Interaction Design and Architecture(s) Journal - IxD&A, N. 7-8, 2009, pp. 30-34

Self-regulated and Informal Learning: understanding How New Digital Contexts Support Autonomous Learning Processes

Verónica Donoso
Centre for Usability Research (CUO)
IBBT / K.U.Leuven
Leuven, Belgium
+32 16 32 04 80
veronica.donoso@soc.kuleuven.be

Licia Calvi
Centre for Usability Research (CUO)
IBBT / K.U.Leuven
Leuven, Belgium
+32 16 32 04 80
licia.calvi@soc.kuleuven.be

ABSTRACT

The aim of this paper is to reflect on the new challenges associated to online digital content creation and use and its impact on learning based on some of the findings of the ongoing eContentplus European project KeyToNature. This three-year project aims at developing interactive e-tools for learning and teaching biodiversity providing common access to data and interactive educational tools for the identification of organisms tailored to the needs of different educational users. A theoretical approach based on self-regulated and informal learning will be the basis upon which our findings will be framed.

Categories and Subject Descriptors

J.1 [**Administrative data processing**]: Education

General Terms

Design, Theory.

Keywords

Learning contexts, learning processes, e-learning tools, biodiversity.

1. INTRODUCTION

Until now, the teaching of biodiversity has mainly been reduced to species identification based on paper-printed tools which have shown to have several educational drawbacks [11]. By creating e-tools, KeyToNature seeks to achieve a pan-European approach to teaching biodiversity, focused not only on current learners' needs, but also on existing biodiversity knowledge which provides the basis for the re-engineering of digitalised content and of diverse identification tools.

Studying the impact of digital content on learning requires exploring less traditional and less studied contexts where there is a lack of consistent theoretical and methodological frameworks. In this paper we will, therefore, apply a methodological framework that will allow us to reflect on the didactic impact of the digital tools developed within the framework of the KeyToNature project. By combining some of the most important principles of self-regulated learning and informal learning [4], we will reflect on the impact of new digital tools, their contexts of use and their implications for learning. We claim that new digital tools constitute not only powerful learning instruments, but also an important means to support more autonomous learning processes by providing more opportunities for learners' control and initiative both in terms of information access and learning styles.

In the last section of our paper, we will reflect on the need for a broader definition of learning that better accounts for the intricate nature of learning in times of complex technological and social contexts.

2. THE KeyToNature PROJECT

KeyToNature (K2N)[1] is a 3-year project funded by the European Commission under the eContentplus Programme. The KeyToNature consortium is a public-private partnership combining scientific, education, business and information technology expertise in order to develop solutions which support the teaching and learning of biodiversity. The main objectives of the project can be summarised as follows [11]:

- Increase the access and simplify the use of e-learning modules and tools to identify biodiversity.
- Address the issue of the interoperability of digital content.
- Optimize the pedagogic efficacy and the quality of biodiversity educational content.
- Give more value to the existing educational content by means of multilingual and easy-to-access content.
- Suggest best practices to avoid the barriers associated to the use, production, discovery and acquisition of interactive systems on bio-organism identification.

2.1 Re-engineering content and simplifying use: What we do at KeyToNature

The majority of KeyToNature tools are based on the contents (primary[2] and secondary [3] data) that are stored in different

---

[1] Key to Nature – interactive e-tools for learning and teaching biodiversity. URL: http://www.keytonature.eu/wiki/Main_Page.

[2] Primary data are the essential features ("characters") associated with organisms such as "flower colour". These data are used for the construction of identification tools.

[3] Secondary data are data which have a single and clear link to a specific organism (taxon name), e.g. pictures, drawings, distributional maps, sounds, textual descriptions, etc.

databases such as FRIDA or LINNAEUS. These databases are not identification tools, but software to produce them. From the KeyToNature perspective, an identification tool is "a tool which helps a given type of user to identify a given set of species using a given type of media in a given language" ([9], p.46). Such a customization (i.e., particular species in a particular context) concerns, in the first place, the content to be presented to potential users and only in a second instance the modalities to present such content on the basis of the used platform, the users' preferences or the target users' cognitive styles. In this way, the material to present is selected depending on the learning needs of both teachers and learners. An example of this kind of personalization consists in the possibility to produce tailored keys to identify plants that grow in the school garden instead of using species that children may only encounter in books or via the Internet, but certainly not in their everyday lives.

