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Towards an intelligent environment for distance learning

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Abstract

Mainstream distance learning nowadays is heavily influenced by traditional educational approaches that produces homogenised learning scenarios for all learners through learning management systems. Any differentiation between learners and personalisation of their learning scenarios is left to the teacher, who gets minimum support from the system in this respect. This way, the *truly digital native*, the *computer*, is left out of the move, unable to better support the teaching-learning processes because it is not provided with the means to transform into knowledge all the information that it stores and manages. I believe learning management systems should *care* for supporting adaptation and personalisation of both individual learning and the formation of communities of learning. Open learner modelling and intelligent collaborative learning environments are proposed as a means to care. The proposal is complemented with a general architecture for an

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intelligent environment for distance learning and an educational model based on the principles of self-management, creativity, significance and participation.

Keywords: intelligent learning environments, technology enhanced learning, e-learning, distance learning.

1. INTRODUCTION

Metaphors are a very important tool for exploring new lands of knowledge and constructing descriptions of what is found or created there; objects never seen before and hence impossible to represent in our minds are brought to life by constructing a montage using our baggage of already known images. However, metaphors bring with them the risk of cutting down on our freedom to imagine and to invent by introducing too many ties to our current reality that impedes us creating new ones.

A classroom is probably the first thing we thought of in response to hearing the word 'education,' and it may bring with it nice feelings, product of our memories or our rationalisation of the classroom as a safe place where we are exposed to carefully controlled and programmed learning experiences under the direction of a knowledgeable teacher. On the other hand, we think of it as a tightly closed room where not only our freedom to move was severely limited but also our freedom to explore outside the curricula, to follow our preferred path at our own pace, connect to our environment and to pay attention to something else other than one source of information at a time.

So I propose to avoid the venerable but closed 'classroom' methaphor from learning management systems. It is not a small change, as a few other things disappear with the former, or change their role in the learning process:

- Courses and "textbooks" get their importance reduced, giving way to competency collections to be learned through personalised paths using large collections of educational materials.
- Curricula is no longer a restriction but a recommendation, a challenge to earn "points" and move to new levels of learning (and getting some certificates on the way).
- Teachers (human and artificial) take the role of advisors, discussing learning outcomes with learners, suggesting moves in the learning space and providing feedback on their performance.

- Students are autonomous and self-managed. They exercise their metacognition through constant monitoring and control of their learning process. They fill their learning gaps and explore the learning space for challenges.

An approximation to the goal of designing and then developing an intelligent environment for distance learning along the lines suggested above has to deal with a large collection of issues, which are grouped into a few dimensions, as illustrated in Figure 1 below. Some of these dimensions are explored in the following sections, and the paper ends by providing some conclusions on the project.

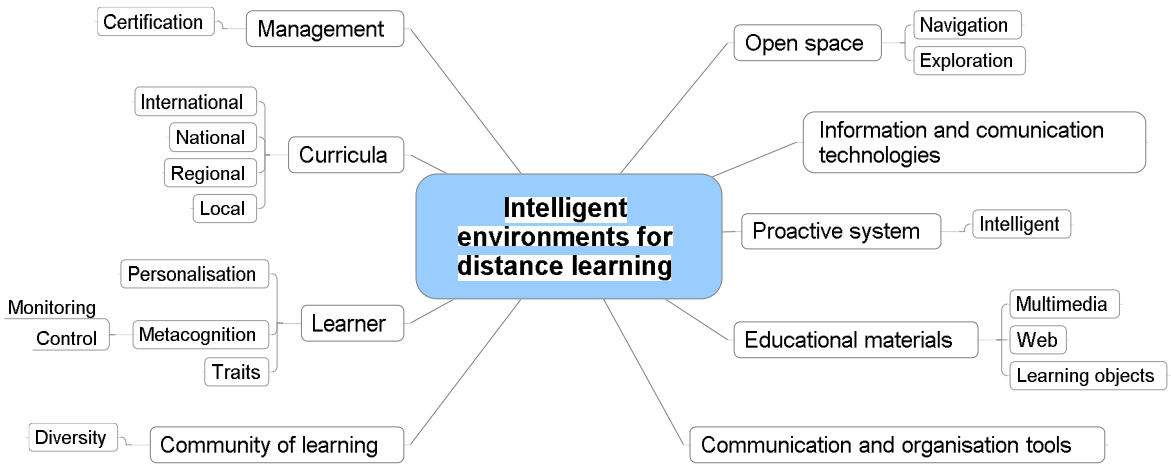

Figure 1. *The many dimensions of discussion in relation to the International Internet Learning Space project.*

2. PERSONALISATION

Modern educational theories tell us that learning is both a cognitive and a social process: people learn as they process information while observing and interacting with other people (Ausubel, 1968; Vygotsky, 1996). So the IILS have to pay attention both to the learner as an individual and as a member of a community of learning.

Intelligent tutoring systems have long used automatic adaptation for personalisation as essential mechanism to 'care, precisely' for the individual (Self, 1999) and some studies have shown the kind of improvement on learning this type of system can produce in real situations (eg. Koedinger & Anderson, 1997). Learner models have been a core part of intelligent tutoring systems from the beginning, providing the knowledge required in order to achieve personalisation, hence learning modelling is a process we must introduce into IILS, adapted to its new working conditions, if we aim at similar improvements in learning following a similar approach as intelligent tutoring systems.

