THE MEDIUM IS THE MESSAGE: TECHNOLOGY ENHANCES DIFFERENT ASPECTS OF THINKING

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Abstract - The current study evaluated a program in which technology was designed to enhance thinking among preservice teachers. The study examined whether and how technology contributed to enhancing thinking and revealed that the use of different technological environments enhanced different aspects of thinking (thinking-skills; understanding; thinking-dispositions). Three courses used three different technological environments: computer-games, Wiki or video. Based on analyzing participants' reflective journals, projects and questionnaires, technology seemed to have a potential to enhance thinking as an equalizer of thinking processes: it intensifies the learning experience and stimulates thinking.

Indexterms - Technology, Teaching Thinking, Preservice Teacher Training**.**

I. INTRODUCTION

Educational policy in many nations encourages two emphases within the school curriculum, which seem particularly important in the second millennium: enhancing thinking and integrating technology. Future students should not only acquire a predefined constant knowledge, but high order thinking abilities, enabling them to acquire new knowledge throughout their live, preparing them to live and work in a modern technological world as well as intelligently analyze and deal with different situations.

Several theories and models are suggested for 'teaching for thinking'. Harpaz (2007) offers a model describing three main aspects of thinking: thinking skills, thinking dispositions and understanding. Thinking skills are means that streamline the thought processes: from simple skills like rating and comparison to higher skills of problem solving. A 'skilled thinker' uses practical and efficient tools to make effective decisions. Teaching of thinking skills includes impartation: ordering skills by sequencing-taxonomic or hierarchical, demonstrating and practicing; Thinking dispositions are reasoned motivation for a certain thinking pattern. They are seen as the 'energy supplier': people may have thinking skills, but no motivation to implement them. Dewey considered disposition as the most important feature of good thinking - 'reflective thinking' (Dewey, 1933/1998). Teaching for thinking dispositions means fostering a "culture of thinking": personal models, engaging activities of conscious choice, preferential and a reasoned authentic attitude; Understanding means to see something in its relations to other things: to see the way it operates or functions, what consequences follow from it, what causes it, what uses it has, to implement it in a new situation and to be able to flexibly perform various operations around it- to explain, justify, uncover, treat, apply. When an idea is well connected to various concepts, it is better understood. Understanding is to put in context, so teaching for understanding strives for interdisciplinary, organize settings of "big ideas" connections, and undermine basic premises and taken-for-granted beliefs. The main metaphor guiding the understanding approach is a network: to understand something - means to place it. Models of teaching for thinking attach importance to teaching thinking as a distinct and structured process (Black, 2005; McMahon, 2007; Ringstaff& Kelley, 2002; Ritchhart& Perkins, 2008).It is stressed, as well, that incorporating technology into the curriculum positively affects the performance of thinking (Annetta, Cheng, & Holmes, 2010; Loveless, 2007; McMahon, 2007; Pilter, Hubbell, Kuhn, &Malenoski, 2007). However, despite the growing interest and research related to technology and teaching for thinking, the nature of the relations between the technological environment and the kind of thinking that it might develop remains largely undiscovered. One way research might relate to this area is by investigating how different technological environments might contribute to developing different aspects of thinking. Anneta et al. (Annetta, Cheng, & Holmes, 2010) elucidated that there are not enough tools and knowledge for teachers to integrate technology, whereas teacher quality and preparation are critical(also: Gallagher, Hipkins, & Zohar, 2012). Therefore, the current study focused on a preservice teacher training program, examining whether and how technological environments may contribute to enhance thinking and how the use of various technology environments may suit enhancing different aspects of thinking.

II. THE CONTEXT OF THE STUDY

This teacher training program included three courses that were selected to comply with the goals of enhancing the aspects of thinking based on Harpaz's model (thinking skills, thinking dispositions and understanding). Respectively, a selection of different technological environments was made for each of the courses, each one adequable to enhance a particular

aspect of thinking. Course content, learning processes and evaluation methods were planned to closely match the purpose of enhancing thinking using the technology.

1. Fostering social skills course: the course aimed to develop the skills aspect of thinking, using computer games. Developing computer games requires analyzing a series of actions, and then building an algorithm of decision making and problem solving. This application has been applied in this course onto social situations: participants were required to analyze and then develop computer games to foster social skills in children. Participants had to actively engage in the skill type of thinking: analyzing (e.g., what skills involve social activities such as choosing a friend), organizing in order, and altogether representing it in developing a full computer game in which children have to solve social problems.

2. Motivated learning course: the course aimed to develop thinking dispositions. The purpose of this course was to develop introspection, a dedicative reflective, personal and authentic thinking while striving to clarify and examine one-self goals and values as a motivating teacher, and to develop a culture of thinking. Video analysis was chosen for developing thinking dispositions. Films are known for their capability to stimulate and overwhelm (Bulgar, 2007), thus proposed to arouse personal thinking and discussions, and trigger reflective thinking and inquiry. Video-analysis included films showing mostly participants' teaching performances. Participants were encouraged to use the video to seek their own teaching style. Enhancing thinking dispositions included: state-of-the-art models (performances of various teaching models); activities for fostering thinking dispositions (through feedback on the presenter's personal style from the audience – course participants); and explicitly thinking dispositions actions (discussions).