In doing so, KeyToNature offers its users an integrated and user-friendly access to a unified and complex set of biodiversity data and repositories which would otherwise be fragmented and difficult to access by non-expert users) through the development of the so-called keys. Such keys are automatically generated by an information system on the basis of species lists that are inserted a priori in the system itself. Once generated, they are presented to users via various media such as paper-based form, interactive web-based systems, CD-ROMs or cell phones. One important aspect of our project is educational content re-engineering, that is, the unification of biodiversity resources coming from various data sources in order to build high quality e-learning tools. By means of the reengineering of existing educational e-content into new e-learning products, we also attempt to make biodiversity teaching and learning more user-friendly [12]. In order to accomplish this objective, KeyToNature has developed three reengineering e-content show cases. These showcases will allow us to discover in a practical way what technical, administrative, didactic and market issues are involved in the reengineering of e-content from different resources, of different qualities and structures and for different regions [12]. The three show cases are:

1. *European birds: Reengineering and reapplying identification data*. Within this showcase, "the identification data (stored in Linnaeus II system) will be 'atomized' to prepare for re-engineering in customizable keys that can be targeted to different user groups or regions" ([12], p. 6).
2. *Merging flora keys: Integration of primary and secondary data from different sources.* By integrating, merging and recombining primary and secondary data from different sources, namely the UNITS Flora of Italy (comprising 5,000 plants with short descriptions and photographs of identification characters) and the Interactive FLORA from the National Herbarium of The Netherlands (encompassing some 2,000 species with full descriptions and habits illustrations), a new and enriched e-product is created. The merger of these two data sources results in an improved identification system from The Netherlands and an increased image content for the Italian flora [12].
3. *Combining bird, butterfly and flora keys of different sources in an e-learning environment.* In this showcase, an e-learning product is developed using data from different KeyToNature partners so that, on the one hand, the flora data from Italy can be re-used to generate a plant key for Bulgaria while, on the other hand, the data on European birds and butterflies can be re-atomized to develop a fauna key for Bulgaria. Flora and fauna are, thus, combined in one re-engineered identification product: the flora and fauna of Bulgaria, which will be embedded in the ILIAS e-learning platform, GLABS eXact e-learning software, and in Moodle, another popular e-learning Content Management System.

These three showcases are intended to examine the re-use of content, technology, fitness of use to users, and potential markets. The cases will be tested and improved or adapted later on in the project. An initial blueprint for a data infrastructure to improve (re)use of identification data for e-learning has already been produced [12]. This will be used as a technical and organizational guideline [12].

2.2 The educational impact of KeyToNature

Even though technical aspects such as the re-engineering of content are extremely important for KeyToNature, school involvement is at the centre of the project. All the products and solutions developed within our project (e- and m-learning solutions to identify and learn about biodiversity) are targeted at local needs and contexts and are appropriate for different levels of knowledge and different types of users because they are not tied to rigid systematic[4].

The didactic efficacy of the keys is being evaluated by means of an appropriate questionnaire which relies not just on the didactic efficacy of the keys in terms of acquired knowledge (post-learning), but also on their presentation and organization modality (the SUS questionnaire [1], a quick and dirty method to evaluate the usability of a given system). The network of digital didactic and distributed repositories on biodiversity that this project will build at European level will rely on international standards so as to ensure that already existing content becomes more easily accessible, usable and indeed, that it will be used within formal educational systems.