I propose a way of achieving personalisation which does not make covert use of learner models for adapting system behaviour but makes learner modelling the open and central process learning is organised around (Morales, Van Labeke, Brna, & Chan, 2008). A typical session would develop along the following lines:

1. **System:** Hello dear! What would you like to do today?
2. **Learner:** Do you have any suggestions?
3. System: Well, you can try improving your factorisation skills. I believe you still have some problems there. *(It shows the topic in context and provides a summary of its belief)*
4. **Learner:** Why do you think so?
5. **System:** The evidence I have got suggests your competency is low on the topic. *(It expands the display of its belief including summaries of evidence, as it reduces the amount of context)*
6. **Learner:** What evidence is that? *(She points to a particular evidence summary)*
7. **System:** This is what I got on my records. *(It shows the relevant parts of the learner performance history, together with their interpretation)*
8. **Learner:** What kind of exercise is this one?
9. **System:** Here it is. *(It shows the exercise that provided the evidence and/or information about it)*
10. **Learner:** Factorisation is OK by me. *(After closing the branch of the dialogue that started in step (4), devoted to belief revision)*
11. **System:** What about practicing some (real life) problem solving with factorisation? *(It shows the corresponding competency in context)*
12. **Learner:** No. I better do some factorisation practice before.

13. **System:** I would recommend the following learning objects. *(It shows a list of selected learning objects)*
14. **Learner:** Thank you, but I would prefer to see the full list.
15. **System:** OK. Here it is. *(It shows the full list of relevant learning objects)*
16. **Learner:** *(Chooses some learning objects from the list and works on them, while the system captures information on performance)*
17. **System:** Well, it seems you have improved your competency on carrying out factorisation. What would you like to do now? *(It shows the topic in context and a summary of its new belief)*
18. **Learner:** What about trying some real life problems now?

The learner-system dialogue is presented here in natural language (English) not only because it nicely illustrates our point of how learning evolves from and revolves around open learner modelling, but also because it is feasible to build such a kind of multimodal interface given what has been done so far in natural language processing (Allen, Ferguson, & Stent, 2001). It is also worth noticing that the knowledge necessary to support the dialogue on behalf of the system is not about the subject matter of learning (mathematics in the example above) but about beliefs, evidence, judgements of behaviour, belief negotiation, etcetera; hence the same framework would apply to any subject domain, what makes it more practical than other domain-specific approaches (Zinn, 2006).

An important reference for this proposal is the Open Learner Model (OLM) developed for LeActiveMath (LeActiveMath Consortium, 2007; Van Labeke, Brna, & Morales, 2007), and which was yet another tool in the system the learner could choose to use, or not, as it was hidden behind an option in the main menu. OLM worked along the lines described above but made no use of natural language other than to represent the ongoing dialogue carried out on OLM's graphical user interface.

3. COLLABORATION

In the previous section I presented a way in which IILS could support learning of individuals. However useful it could be, its support is only partial if seen in the context of learning as a social process. This is particularly the case in distance learning education settings, where students are usually dispersed and separated by long distances, hence depending more on the informational

support of the learning management system (LMS) for communicating with other students and forming communities of learning.

In Figure 2 I present a broader view, in which open learning modelling is located in the context of a proposed architecture for IILS. The figure shows evidence for updating the beliefs in the learner model can come from a variety of sources: interaction with learning objects reported back to the LMS – e.g. using SCORM (ADL, 2004) – including some evaluation of learner performance, evaluations by teachers of learner activities in courses, learner opinions exposed in the open learner modelling dialogue, and evaluations of activities carried out inside environments designed for collaborative learning.

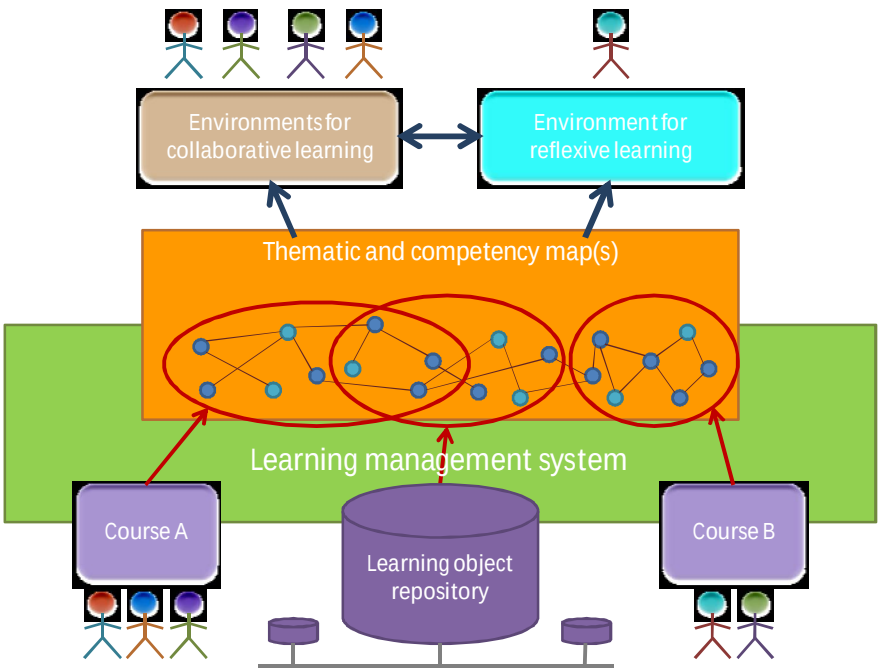

Figure 2. *Envisioned architecture for the International Internet Learning Space.*

