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TECHNOLOGIES FOR SELF-REGULATED LEARNING

INTRODUCTION

Over the last three decades as Western societies have turned into knowledge societies, self-regulated learning (SRL) has come to be an important topic in educational research. In such societies learning not only takes place in traditional educational institutions, but in the form of lifelong learning far beyond these institutions. In education, the focus is therefore shifting from teaching to learning. This places more responsibility on the individual learner; learners' strategies for self-regulating their learning are therefore becoming more important.

At the same time, technological innovations have made it possible to design powerful technology enhanced learning environments (TELEs) many of which have a potential to foster SRL.

In this contribution, we consider the relationship between these new educational technologies and SRL. In section 1, we shortly reflect on educational technology and its relation to theories of learning and to SRL. In section 2, we present three characteristics which we think any TELE that is to foster SRL should have. In section 3, we investigate whether technologies which are used in TELEs do in fact exhibit these characteristics. In section 4, we introduce connectivism, a new idea on learning in a networked world which stresses the importance of SRL in communities of learners. In section 5, we will present our conclusions including a brief reference to generativism, a learning theory that relates the co-creation and re-creation of new knowledge to human meaning making [1].

TECHNOLOGY AND EDUCATION

Educational technology and learning theories

Theories of learning have been developed under three different paradigms: the behaviourist, the cognitive and the constructivist paradigm. While under the behaviourist paradigm, learning was defined as a change of behaviour due to

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external stimuli, the cognitivist paradigm essentially argued that the "black box" of the mind should be opened and understood. The model of the learner was not of a recipient of knowledge but an information processor. Constructivist while agreeing that learning is related to knowledge about the world stress the fact that this knowledge is constructed by the individual in a social context.

Each of these learning theories has been used to underpin the instructional approach and design of learning software. However, there is one instructional approach, we argue, that is particularly suited for the design of TELEs which have the potential of fostering self-regulated learning: cognitive apprenticeship (Collins, Brown & Newman, 1989). Cognitive apprenticeship was based on the concept of situated cognition which was introduced by Collins and his colleagues (Brown, Collins & Duguid, 1989a). Collins et al. argue that knowledge is always acquired in specific situations; this makes it possible to apply the acquired knowledge in these and similar situations. He believes that schools largely provide their students with abstract knowledge, thereby rendering it inert; inert knowledge may be recalled in examinations but cannot be applied.

According to the cognitive apprenticeship model, an expert serves as a model for the learner in the first phase (modelling). In the second phase, the learner engages in the relevant activities under the supervision of the expert (coaching). In the third phase, the expert gradually withdraws, giving more and more freedom to the learner (fading). Technology enhanced learning environments which are based on the concepts of situated cognition and cognitive apprenticeship were developed by Bransford and the Cognitive Technology Group at Vanderbilt University (anchored instruction, CTGV, 1990, 1997) and by Spiro (cognitive flexibility theory, random access instruction, Spiro et al., 1991).

Educational technology and self-regulated learning

Research on SRL was greatly influenced by the works of Zimmerman and Schunk (Schunk & Zimmerman, 1994; 1998, 2008; Zimmerman & Schunk, 1998, 2008). According to Zimmerman, self-regulation is achieved in cycles consisting of (1) forethought, (2) performance or volitional control, and (3) self-reflection (Zimmerman, 1998, 2000). For a more elaborated presentation of this concept and related ones, see the chapter by Beishuizen and Steffens (Beishuizen and Steffens, in this book).

Zimmerman (Zimmerman & Kitsantas, 2005; Zimmerman & Tsikalas, 2005) also presented a social cognitive multilevel model of self-regulatory development. He assumes that at the first level, an expert model is of great importance (observational level). At the succeeding levels (emulation, self-controlled, self-regulated level) learners become increasingly independent of the expert model, improving their self-regulatory skills at each level. The model very much resembles the cognitive apprenticeship model developed by Collins and his colleagues (Collins, Brown & Newman, 1989) described above. Both models assume that there is an expert in the first stage whose behaviour is to be modelled. In consequent stages, the expert gradually withdraws, giving the learner more and more autonomy.

Technological developments have made it possible to design technology enhanced learning environments which have a rich potential for fostering self-regulated learning, and there is some empirical evidence that they actually do so (Carneiro et al., 2005; Steffens, 2006; Beishuizen et al., 2007). More evidence will be presented and discussed in the remaining chapters of this book.