3. CONCEPTUAL FRAMEWORK

Today's children constitute the first generation to live in an information and communication technology-rich environment. Many children have access to computers and the Internet both at home and at school. Moreover, since the introduction of computers in schools in the early 1980's, it was believed that the quality and the outcomes of student learning would improve significantly. Nevertheless, there still is lot of controversy regarding whether or not there are real benefits to be gained from employing new ICTs (Information and communication technologies) to deliver instruction. On the one hand, authors such as De Corte, Verschaffel and Lowyck [5] state that the mere adding of computer use in schools does not produce significant changes in the nature of school learning, unless embedded in powerful teaching/learning contexts, i.e., "instructional settings that elicit from students the acquisition processes necessary to

[4] Biological systematic is the study of the diversity of life on the planet Earth and the relationships among living things through time (definition from [13]).

attain worthwhile and desirable educational objectives" ([5], p. 699). On the other hand, Erstad [6] suggests that new digital artefacts such as computers may support students' empowerment during their learning process. As a matter of fact, because access to new technologies and tools such as the World Wide Web (WWW) has increased dramatically and also because digital tools have become cheaper and more user-friendly, Erstad [6] claims that these tools may open up many possibilities above and beyond the textbook or the teacher.

At the same time, however, the availability of so much information prompts a debate about students' ability to evaluate different sources critically as children find it difficult to use on-line information resources [7]. But new digital tools not only provide new opportunities (and also some obstacles) for information access, they also constitute new communication tools which give students the possibility to become their own knowledge producers, not only consumers. Broader communication possibilities together with the development of new technological platforms like Learning Managing Systems (LMS) may give new opportunities for students' and teachers' collaboration. Erstad [6] affirms that all these features of new technologies can be implemented in learning environments in different ways and that, therefore, it is important to study specifically how young people act when new technological contexts such as the Internet are introduced into their educational contexts. Answering questions such as the following is therefore crucial: Are children turning away from traditional sources of knowledge, with new literacies being developed through interactive play and the many other applications that the Internet and other new technologies offer? Is the home really becoming an informal learning environment, and how does this interface with school?

3.1 Self-regulated learning

In recent years, the concept of self-regulated learning has been heavily researched. Zimmerman and Schunk [15] define self-regulated learning as self-generated thoughts, feelings, and actions, which are systematically oriented toward attainment of students' own goals. Boekaerts [2] recognizes three key aspects in self-regulated learning, namely, cognitive, meta-cognitive, and motivational/affective. Cognitively speaking, one important issue in self-regulated learning is the students' ability to select, combine, and coordinate strategies in an effective way. In relation to the meta-cognitive aspect, students should be able to direct their own learning. In this respect, Zimmerman [14] points to evidence that students who are taught meta-cognitive strategies can achieve improved learning outcomes. Finally, the motivational and affective features of self-regulated learning are expressed through the students' involvement in and commitment to self-chosen goals. Students, on their turn, rarely pursue single goals and indeed, they usually tend to pursue multiple goals which are part of their complex goal structure.

Until now, most research on self-regulated learning has focused on its cognitive and meta-cognitive aspects without paying much attention to its motivational and affective features (Boekaerts, 1999). However, as Boekaerts points out, these aspects are particularly relevant because students who do not identify with the goals and values of a specific learning context, i.e., students who are not motivated by that context, will face more difficulties in developing successful learning episodes than the ones who are motivated by them. Furthermore, motivational and affective factors, such as students' ability to define ongoing and upcoming activities based on their own wishes, needs, and expectations, also play an important role in effort allocation, involvement, and commitment, and therefore, will also have an impact on students' learning outcomes [3]. On the basis of the current research literature, it seems reasonable to conclude that in order to develop a comprehensive model of self-regulated learning, an integration of cognitive, meta-cognitive and motivational-affective frames of reference is necessary. In this respect, Boekaerts [2] argues that this conceptual map is necessary to understand the potential as well as the limitations of learning environments and to identify those self-regulatory skills that students need to acquire at a particular moment in their development. Finally, learning and achievement goals cannot be understood when isolated from salient socio-emotional goals and from motivation processes that guide the pursuit of personal goals. If we want to describe and explain students' self-regulatory processes, we need to construct a comprehensive theory that incorporates self-regulation of both academic and socio-emotional goals. Studying the impact of the digital-based tools from the perspective of self-regulated learning provides a useful framework to explore the learning processes developed by youngsters as they perform digital-based activities. By saying this, we do not imply that every single activity performed by means of digital tools is conducive to learning. However, we cannot deny the potential of these tools to support learning processes. Consequently, it is relevant to explore the ways in which the interaction of children and young people with these artefacts may contribute to the generation of significant learning episodes.

