DEVELOPING HIGH-LEVEL COGNITIVE SKILLS IN E-LEARNING

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Abstract – This research analyses how the development of high-level cognitive skills happens in higher education distance learning courses that employ e-learning. The determining and restrictive factors to the development of high-level cognitive skills through e-learning were investigated; academic activities that facilitate the development of these skills were identified, procedures for assessing the development of cognitive skills and for creating the course design links that facilitate the development of high-level cognitive skills in higher education courses delivered by e-learning were identified. This study shows that e-learning provides a number of benefits that facilitate the development of high-level cognitive skills. Specifically, the ability to develop asynchronous activities was the quality most often cited. E-learning also displays some restrictive factors, such as difficulties that e-learning students had during autonomous studies. The results highlighted that the development of high-level cognitive skills is assumed in all courses offered by key informants; however it is not always part of the specific objectives or the design of these courses. Some activities are given to facilitate or support the development of high-level cognitive skills by e-learning. From this research a set of guidelines has been drawn up to facilitate the development of high-level cognitive skills through distance learning when working with e-learning.

Keywords: cognitive skills, distance education. E-learning.
1. INTRODUCTION

The labour market requires professionals with high-level cognitive skills, which means professionals who know how to think in analytical, critical and reflective ways, how to ask questions, make decisions, solve problems, and know how to learn independently. (Zoller & Pushkin, 2007). To meet this demand, the focus of education should target the development of skills of critical thinking and of autonomous and organized study. These skills will be useful to individuals because success in university courses and in most professions require such skills (Cottrell, 2005; Garrison & Anderson, 2003). They are skills for life long learning. Although there is consensus on the need to develop these skills, what is not so clear is how they can be developed in students in university courses (McLoughlin & Luca, 2003) as well as being assessed.

The advancements in communications technology and the increased use of computer networks have made distance education based on the Internet, e-learning, a widely recognized approach in the field of education. Distance education using e-learning is rapidly becoming an alternative to face-to-face teaching at universities, in which those who teach and learn are physically separated in time, in space or in both.

Saba (2003) suggests that one of the main characteristics that differentiates distance education from other forms of education is the central focus on the student and on their independence in the learning process. Can it be deduced from this that successful distance learning helps to develop autonomous and organized study skills? Is it possible to develop other high-level cognitive skills learning at a distance by e-learning? The purpose of this research was to identify how the development of high-level cognitive skills happens in higher education distance learning courses that employ e-learning.

1.1. Research approach

The research was a preliminary exploratory investigation of perceptions of teachers and researchers involved in the design and delivery of e-learning at a distance. It involved an extensive literature analysis and empirical observations based on
interviews with staff at the following universities in the UK: University of Manchester, Open University, Manchester Metropolitan University, University of Liverpool, University of London, and Cranfield University. Selection of teachers and courses was based on preliminary introductions through personal contacts and subsequently through selection of courses from web based course descriptions.

A survey was designed to establish the nature and extent of teaching and learning practices related to development of high-level skills and to elicit views and opinions of participants regarding their efficacy. The survey reported in Iriondo (2008) contained 10 questions covering aspects of policy, design strategies, learning objectives, learning design, teaching practice, learning outcomes and performance.

A total of 26 people from 6 universities were interviewed representing 26 courses. Interviews were conducted in 2007-8. Twenty five interviews were face-to-face and one person was interviewed by telephone. A full description of the results is provided in Iriondo (2008).

In addition the literature on distance e-learning was systematically examined for evidence of good practice and of other empirical studies of issues around the development of high-level skills. The research is exploratory, with predominantly qualitative data processing and the results are provided in a descriptive form. This paper provides an overview of the main outcomes of this research.

2. Discussion of Results of Literature and Empirical Investigations

The idea of using information technologies to deliver education at a distance for people who had no access to traditional institutions of education is as old as the invention of the post in the later part of the nineteenth century. Distance Education aimed to reduce social inequalities, opening new opportunities and returning to students some of the control and authority that traditionally belonged to teachers (Moore, 2003).

Technological conditions are changing rapidly and the development and refinement of new technologies has enabled the reduction of prices of equipment, programs and computer networks. The current speed of transformation causes radical changes in economics, society and culture, requiring the reassessment of the
conditions of human existence. New technologies and new forms of work organization are accompanied by an unprecedented restructure of cultural production process and, consequently, of the roles and capabilities of people. The technology of digital communication in the daily lives of people has attracted the interest of education professionals to harness the potential of these resources in pedagogical work. This challenge has generated numerous projects and products and the most diverse forms of implementation. (Catapan, 2001; Breitner & Hoppe, 2005).