TECHNOLOGIES FOR SELF-REGULATED LEARNING

Characteristics which a TELE that supports SRL should have

On the basis of the analysis of the relevant literature (e.g. Lepper et at., 1993; Schunk & Zimmerman, 1994; 1998; Zimmerman & Schunk, 1998; Zimmerman & Tsikalas, 2005; Carneiro et al., 2005; Steffens, 2006; Beishuizen et al., 2007; Winters et al., 2008) we identified three criteria which a TELE should meet in order to be capable of supporting SRL. We will first present these criteria and then have a look at some specific technologies to see to what extent they meet these criteria.

(A) Learners should be encouraged to plan their learning activities

Students' skills to plan their learning activities refer to the actual planning of these activities as well as to their time management. They should be encouraged to develop the following skills:

– Planning skills: skills to select between different types of activities, distinguishing between different channels of communication (e.g. written text, spoken communication, multimedia presentation) as well as between different forms of interaction (e.g. documents, tutorials, programs for self-learning, simulations);
– Time management skills: skill to choose the point in time when to actually carry out the activity and the amount of time to dedicate to its execution.

These decisions may be taken according to options given to students by the learning environment or they may be completely open. The extent to which a technology will foster these skills will depend on its capacity to present information in different modes and on its options for interaction.

(B) Learners should receive appropriate feedback so they can monitor their learning

The fact that technology should support students to develop planning skills does not mean that they should be left on their own. It is important that students receive some kind of feedback from the respective learning environments with respect to the activities they are carrying out. This feedback should enable students to draw appropriate conclusions as to the progress of their own learning.

Provision for feedback refers particularly to the communication mechanisms between students and their teachers and peers or the learning environment as a whole. In order for the teacher or the learning environment to provide appropriate feedback, the technology in question should have the capacity to record students' activities.

(C) Learners should be given criteria so they can evaluate their own learning outcomes

After having carried out their activities, students will have achieved specific outcomes. Students should be able to evaluate these outcomes and draw conclusions that will guide future activities. In order to be able to do this, students need to have or to be given some criteria with respect to their original goals or with respect to the competencies they set out to acquire.

Providing criteria requires the existence of an evaluation space which is based on recordings of results, information on criteria and means of communication. Peer participation will be of particular importance.

TECHNOLOGIES AND CRITERIA FOR SRL: DO THEY MATCH?

In the following paragraphs, we will discuss to which extent different technologies meet the aforementioned criteria.

(1) ePortfolios

There exist different kinds of digital portfolios but a characteristic which they all share is the capacity to register and save students' activities and products and the teachers' feedback (B). They do not explicitly foster self-regulated learning (A). Since eportfolios do have an evaluative character, they should help students to evaluate their learning outcomes themselves (C), but not all of the existing models provide for an explicit self-evaluation.

(2) Blogs

Blogs are used in different ways by both teachers and learners. If teachers use blogs to organise their classes to which students may add their comments, this kind of usage hardly meets the three criteria established in the preceding section. However, if blogs are used as personal diaries, they acquire many of the characteristics of eportfolios. In that case, criterion B would be the most important one: recording of activities and of feedback by teachers or peers. With respect to criterion A, blogs may give a greater flexibility to students; blogs may help students to look for resources to support their learning. In this sense, this way of using blogs may foster SRL to a greater degree than most of the eportfolios. This is not true with respect to evaluation (C); blogs do in general not include any options for providing students with criteria for evaluating their own learning.

(3) Office online, Wikis

To create documents in collaboration with others online does not seem to relate to criteria A and C. However, with respect to criterion B, it has to be said that these environments do provide for feedback mechanisms with respect to the work of individual students, either by modifying or correcting their work or by adding comments. It is important that this may be done by different users in real time.

Wikis are somewhat similar in this respect. In both cases, there exist interesting tool which may provide relevant information: the system's history will record the group's interaction and its progress over time.

(4) Virtual environments

Virtual environments contain many tools which in general include resources that will meet criteria A, B and C. This does not mean, however, that these resources will automatically be used to foster SRL. In the European TELEERS project, different technology enhanced learning environments were studied with respect to their potential to foster SRL (see http://www.lmi.ub.es/telepeers/). Instruments to evaluate this potential were developed in the course of the project and can be downloaded from the TACONET web site (http://www.lmi.ub.es/taconet/).

(5) Personal Learning Environments (PLE)

Personal Learning Environments (PLE) have been defined as "consisting of snips, bits and pieces, collections of tools and services which are bundled to individual and/or shared landscapes of knowledge, experiences and contacts" (Ehlers & Carneiro, 2008). This is the first time that individualization of training and learning has actually been achieved. Each student builds his/her own working space, connected with the resources offered from educational institutions, web services and his/her own social network.