3.2 Informal learning contexts

Boekaerts and Minnaert [4] define informal learning as an active, voluntary, self-discovering, self-determined, non-threatening, enjoyable, and explorative process. According to them, most informal learning is embedded in a social context where social cues are highly relevant and where students engage in co-operative learning activities. These socially situated learning activities are loosely structured, learner directed, and mediated by peers who often share the same values, attitudes, interests, and beliefs. Furthermore, informal learning situations employ realistic objects, materials or settings that are highly contextualised.

In an informal learning context, time-allocation is unhurried in nature, self-paced, and with relatively few time constraints. Besides, the learning experience is more qualitative than quantitative, and is more process-oriented than product-oriented. Finally, there is no compulsory, individual testing or assessment procedure, but rather a collective, informal type of assessment based on feedback. In summary, informal learning settings help to produce a natural form of learning that gives students the impression that they learn spontaneously and without much conscious effort.

The importance of studying informal learning lies in the fact that students' appraisal of a specific learning environment affects not only the value they attach to learning goals but also the quality of the learning process [2]. In this sense, self-regulatory skills are essential for the appraisal of non-traditional learning environments as powerful facilitators of learning and for the use of resources, such as digital tools and the Internet, that are also available in out-of-school environments.

4. HOW DIGITAL TOOLS SUPPORT SELF-REGULATED AND INFORMAL LEARNING

4.1 Digital tools and the development of self-regulated learning

As previously mentioned, one of the most important characteristics of the tools developed within the KeyToNature framework is that they can be optimized to the target users so that they can differ both in terms of the hierarchies of characters as well as in the terminology employed [11]. In terms of self-regulated learning, this characteristic is relevant because by providing this flexibility, learners have the possibility to bring about self-generated thoughts, and actions which may be conductive towards the attainment of students' own goals.

Moreover, as self-regulation is intricately linked to an individual's goal structure where personal choice and control are relevant for the generation of effective learning processes, then the flexibility allowed by KeyToNature tools can help to foster such aim.

Self-regulated learning is characterised by the individuals' striving to obtain, retain, foster, and protect the goals they value. Consequently, the availability of tools provided by KeyToNature and which can be tailored to users' needs and motivations can be a helpful mechanism to support learners' accomplishments of their personal learning objectives.

Also important in self-regulated learning is the taking into consideration of the local conditions. By offering the possibility to tailor the digital identification keys according to the local contexts such as the school garden, and also by the incorporation of new technologies that allow the mobility of such tools, KeyToNature also takes into consideration learners' real lives contexts by adapting the tools according to their specific learning environments.

The cognitive, meta-cognitive, motivational and affective characters of self-regulated learning are also relevant. On the one hand, fostering students' ability to select, combine, and coordinate strategies in an effective way is realised by allowing students to identify species by means of tools that give them enough freedom to perform these actions on their own, at their own pace, learning by trial and error. On the other hand, by doing this, students indirectly also develop the meta-cognitive aspect of self-regulated learning, i.e., they can direct their own learning even if supervised by their teachers. This feature is important because, as previously mentioned; evidence shows that students who develop meta-cognitive strategies can improve their learning outcomes.