Downes (2004) and Fox (2005) argue that the use of the Internet in education changes the expectation of learners. With the use of the Internet, learning is more a process of navigation through a web of meaning, like a continuous resource that can be used when and where is needed, achieved through interaction and application, not just delivery of information. People learn more effectively by doing, not just by being told, so there is a change towards active learning, and away form didactic exposition or demonstration. Since the motivation for learning is driven by the desire to learn to achieve something, learning can be configured to personal preferences rather than provided as a universal solution.

According to Garrison and Anderson (2003), the traditional approach adopted in higher education, which could be defined as "passive transfer of information", contrasts with the potential of constructive and interactive of e-learning, where students and teachers form part of a community that recognizes the ideas of its members and discussed them in the light of its knowledge, norms and values. E-learning allows users to communicate in both synchronous as asynchronous modes, using various formats, based on text, audio and video or a combination of these elements. But the great advantage of e-learning is its ability to support asynchronous text-based interactions, which enable reflection, independent of pressure of time and the restrictions imposed by distance. The use of e-learning to implement these interactions offers advantages that were not present in other forms of Distance Education. Following the registration in forums, e-mail and instant messages, student-teacher and student-student interactions can be analyzed and measured, providing the opportunity for feedback and evaluation and a new dimension of impacting on learning outcomes. Since communication is paramount in all forms of educational interaction, it is clear that the impact of e-learning in education systems, as well as teachers and students, will be significant through its impact on
2.1. High-level cognitive skills

Skills are complex capacities that require knowledge and involve performance. There are physical skills and cognitive skills. Certain skills are easily identifiable, and others are less easily and therefore should be identified, characterized and assessed by studying the behaviour of individuals (Haladyna, 1997). Cognitive skills are capabilities that make the individual responsible, allowing interaction with the environment. These skills form the basic structure of what might be called cognitive competence of the person, allowing him to discriminate objects, events or stimuli, to identify and classify concepts, raise and build issues, rules and to solve problems. Cognitive skills, termed synonymously as thinking skills (Marzano, 2004; Marzano & Arredondo, 1986) are the set of basic skills that governs people’s high-level mental process. According to Van Lehn (1995), the acquisition of cognitive skills means to develop the ability to solve problems in intellectual tasks, where success is determined more by knowledge and by knowledge processing than by the physical fitness of the individual.

A dominant component in current reforms in education is the effort to train students to develop high-level cognitive skills. This requires changes in teaching-learning processes, encouraging students to acquire analytical, critical and reflective thinking, learning how to make decisions, solve problems, learning to learn independently and to ask questions, combating the notion that every problem has a unique and correct solution (Zoller & Pushkin, 2007).

In this work, we considered some of the high-level cognitive skills most often referenced in the literature, i.e. the skills of reflection, of critical thinking, of autonomous study and of problem solving (Zoller & Pushkin, 2007; Marzano, 2004; Cotton, 1991; Marzano & Arredondo, 1986).

2.1.1. Reflective skill

Reflection is defined by McLoughlin and Luca (2003) as the process that enables connections between various elements of some experience. According to Schön
(1999), learning occurs only when the individual reflects on his personal experience. Corroborating, Socha, Razmov and Davis (2003) comment that one of the most effective tools to facilitate lifelong learning is the ability to reflect and learn from experiences. The discussion helps to clarify the understanding that individuals have of the world and create new possibilities for the future. Kolb (1984) refers to reflection on experience as a "loop" of learning that runs back and forth between the experiences and relationships that are inferred.

Teaching how to develop reflective skill is not an easy task. The reflective process puts most students and some teachers in an uncomfortable situation (Philip, 2006). According to Fleming and Martin (2007), strategies to facilitate the development of skills of reflection significantly improve the results obtained by students in the teaching learning process. Philip (2006) agrees that reflection is a valuable skill to develop quality learning, but comments that the concept of reflection seems difficult to understand, both for students and for some teachers.

e-learning courses provide a benefit that was mentioned by the majority of people interviewed in this study. This is the possibility of asynchronous teacher-student and student-student communication, with the ease of record of all interactions in a "log" of the course, for further evaluation. To record and evaluate students’ shares in face-to-face meetings would be virtually unthinkable, but achieving this in an on-line seminar or discussion forum is perfectly feasible.