PLEs directly relate to criteria A, B, and C. Aviram et al. (2008) suggested the name "Self-Regulated Personalized Learning" (SRPL) to refer to the kind of learning afforded in these kinds of TELEs. The whole conception of PLE is oriented towards SRL: Students have to define their own learning goals, assemble the required resources and organize them in a personal web environment. It is the role of the teacher to guide and coach students and provide criteria for self-evaluation.

(6) Web 2.0

A number of the above tools can also be considered to be resources of Web 2.0. Does this mean that Web 2.0 tools support SRL? This question is by no means trivial. Some characteristics of Web 2.0 seem to meet the three criteria established above; these are collective intelligence, administration of information and social authorship. In many cases, however, these resources are used in educational

programmes where they are adapted to the old learning models thereby eliminating the characteristics related to the criteria we established above.

Recently the British Educational Communications and Technology Agency (BECTA) published its report on Web 2.0 technologies for learning at KS3 and KS4 (11-14 and 14-16 year old students) (BECTA, 2008). In its conclusion, the educational potential of Web 2.0 was acknowledged across the curriculum in many different subject domains. The report also concludes, however, that good practices are only slowly arriving in schools.

Some of the difficulties that BECTA encountered in implementing Web 2.0 in schools were the following:

– filters for different content,
– insufficient band width,
– lack of access to computers in schools as well as at home.

Also, some pedagogical problems are mentioned:

– students do not really create pieces of work on their own;
– in many cases they just "copy and paste";
– student evaluation is not formative nor does it involve several technologies;
– only the teacher and the text book seem to be endowed with authority.

The focal points of Web 2.0 seem to challenge old teaching and learning structures; they are replacing these with open learning environments and open evaluation procedures, with learning achievements based on several media, learning achievements which are creative and which are evaluated in the context of new structures of authority and ownership. These circumstances have given rise to new ideas on technology enhanced learning.

CONNECTIVISM AND SRL

As the Internet has become central to all our lives a new learning paradigm has emerged. In 2005, George Siemens published an article titled “Connectivism: A learning theory for the digital age” (Siemens, 2005). He argued that today we live in a networked world where traditional theories of learning have only limited explanatory power and where the kind of instruction which is still delivered in our schools does not prepare our children to cope with the challenges of the digital age. Therefore, an entirely new approach to learning is needed which is capable of describing learning that is taking place in networks and which redefines the role of educators in a world increasingly defined by network structures (Siemens, 2008).

According to Siemens, “Connectivism is the integration of principles explored by chaos, network, and complexity and self-organisation theories. Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organisation or a database), is focused on connecting specialised information sets, and the connections that enable us to learn are more important than our current state of knowing” (Siemens, 2005, p.5).

Under the connectionist paradigm, learning occurs when individuals who are part of a specific community access knowledge that is available in the community and also feed knowledge into that community. A prototypical example would be a

group of people who share a specific set of interests and who interact with each other and with specific resources through the Internet. Learning then refers to processes of knowledge acquisition at the individual as well as at the community level.

To assess the increased number resources that may be connected, one should have a look at an audiovisual document (networked students) which is based on a class on connectivism which was offered by George Siemens and Stephen Downes in the fall of 2008[2]. Some of the resources that are cited in the video are search engines (Google scholar), shared bookmarks (delicious), blogs and RSS pages (Google Reader), podcasts (iTunes), video conferencing (Skype), wikis (Wikispaces, pgwiki), social networks (facebook, Xing) and many others. These resources may be classified into several groups according to their usage: administration of knowledge, access to information, communication, establishment and maintenance of social networks.

The connectionist point of view also implies a new understanding of knowledge (Downes, 2005; Siemens, 2005). Siemens (2005) states that connected knowledge is emergent and adaptive. Or, as Downes (2007) puts it: "Knowledge is, on this theory, *literally* the set of connections formed by actions and experience. It may consist in part of linguistic structures, but it is not essentially based in linguistic structures … Hence, in connectivism, there is no real concept of transferring knowledge, making knowledge, or building knowledge. Rather, the activities we undertake when we conduct practices in order to learn are more like growing or developing ourselves and our society in certain (connected) ways" (Downes, 2007).

As for the changing role of teachers in a networked world, Siemens (2008) suggests a number of metaphors which in his opinion capture this new role:

- The teacher as a master artist (Brown, 2006) who collaborates with a group of art students thereby introducing them to the culture of artists.
- The teacher as a network administrator (Fisher, n.d.) who helps his students to form connections and create learning networks.
- The teacher as a concierge (Bonk, 2007) who supports his students in finding resources and learning opportunities.
- The teacher as a curator (Siemens, 2007) who as an expert constitutes a source of knowledge in a specific domain and who also serves as a guide who fosters and encourages learner exploration.