3. Assessment in Early Childhood course: the course aimed at developing understanding. In order to understand, one has to be knowledgeable, and be able to explain, justify, and apply. Assessment is interdisciplinary by nature:

students must orient knowledge and understand the relationship between the content learned in various courses and between theories and methods of implementation. They must understand how individuals and systems operate and how these are translated into a general understanding. Teaching for understanding means organizing and structuring knowledge as networking concepts. The course therefore used the Wiki environment, using a variety of information sources, sharing peer knowledge. Course activities encouraged investigative learning and the development of knowledge networks.

III. RESEARCH QUESTIONS

1. Whether and how technology contributes to the enhancement of thinking?
2. Whether the use of different technological environments (computer games, video, Wiki) contribute to enhancing different aspects of thinking (thinking-skills, understanding, thinking-dispositions)

IV. METHODOLOGY

Research used a mix-methods methodology of a Triangulation Design (Creswell, Plano Clark, Gutmann, & Hanson, 2003).

1. Participants

73preservice teachers at their 2nd and 3rd year ofB.Edstudies. 92% of them were women.Average age was 25.3 years.

2. Tools and Data Collection

The qualitative section: Participants' reflective journals and final projects were collected and analyzed. Analyzing methods included a set of systematic processes, open coding, axis coding and optional coding, analyzing both content and discourse analysis, enabling studying “means of constituting cognition” (Resnick, Pontecorvo, &Säljö, 1997, p. 2).

The quantitative section: Using a 10 degreeLickert scale questionnaire, participants were asked to attest the extent to which the course enhanced different aspects of thinking. Questionnaire items were based on Harpaz's model. The questionnaire included 15 items: 5 items regardingunderstanding (e.g. "The course taught me as a teacher to flexibly explain, justify, apply," or - "I can now connect different concepts and implement them in my work"), 5 items regardingthinking dispositions (e.g. "The course emphasis was placed on authentic personal thinking," or - "Following the course I think about my own approach regarding how I work as a classroom teacher"), and 5 items regardingthinking skills (e.g. "I can now break down behavior to a continuous series of steps ", or -"I now understand that in order to know better I have to analyze situations and understand what they require").Reliability of the questionnaire-Crohnbach's alpha: 0.881

3. Procedure

In the first lesson of the semester, students were asked whether they were willing to participate in a research that studies the impact of different learning environments on several aspects of learning, including questionnaires and analyzing reflective journals and final projects. Research ethics were assured. They all consented.
The quantitative section: In the last lesson of the semester, questionnaires were distributed in classes. Students were told that the questionnaires were not a

'teaching satisfaction survey' but were for research purposes. Confidentiality and anonymity were assured and honored. The rate of response was 95%.

The qualitative section: Participants kept reflective journals, where they were reporting and reflecting upon their learning, writing their observations and responses to situations, starting from the first lesson of the course. After the course end, the reflective journals were collected along with participants' projects, confidentiality was assured and honored.

V. RESULTS

(1) Whether and how technology has contributed to the enhancement of thinking?

Technology was an experience intensifier. In the reflective journals phrases of excitement repeated: "I was shocked," "surprised", "It fascinated me". Technology enhanced thinking through the impact of a powerful experience on the brain and learning: "learning was generally experiential and our experiences were impressed in long term memory"; "engraved in my memory"; "left me a deep impression". Exposure to those technologies encouraged daring and boldness: "I learned that there are countless tools… and it made me question". This was followed by thinking processes: "When I saw so many possible directions, I questioned: Are there other factors that impact!"; "And suddenly I understand how it was all like a puzzle, each part creates the whole". Exposure to "the scope of infinity" as in the words of one student, that technology offers, seemed to amaze the students: "… and suddenly found the ideas and issues were all related to this topic", or-: "this exercise exposed... you could actually see how a child's diagnostic characteristics all interrelated ".

Another aspect in the contribution of technologies for teaching thinking reveals an important aspect of the learning process in the second millennium. In an era of wealth of materials, teaching for thinking through technologies enabled the transition from coping with overwhelming knowledge and tools to the essence of thinking when exposed to wide options: "I learned not only to run the tools, also thinking what I was getting of it".

Evoking thinking in given tools means changing routines of mind: "Since we tend to use the ready tools without criticism, the teacher must be sufficiently coherent to act in a comprehensive manner", to start thinking with all-prepared tools as part of the professional development and the professional identity formation: "In this lesson, an important phrase etched in my mind calls the teacher to be discretionary" testified a student. As learning to be a thinker, a student thinker, a teacher thinker.