Some interviewees commented that learning in face-to-face courses is passive; students hear what the teacher says and then reproduce. It is difficult to find examples of courses that do not include this approach. Students know exactly what to do, and teachers know that there will be no challenges; they only have to distribute the material and be in control of the situation. This is a comfortable situation for both parties because it is an easy way to teach and an easy way to learn. Students seem to get results, but this is not an effective way of learning.

But in e-learning, students must be active in the learning process. This is one of the benefits of e-learning. In online courses a system of learning is imposed which rejects the passive attitude of students and demands participation and interaction with the teacher, with the materials, and with other peers. The way to check the engagement of students in this type of learning is through assessing the concrete contributions in the discussions and in interaction with the environment of learning.
with the teacher and with other peers.

When students work in an online environment they have the opportunity to collaborate with each other as well as sharing tasks and offering support, both in the form of reviews and assessments made by the peers themselves. Additionally, face-to-face courses are distinct in that non-active participation of a student in an e-learning course will not stay unnoticed by the teacher. Through analysis of the “log” of the course, teachers can identify the interactions and contributions of each student and assess the development of high-level cognitive skills.

But the resources offered by e-learning are not always used for the development of cognitive skills in high-level university courses. Our survey showed that e-learning is often used merely as access to a repository of information or to expand the ability to provide resources, but the resources offered by e-learning are not being used properly for the development of high-level cognitive skills.

However, all the interviewees concur in saying that the development of these skills is the basic assumption of what is behind achieving success in the courses they taught.

2.1.2. Critical thinking skill

A person that asks “why?" is looking for a reason behind what he/she is being asked to do or to believe in what is being said. To decide whether or not to believe in what is being said or to act as requested, or to make a decision, the individual should consider the arguments of the other party, using the skills of evaluation and interpretation. Critical thinking enables an individual to decide whether he/she has good reason to believe or to do what other people try to persuade him/her to do or believe (Bowell & Kemp, 2002). The main goal of critical thinking is to determine whether the arguments used by other party are valid or not. Good arguments are those that give good reasons to act or to accept a statement (Hughes & Lavery, 2004).

Garrison and Anderson (2003) consider that the formation of communities of students to investigate and discuss academic issues may be the means to develop in them critical thinking and reflective skills. The purpose of these communities goes
beyond social interaction. The intellectual environment that supports the development and application of high-level cognitive skills facilitates the analysis, construction and confirmation of meaning and understanding within a community of students, using speech and sustained reflection. Rovai (2007) also highlights the importance of communities of students as facilitators of discussions in e-learning.

According to one interviewee, students will not begin to think critically by giving them a one-hour classroom discourse. They need to be engaged in conversations, they need to be engaged in discussions, or joint analysis of questions and texts, or be induced to self-reflection. It is necessary to make students deal with elements that motivate discussion and critical thinking. Reading and discussion of books should be compulsory, with the development of critical thinking as one of the primary goals of this activity.

Other interviewees said that when students are required to think critically, it is important to provide them with feedback about their performance, because people do not become independent thinkers suddenly.

At the first attempt students should be understood as consumers of information, then later understood as researchers. As a result, students should build and should be supported to build positions more and more sophisticated and, in some ways, more and more audacious. Students begin by learning how to read, then learning how to discuss and then learning how to produce. This allows the construction of critical thinking within a learning process that is responsive and complex.

### 2.1.3. Problem solving skill

Problems are characterized when a goal cannot obviously be achieved because of lack of resources, or lack of knowledge or for any other reasons. According to Kahney (1997), actions taken to achieve the objectives outlined are attempts to find solutions to problems. There are different types of problems, depending on their structure or definition. The problems can generally be classified into a scale that ranges from well-structured, moderately structured through a poorly structured. (Newell & Simon, 1972). The position of a problem along this scale determines how the solution can be taught and learned.
Well defined or structured problems are those in which the initial and final state, as well as the allowed operations and restrictions are provided when the problem is presented. Furthermore, ill-defined problems are those where information concerning the number of states, operations or restrictions of the problem are not provided or are incomplete. In such cases, the individual who is trying to solve the problem should resolve the lack of such information.

Many of the interviewees identified the development of the ability to solve problems as one of the objectives of the courses in e-learning mode. E-learning courses can use tools to facilitate the development of the ability to solve problems within the context in which these skills are used. E-learning enables the use of authentic problems, based on scenarios, projects and games. The idea is not to teach how to solve problems as an autonomous skill, decontextualized and abstract, but as part of a real activity. This usually motivates the interest, confidence, persistence, the acquisition of knowledge and reduces the anxiety of students.