The motivational and affective features of self-regulated learning are expressed through the students' involvement in and commitment to self-chosen goals. Indeed, results from the first workshop with students carried out at the Real Jardín Botánico de Madrid with 19 secondary school students revealed not only high levels of motivation and interest from the students' side, but also high efficacy in the identification of the species selected for this purpose [8]. Yet, we cannot make general claims about the success of the KeyToNature tools to fulfil these goals because little research with actual users employing KeyToNature tools has been carried out so far and while some trials have already been conducted [9], others are still underway. However, by means of the analysis of focus groups and interviews carried out with teachers and other stakeholders in all the 13 countries from the KeyToNature consortium, we were able to observe that a high motivation from students is expected due to the multimedia character of the KeyToNature keys as opposed to the traditional paper-based ones.. More definitive results are expected in September 2009 including feedback from students and teachers from all the countries belonging to the K2N consortium... This is relevant because students, who are motivated by a certain (learning) context, will find it easier to develop successful learning episodes than the ones who are less (or no) motivated by them.

In fact, KeyToNature tools are targeted at local needs and contexts so that, for instance, pupils can identify and learn about the plants that can be found in their own school garden, in local parks, etc. Moreover, these tools will be appropriate for different levels of knowledge and formal learning because they are not tied to rigid systematic and also because they will cover only a limited number of local species which can be modified according to the level of education. In other words, the smaller number of species will facilitate the species identification process.

4.2 Digital tools and informal learning

As previously mentioned, informal learning is characterised by being active, voluntary, self-discovering, self-determined, non-threatening, enjoyable, and explorative. Many of these characteristics are clearly present in the KeyToNature products which lend themselves to be used beyond the classroom, particularly for field work due to their flexibility and ease of use. This is for instance the case of a prototype under development within the consortium, where learners can record information using a GPS embedded in a mobile application, which enables them to automatically identify their geographical position, to take pictures of a plant, to add comments and metadata to the pictures. They can recall information because the photos they shot are stored in a central repository that can also be accessed remotely to perform identification of a given organism. They can also recall learning materials and recall other information available for instance online. They can relate to their peers, or to the teachers, communicating via phone or text messages. They can reinterpret information performing an identification session on-the-fly or putting several pieces of information together to build a lesson, in the case of a teacher.

Another relevant characteristic of informal learning is that it is embedded in a social context where social cues are highly relevant and where students engage in co-operative learning activities. By employing KeyToNature keys students have the possibility to engage in socially situated learning activities, which are usually more loosely structured than traditional book-based classroom. Moreover, the possibility of working with digital keys which provide learners with constant feedback (by means of high quality graphics, contact with peers or/and their teacher, reduced and manageable amounts of data, etc.) can result in learner-directed processes which can be highly mediated by peers as interaction and collaboration is encouraged, especially in fieldwork activities.

Furthermore, just as in the case of informal learning situations which typically employ realistic objects, materials or settings that are highly contextualised, KeyToNature products may also be used in real-life natural settings which make the learning process much more meaningful for students. In addition, by employing digital tools, students also have the opportunity to work and learn in a context where time-allocation is unhurried in nature and self-paced as every student can work at their own rhythm while identifying plants or other species.

We certainly believe that all the aspects previously mentioned have the potential to make the learning experience of biodiversity more qualitative, so that learning becomes more "natural" giving students the impression that they learn spontaneously and without much conscious effort.

Finally, the importance of studying aspects of informal learning that may be present in formal learning situations lies in the fact that students' appraisal of a specific learning environment affects not only the value they attach to learning goals but also the quality of their learning process [2].

5. DISCUSSION

Studying the impact of innovative digital tools on learning, and more specifically of the digital tools developed within the context of the KeyToNature project, requires exploring less traditional and less studied learning contexts with the consequent lack of consistent theoretical and methodological frameworks. In our paper, we have tried to combine some of the most important principles of the theory of self-regulated learning and the theory of informal learning [3], as we believe that the integration of these two complementary approaches provides a useful framework for the study of the learning processes developed by means of digital tools.