Independent of the status we assign to Siemens' ideas, it seems to us that his theoretical approach as well as the examples he cites to characterise the role of the teacher in a networked world both are based on the belief that learners should be given more autonomy in their learning. We ourselves believe that connectivism constitutes a point of view which encourages the development of SRL competences.

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[2] http://www.youtube.com/watch?v=XwM4ieFOotA

Let us examine the three criteria which digital tools need to meet in order to support SRL:

(A) Learners should be encouraged to plan their learning activities.
(B) Learners should receive appropriate feedback so they can monitor their learning.
(C) Learners should be given criteria so they can evaluate their own learning outcomes.

If we look at how digital tools are used from a connectivist point of view, or more specifically, how these tools are used in communities of learners which can be described in terms of connectivism, we find that in general, the ensemble of these tools meets the criteria listed above. Social networks constitute the base for self-monitoring of learning. In an educational context, the teacher's role is to provide criteria which students can use to evaluate their learning outcomes. As for the first point, it is the students who design and construct their own network.

From the point of view of connectivism, we do not look at each resource separately to see if it has a potential to foster SRL; instead, we aim at initiating communities of learners which we provide with a number of web-bases resources (mainly those of Web 2.0 or 3.0) to help them create a network in which SRL can develop.

CONCLUSION

Developments in educational technology and in educational theory and practice are not independent of each other, nor have they ever been. Paradigm shifts in the field of learning theory have facilitated the development of new educational technologies and even new ways of using existing technologies. On the other hand, technological innovations have favoured new uses of technology in education. The creation of TELEs to support self-regulated learning has been facilitated by new approaches in instructional design as well as by new developments in educational technology.

From the literature on self-regulated learning, we extracted three characteristics which we think any TELE that is to support self-regulated learning should exhibit, and we looked at a number of educational technologies to see whether they meet these criteria. By and large and on a very general level, this seems to be the case.

We are under the impression that educational technologies which were designed from a constructivist point of view are particularly apt to promote self-regulated learning. This is why we put some emphasis on the model of cognitive apprenticeship as a base for instructional design, and, as we pointed out, TELEs were indeed designed which made specific reference to the cognitive apprenticeship model.

We also see some resemblance between the cognitive apprenticeship model and Siemens' ideas on connectivism. This seems to be particularly evident when we look at the metaphors he presents for teachers in today's networked world. Brown's metaphor of the teacher as a master artist is directly derived from the cognitive apprenticeship model; in fact, Brown was one of the developers of the cognitive apprenticeship model. However, the cognitive apprenticeship model

depicts the changing relationship between an expert and one learner, while in Siemens' model, the expert and a group of learners constitute a community.

There are also differences between the two models: the cognitive apprenticeship model is explicitly stated as an instructional model while Siemens' connectivist model is a purely descriptive model. And while the cognitive apprenticeship model as an instructional model aims at changing the relationship between expert and learner, making the learner more autonomous, this change is not explicitly considered in Siemens' model. Nonetheless, due to its close relationship with the cognitive apprenticeship model, it comes at no surprise that the connectivist model also places great emphasis on the autonomy of learners and on their capacity to self-regulate their learning.

As for the theoretical status of Siemens' ideas, we doubt – like others (e.g. Kop & Hill, 2008) – that they constitute a theory of learning. They are, however, a good starting point for developing new perspectives on technology enhanced learning which is taking place in a networked world.

One of the most recent perspectives on learning in a networked world was proposed by Carneiro (2010a,b). Carneiro argues that the availability of Open Educational Resources OER) so far has not facilitated the implementation of Open Educational Practices (OEP) on a large scale. In his opinion, the traditional learning theories do not lend themselves to a theoretical underpinning of OEP, but neither do Siemens' ideas on connectivism. Carneiro argues that Siemens' ideas still focus too much on individual learning. What is required, according to Carneiro, are new sets of competences and different ways of enhancing social learning. He himself proposes a point of view which he calls "Generativism" and which might be – after behaviourism, cognitivism, constructivism and connectivism – considered to be a fifth approach to the theory of learning. The basic idea is that learning does not or should not mainly consist of acquiring existing knowledge, but of creating or generating new knowledge. "Generativism lies in the intersection between innovative learning and learning for innovation and addresses the foundations of a creative society. … Generativism understood as a constant co-creation and re-creation of knowledge appeals to the unique human ability to derive new meaning from experience and to build sense out of a shared body of conventional knowledge" (Carneiro, 2010b, p. 19).

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