Teachers can help students to develop problem solving skills while the problem is addressed. During the solution of the problem they can help students to understand and define the goals to be achieved and, in sequence, help them to target them into intermediate goals. Another approach is to use the errors that students make as evidence of lack of understanding of the problem, being the basis for determining the cause of poor understanding and then correcting it.

E-learning also offers the facility to locate numerous sources of information to characterize and solve problems. Once the context of the problem to be solved is introduced, it is necessary to acquire knowledge to its solution, identifying the components of declarative and procedural knowledge and providing appropriate emphasis on the development of each.

2.1.4. Autonomous study skill

Autonomous study is a purposeful mental process, usually accompanied and supported by behavioural activities involved in finding and identifying information. The student accepts the responsibility of making decisions about the goals and the effort to be done, becoming, therefore, his own change agent for learning. (Long, 1990). Autonomous study is critical, according to Fischer and Scharff (1998), when it
becomes an integral part of people's lives, based on the desire and need to understand something or to perform some activity. But Long (1990) comments that it is not reasonable to expect that people who during all their years of school life have been used to receiving ready-made and formatted information, now will be instantly transformed into independent learners.

Students become autonomous when they make more choices about what and how to learn, accepting the responsibility for decisions regarding the goals and the effort to be made. From that moment, students have more responsibility in the teaching-learning process, the planning and organization of learning, the assessment of learning and even the suggestion or negotiation of results to be obtained of the learning process.

But, according to some of those interviewed, not all students know how to manage their time and their activity. Teachers usually speak with confidence about autonomous study, assume that students can act with autonomy, but this is not always true. It is a mistake to assume that all students are familiar with technology and can study with autonomy. This assumption can leave students on the abandoned, and if they feel they are alone, teachers may lose them forever.

Others believed that students should be encouraged to do things by themselves in order to identify problems, to fill gaps and find the solutions in a collaborative way. There were expressions of optimism that such independent approaches could lead to success, and teachers could be surprised by students' performance.

Several interviewees suggested that, to keep students motivated to autonomous study, it is necessary to explain all the time "what" they are learning, "why" this must be learned and "how" the subject should be studied. Students need also to know what is expected of them to obtain the maximum score on the course (as scores continue to be a motivating factor for students). Another way to motivate autonomous study is by proposing activities for further work to be carried out collaboratively.

Although this may seem a contradiction, the development of autonomous learning skill in e-learning is to encourage or require collaborative activities. Students are encouraged to work and learn independently and at the same time to develop
activities that require the collaboration of other colleagues.

Working collaboratively, students participate actively in the teaching-learning process, which is opposite to a traditional classroom, where students are considered to be empty containers to be filled with information. Another advantage is enhanced by socialization collaborative learning, which allows the creation of a shared identity among students and teachers. This relationship, although may result difficult to be established at the beginning, may last for a long time and is important, especially in heterogeneous groups, such as distance learning courses.

Apparently collaborative learning is more effective than other approaches because students themselves organize, summarize, elaborate, explain and defend the concepts and ideas discussed. Students who do intellectual work, especially the conceptual work are the students who learn more, according to interviewees.

Support for colleagues with the same aim of learning produces synergy between the members of the group. The interviewees commented that, working in a collaborative way, students feel motivated and engaged to participate in an activity.

Work with students in a collaborative environment is a challenge for e-learning, since this is not the way of learning to which students are accustomed. Historically, students worked individually for themselves, and exchange of information or cooperation could be interpreted as cheating. Collaborative work can also be a challenge for students where collaborative activities should be developed by groups of people that have never participated in one face-to-face meeting, just working at a distance, with members of the group that they do not know, and perhaps will never meet personally.

It is necessary to create a climate to facilitate the emotional relationship of students who study at a distance, providing a favourable environment for collaboration. E-learning offers many possibilities for this relationship, such as "blogs", where each participant is presented and records information about themselves, as well as tools of synchronous and asynchronous communication, that are features offered by most e-learning environments to facilitate dialogue and collaboration between participants.
2.2. Advantage and restrictive factors of e-learning for the development of high-level cognitive skills

The interviewees identified several advantages and benefits of e-learning directly related to the development of high-level cognitive skills. The most frequently cited by interviewees were the possibility of developing asynchronous interactions, ease of tracking students' performance, the possibility of designing more sophisticated study material and learning activities, the development of autonomous study skills and collaborative activities and developing reflection and critical thinking.