Our paper shows that digital tools provide a real opportunity for students' control and initiative both in terms of information access and learning styles. Moreover, the use of tools like the ones developed by KeyToNature may help students to develop their learning autonomy while providing more opportunities to interact with their teachers and peers both in the classroom as well as in other settings outside the school.

However, more research is needed in order to understand the actual processes by means of which specific digital tools may be conducive to successful learning, and also to explore other factors, such as students' personal characteristics and learning styles and the way their interaction may have an impact on the development of more effective learning experiences.

To conclude, we believe that researchers should be aware that the spatial, temporal and social contexts of learning have been transformed [10] and that this transformation has important implications for research. Consequently, on the one hand, it becomes necessary to expand our focus of attention beyond the school so as to include those places where children and young people's digital activity is mainly taking place and where a greater impact of these new technologies has been felt. By doing this we will be able to provide a more comprehensive insight into the complex relationship between learning and new technologies. On the other hand, a broader definition of learning is needed that better accounts for the intricate nature of learning in times of complex technological and social contexts. In this respect, we believe that self-regulated learning theory constitutes a comprehensive framework to explore the mechanisms through which new media such as digital tools or the internet are boosting students' opportunities to learn practically anything, anytime, anywhere.

6. ACKNOWLEDGMENTS

We will like to thank all other partners in the K2N consortium (ECP-2006-EDU 410019/KeyToNature).

This project is funded under the *e*Content*plus* programme, a multiannual Community programme to make digital content in Europe more accessible, usable and exploitable.

7. REFERENCES

[1] Brooke, J. (1996) *SUS: a "quick and dirty" usability scale*. In P. W. Jordan, B. Thomas, B. A. Weerdmeester & A. L. McClelland (eds.) Usability Evaluation in Industry. London: Taylor and Francis.

[2] Boekaerts, M. 1999. Self-regulated learning: where we are today. International journal of educational research, 31 (1), 445-457.

[3] Boekaerts, M. 2002.Interested in learning, learning to be interested. Learning and instruction, 12, 375-382.

[4] Boekaerts, M. and Minnaert, A. 1999. Self-regulation with respect to informal learning. International journal of educational research, 31 (6), 533-544.

[5] De Corte, E., Verschaffel, L., and Lowyck, J. 1996. Computers, media and learning. In International encyclopaedia of developmental and instructional psychology, E. De Corte and F. E. Weinert, EdsOxford, Elsevier Science, UK, 695-700.

[6] Erstad, O. 2003. Electracy as empowerment. Student activities in learning environments using technology. Young. Nordic Journal of Youth Research, 11(1), 11-28.

[7] Fasick, A, 1992. What research tells us about children's use of information media, Canadian Library Journal, 5, 1-54.

[8] Ferrer, M. 2008. WP8: First workshop on the RJB-CSIC.

[9] Hetzner, S. et al. 2008. D 7.1: Evaluation of existing educational tools and products, WP07. Public project report, http://www.keytonature.eu/wiki/Media:D.7.1.pdf, accessed on 20.07.2008

[10] Livingstone, S. 2003. Young people and new media. Sage, London.

[11] Martellos, S. and Nimis, P.L. 2008. KeyToNature: Teaching and Learning Bioviversity: Dryades, the Italian Experience. Paper presented at the IASK International Conference Teaching and Learning, Aveiro, Portugal, 26-28 May, 2008.

[12] Schalk P. and Brugman M. 2008. Working paper Work Package 9.

[13] Systematics. (2008, July 5). In Wikipedia, The Free Encyclopedia. Retrieved 16:35, August 1, 2008, from http://en.wikipedia.org/w/index.php?title=Systematics&oldid=223701833

[14] Zimmerman, B. J. 1994. Overview. In D. H. Schunk, & B. J. Zimmerman, Self-regulation of learning and performance: Issues and educational applications. Erlbaum, Hillsdale, NJ, 3-21.

[15] Zimmerman, B. J. and Schunk, D. H. (Eds.). 1989. Self-regulated learning and academic achievement: Theory, research and practice. Springer-Verlag, New York.