There are many approaches to designing collaborative learning environments (Dillenbourg, 1999) yet I would like to single out three of them: peer help system, where learners can help other learners

to overcome their problems on particular topics or activities (e.g. IHelp, ARIES Lab), specialised microenvironments (e.g. collaborative learning objects) where learners can participate to achieve some common learning goal, and microgames, where learners can learn in playful settings not only through collaboration but also through competition. Learner modelling can provide all these types of environments with useful information for tailoring the collaborative learning experience to the benefit of the people.

4. EDUCATIONAL MODEL

In the previous sections I have introduced a collection of desirable features for the International Internet Learning Space, stressing in particular those features that promote individual learning and collaborative learning. Many other features could be introduced, and probably justified (as we did, referring to cognitivism and social constructivism) yet the whole design of IILS should be guided and supported by an educational model.

The design of our educational programmes and courses at UDGVirtual is inspired by an educational model based on the principles of self-management, creativity, signification and participation (UDG Virtual, 2004), in the sense that both the human and computational support for our learners should be guided by these principles, and all four principles should be identifiable as characteristics of our learners.

The combination of the IILS features suggested above support the principles of self-management, significance and participation, as in open learner modelling the system acts as a mediator for learners to make judicious decisions on what to learn next (self-management), according to their particular goals and needs (significance), whereas the collaborative environments help in creating and consolidating communities whose members learn through engaging themselves in joint activities (participation). The addition of a collection of carefully designed courses and learning objects could enforce the effect of their complementary tools while promoting creative thinking.

5. CONCLUSIONS

In this paper I have aimed at trying to solve the problem of designing an Internet International Learning Space (as I prefer to call it) by firstly suggesting it should care for supporting both individual learning and learning in community, and then proposing open learner modelling and different types

of collaborative learning environments as an embodiments of this purpose. A general architecture for IILS has been proposed, and everything has been put under the umbrella of an educational model based on the principles of self-management, creativity, significance and participation.

Currently at UDGVirtual we are in the process of developing a prototype for the open learner modelling component, with previous work in the LeActiveMath project as a reference, while we are pondering on the design of suitable collaborative learning environments.

REFERENCES

ADL. (2004). Sharable Content Object Reference Model (SCORM).

Allen, J., Ferguson, G. and Stent, A. (2001). An architecture for more realistic conversational systems. Paper presented at the Intelligent User Interfaces 2001 (IUI-01), Santa Fe, New Mexico.

ARIES Lab. iHelp: Students Helping Students. Retrieved Sep. 12, 2008, from http://ihelp.usask.ca

Ausubel, D. (1968). Educational Psychology: A Cognitive View. New York: Holt, Rinehart and Winston.

Dillenbourg, P. (1999). What do you mean by 'collaborative learning'? In P. Dillenbourg (Ed.), Collaborative-learning: Cognitive and Computational Approaches (pp. 1-19): Elsevier.

Koedinger, K. and Anderson, J. (1997). Intelligent Tutoring Goes To School in the Big City. *International Journal of Artificial Intelligence in Education,* 8, 30-43.

LeActiveMath Consortium. (2007). Language-Enhanced, User-Adaptive, Interactive eLearning for Mathematics. Retrieved 22 June 2007, 2007, from http://www.leactivemath.org

Morales, R., Van Labeke, N., Brna, P., and Chan, M. (2008). Open Learner Modelling as the Keystone of the Next Generation of Adaptive Learning Environments. In C. Mourlas & P. Germanakos (Eds.), Intelligent User Interfaces: Adaptation and Personalization Systems and Technologies (pp. 288-312): Information Science Reference.

Self, J. (1999). The Defining Characteristics of Intelligent Tutoring Systems Research: ITSs Care, Precisely. *International Journal of Artificial Intelligence in Education*, 10, 350-364.

UDG Virtual. (2004). El Modelo Educativo de UDGVirtual. Universidad de Guadalajara.

Van Labeke, N., Brna, P. and Morales, R. (2007). Opening up the Interpretation Process in an Open Learner Model. *International Journal of Artificial Intelligence in Education*, 17(3), 305-338.

Vygotsky, L. (1996). Thought and Language: MIT Press.

Zinn, C. (2006). Supporting Tutorial Feedback to Student Help Requests and Errors in Symbolic Differentiation. Paper presented at the 8th International Conference on Intelligent Tutoring Systems, ITS 2006, Jhongli, Taiwan.