When interviewees were asked about the restrictive factors of e-learning for the development of high-level cognitive skills, the most frequently cited restrictions were: first, technical problems, both in the Virtual Learning Environment and in students' computers that made it difficult to keep students motivated, secondly, difficulty in planning the courses and in the development and maintenance of learning material that addressed the development of high-level cognitive skills, thirdly, the need of better teachers training to learn how to develop those skills in students, fourthly, the diversity of information available on the network, fifthly, the lack of autonomous study skills in students and the difficulty students had in participating in collaborative activities and to studying in virtual environments for learning.

It is important that the objectives of the course are present and explicit in the material, in academic activities and assessments. It must be made clear to students what is the alignment of the material, activities and assessments with the goals of the course. The interviewees agree that it is a challenge to design this kind of materials and activities for students to ensure they develop high-level cognitive skills.

When asked about e-learning academic activities that facilitate the development of these skills, the interviewees provided several examples. Activities that incorporate asynchronous interactions were cited most frequently by the interviewees. Apparently this is the feature of e-learning that offers more benefits to the development of high-level cognitive skills.

The activities must be motivating and interesting for students, incorporating within them some kind of self-assessment so that students can see for themselves their engagement in the activity. The activities should be challenging.
The development of high-level cognitive skills in e-learning can be facilitated with activities where students have to "describe", "recognize", "select among a few", and use previously acquired knowledge. Another interesting task to develop the skills of analysis and synthesis is to propose activities where students have to look in a certain critical field, and "discuss", "compare and contrast", identify which are the key points, and express their own opinions on the method used to develop the proposed activity.

There seems to be consensus among interviewees that, allowing the students to express and justify their ideas in blogs, forums, or in any other form of asynchronous communication, make that those ideas and concepts remain with them for much longer. Such activities, as well as discussions with teachers and their peers apparently give better results in the development of high-level cognitive skills.

E-learning offers the advantage of tracking all the activities of students and this is considered a particular advantage in the assessment process, but all the interviewees have the same opinion about the difficulty of assessing the development of high-level cognitive skills. None of them shows a single evaluation method that allows making sure that high-level skills were developed by the students. Apparently, the interviewees are unanimous about the need for a combination of both formative and summative assessments during the learning process to get an overview about the development of those skills. Some interviewees believe that assessments made by peers, or student-student, are also important in e-learning.

3. CONCLUSION

Based on the literature review and on the analysis of interviews with practitioners, some suggestions can be made about how to facilitate the development of high-level cognitive skills in higher education courses delivered by e-learning.

Subjects should also combine exercises of categorization and extrapolation, in order to learn to deal with new information and new relationships. To achieve this objective, materials and activities should encourage students to classify objects or ideas as belonging to a group, and then extrapolate information from one group or area to another. High-level cognitive skills development is easier when students are
encouraged to solve problems by using prior knowledge, facts, techniques and rules, in a different way, triggering the creation of new information to express an idea.

Materials and activities should encourage students to develop, integrate and evaluate knowledge in new ways, adding value to an object, phenomenon or information, developing ideas and taking positions, and also explaining and defending their positions before others. They should also encourage students to combine different values, information and ideas, and put them in a scheme, comparing, relating and creating what has been learned, promoting the demonstration of understanding of facts and ideas. It is important to motivate students to organize, compare, transform and interpret information and ideas and to provide descriptions and ideas if the development of high level cognitive skills is to be promoted.

It is also suggested that learning should include activities to develop analogies, promoting the logic validation of information; encouraging students to infer information not merely acquire explicit information, so promoting the process of finding information and the development of strategies to avoid obstacles and achieve goals. To achieve this, it is suggested that asynchronous interactions are used and group activities are developed, in which students can work collaboratively, and in which students are stimulated to read, reflect and undertake self-evaluation.

The research highlighted that the development of high-level cognitive skills is assumed in all courses offered by the interviewees; however it is not always part of the specific objectives of or design of these courses. The advantage offered by e-learning of tracking students’ activities is considered a particular advantage in the assessment process, but assessing the development of high-level cognitive skills in e-learning still seems to be very difficult.

4. ACKNOWLEDGEMENT

It is a pleasure to thank the many people who made this research possible. We are grateful to CAPES for funding this research and to The University of Manchester for hosting one of the researchers while he was in UK. We would like to thank the twenty six interviewees that took part of the empirical investigation. The support from
Federal University of Santa Catarina (Brazil) is greatly appreciated.

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