At last, finding revealed that teaching for thinking through technologies was perceived as honoring the student. Technology, by evoking a setting of respect, so it appeared, allowed moving from a limited individuality as a student, where voice was not heard enough and students' ideas and knowledge could not be fully expressed, to a setting with a sense of "learning from the student" as one student wrote in the reflective journal. Technology in this manner was even described as a way of moving from anonymity and alienation, to a collaborative learning process. A student wrote (using Wiki environment): "I was immensely significant in this course. I was exposed to many materials, ideas and points of different thinking and I was an active partner in the learning process. I felt respected, me as a student, listening to my opinions, and having belief in my ability to explore, think and draw conclusions on my own. Discussion on various issues interested me". Students wrote about an opportunity, while the technological instruments "gave a seal of approval".

(2) Has the use of different technological environments contributed to enhancing different aspects of thinking?

In order to answer this question a quantitative analysis of questionnaires and a qualitative analysis of journals and projects of students were carried out.

The quantitative section included an analysis of variance for each of the three classes, with repeated measurements in the components of the thinking aspect (thinking skills, thinking distributes, understanding). Results are presented in Table 1.

Table 1. Thinking aspects developed at each course: Means, (standard deviation), F values

	Fostering social skills	**Motivation**	**Assessment**
Thinking skills	7.17 (1.93)	6 (2.11)	7.24 (1.74)
Thinking distributes	6.74 (1.92)	7.84 (1.68)	7.66 (1.3)
Understanding	6.19 (1.69)	6.23 (2.29)	8.33 (1.17)
Repeated measurements	4.19 (2)*	21.61 (2)***	7.82 (2)**

p<.05*
p<.005**
p<.001***

Table1 shows the perception of different aspects of thinking in the three courses: fostering social skills course using computer games most highly developed thinking skills; motivated learning course using video most highly developed thinking dispositions; and

assessment in early childhood course using wiki most highly developed understanding.

The qualitative section included both content and discourse analysis of the students' journals and projects. Expressions that were relevant to express different aspects of thinking (thinking skills, thinking dispositions and understanding) were analyzed and then counted, to reveal the most frequent type of expressions at each course. Percentage was calculated within each course: **frequency of expressions that expressed the assumed aspect of thinking at the specific course** (thinking skills /thinking dispositions /understanding) **/ frequency of total expressions expressing aspects of thinking at this course** (thinking skills +thinking dispositions+ understanding).Results are presented in table 2.

Table 2. Description, examples and frequencies of expressions of different aspects of thinking within the 3 courses

	thinking-skills (computer games)	thinking-dispositions (video)	understanding (wiki)
description	expressions indicative of analyzing processes (analyze, solve)	expressions indicative of authentic thinking and reflectivity (reflect, find my own, internal)	expressions indicative of exploration and information thinking(find, discover, connect)
examples	"So I started to analyze what actually is required so that the child could ...". "just step by step ". "it suddenly 'clicked' regarding my daughter ... then we started working and we analyzed situations".	"adopted", "identified", "It's My Style", "reflected to me", "was like an echo", "I realized I could learn a lot about myself". "It made me feel the power of my duty. When did I have a chance to stop and check myself?"."…because there was a gradual effect on all issues, I will relate to the subjects in that order, and explain how the issue affected me"."I could teach a class without sticking to the text, having my own unique style".	"here I see the connection". "my conclusion: there is a need for information". "opened new avenues of thought to me, made me look". "opened a new line of thought". "she was only taking into account partial knowledge"."a preschool teacher must have organized and consistent information so that it becomes easier to see the process… as I get a broad picture and more comprehensive one, the same information will be more reliable and accurate. Nothing is fixed and obvious".
..frequency	87.2%	94.1%	92.5%

DISCUSSION

Ernst Kapp (1877) described technology as a means to overcome dependence on raw nature and as a means to build a new, enhanced existence in the world. We now need to overcome the challenges of the modern technological era: flood of information, sense of anonymity, need for expertise, lack of confidence.

This study proposes that technology empowers experience and helps broaden thinking processes. The powerful experience would then be translated into a strong, meaningful memory. The research findings indicate an arousal that occurs when faced with technological devices that flood the thinking processes. Positive feelings in the technological environment, sense of interest, personal relevancy and surprise become part of the contribution of technology to teaching and enhancing of thinking processes, a relationship in which technology is a means of presenting realistic situations and used to recreate and construct reality (Hansman& Wilson, 2002).

McLuhan (McLuhan & Fiore, 1967) proposed that a **medium**, not the content it carries, should be the focus of study. Every message transmission device is attributed to the characteristics of the medium itself, "The medium is the message". McLuhan viewed every medium as having its own language, and therefore as a unique shaper of thinking. This research reinforces this philosophy, particularly the findings about the enhancement of different aspects of thinking as a result of different technological

environments. Technological environments appear capable of intensifying various thinking processes with various technological mediums.

Perhaps in response to Heidegger's (1977) question, whether changes that take place in modern society are attributed to the nihilistic ambition to power and degeneration of man to the level of an object, would be the words of one participant in the present study, using technology: "I've learned that I need to think as much as possible!"

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