks. They make choices in keeping with appropriate behaviour.	Making choices.