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## **Technical Report**

DividingQuest: Opening the learner model to teachers

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# *DividingQuest*

## Opening the learner model to teachers

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### RÉSUMÉ

Cet article s'intéresse aux problèmes de recherche concernant la création d'EIAH (Environnement Intelligent pour l'Apprentissage Humain) qui correspondent mieux aux besoins des enseignants, ainsi qu'à leur capacité d'utilisation des nouvelles technologies. Lors de la création d'un EIAH, un problème récurrent apparaît dans la difficulté de créer des environnements d'apprentissage proposant à la fois, un suivi de l'apprenant et permettant aux enseignants « novices » en informatique, un accès « facile » à ces informations. Dans ce contexte, nous présentons la *DividingQuest*, un EIAH couplé à une plateforme logicielle d'évaluation, avec une modélisation d'apprenant ouverte aux enseignants. Notre outil d'évaluation a pour but la réalisation d'expérimentations concernant les questions de recherche suivantes : dans quelle mesure les enseignants ont-ils besoin et envie d'avoir accès, et d'interagir avec la modélisation de leurs élèves ; et comment cela les aide-t-il dans leur planification pédagogique ?

### ABSTRACT

This paper is concerned with research issues in creating educational software that better suit teacher's educational needs, expectations and technological abilities. A recurrent concern is to create learning environments offering teachers useful and expected information about their students' performance and learning strategies, in an accessible manner for teachers inexperienced in the use of new technologies. In this context we present the *DividingQuest*, a learning environment with students' learner model components open to their teachers. Our evaluation tool allows studies to be undertaken investigating the willingness of teachers to access and inspect their students' user model, in addition to the usefulness of such information for teachers in planning and monitoring their classroom learning session.

### Keywords:

User-modelling, computer-based teaching help, Open-user modelling, ITS design and architecture, evaluation platform, adaptive interfaces.

### 1. Introduction

In the last decade, new technologies have been increasingly used in order to support people in their everyday lives. This applies to the domains of education and pedagogy, leading to significant changes in teaching and learning practices. It also inspired the creation of technology-oriented courses in schools such as ICT (Information, Communication, Technology). Moreover technological devices are more commonly used in the teaching of core curriculum subjects such as mathematics, as a medium to facilitate learning.

Computer-based learning environments seem to be of great value in their capacity of producing personalized learning environments in addition to increasing children's motivation in learning. However, a significant number of such existent systems do not suit the teachers' educational needs or technological abilities. In order to overcome this problem, our research aim is to create learning environments more useful and usable by teachers.

The use of user-centred and participatory design strategies has proven to help the elaboration of systems that correspond better to their user's learning and teaching needs [MACKAY & FAYARD 97]. The opening of learner models to their users and peers ([KAY 00], [DIMITROVA 99]) has been shown to have real potential in increasing user's motivation in using the learning environments, in addition to engaging them in the learning experience.

In this paper, we are concerned with the development of a computer-based learning environment that helps us investigate the willingness of teachers to access, inspect and interact with their student's user models. We introduce the *DividingQuest*, educational software aimed at investigating the teacher's willingness to interact with their students' user-model. Results of this research will give insights into the level of 'openness' a teacher might want and need over his/her students' learner models. After reviewing the related research in section 2, section 3 presents the *DividingQuest* along with the functionality it offers to teachers. We will then conclude in section 4 on the research achievements, and some future work considerations.

### 2. Rationale

Research in educational technology is concerned with the creation of learning environments that are not only useful to learn a

particular subject, but also highly usable and able to be integrated into traditional teaching strategies.

Adaptive systems hold the capacity to adapt functionality, structure or interface to users at various moments of interaction. These systems have been considered for learning environments in order to facilitate an individualised learning by using modelling techniques. Part of the user-modelling community is concerned with the creation of Open Learner Modelling systems, or systems that enable access and/or inspection of its students' 'user-model' to themselves and peers. These modelling techniques have been shown to have real potential in increasing student's learning motivation ([KAY 00], [DIMITROVA 99]). Learner models opened to instructors have been used to allow the instructor to follow the evolution of a student's knowledge ([RUEDA & al 03]); to help instructors adapt their teaching to the individual or the group ([GRIGORIADOU & al 03],[YACEF 05]); or to help instructors organise learning groups ([MÜLHENBROCK & al 98]). The use of stereotypes in PepiStereo ([VINCENT & al 05]) or meta-cognitive tools in Exploring the Nardoo ([HEDBERG & al 94]) offer teachers the opportunity to individualise instruction, by having access to information of great pedagogical value concerning their students' learning progress.

However, the lack of teacher's motivation in using educational software has been shown to correlate to their lack of experience in using new technologies, as well as the gap between the pedagogical content of software and the teacher's expectations. Some issues remain as to the effective use of the information provided to teachers when opening student's user-models and their usefulness for planning and monitoring their classroom teaching. To shed some light on this issue, we are interested in the realisation of an evaluation platform using inspection techniques such as Beck's engagement tracing system ([BECK 05]) or Apluxis' user protocols ([BOUHINEAU & al 03]) to study to what extent information concerning students' user-models are suitable for sharing with their teachers in classroom settings.

### 3. The *DividingQuest*, a two-fold evaluation platform

#### 3.1 Creating the *DividingQuest*

The *DividingQuest* is an evaluation tool that enables investigations concerning the openness of children's learner model for two types of users: children and teachers ([GIRARD & JOHNSON 06]). The software has been designed following both the behaviourist (drill-and-practice application) and constructivist trends (with access to learning strategies). Children control their learning sessions by choosing the order of the activities they want to try in a pedagogical session, in order to help them develop meta-cognitive skills [GORDON 96].

The children interact with an adventure and fantasy game used as a teaching-aid tutoring system for the practice of divisions in English schools by children aged 10-11 (level "year6"). It enables investigations of the impacts of using emotive interface personas as helpers on the children's understanding of their user-model, motivation, as well as their development of meta-cognitive skills [GIRARD & JOHNSON 07].

Our application has been designed following an iterative user-centred participatory-design approach using Druin's approach to participatory-design for use with children ([DRUIN 99]). The level of openness of the children's user model to themselves and their teachers has been defined through a dialogue between the developer, teachers and children design partners in order to give the child a level of control over its learning session compatible with its teachers strategy.

#### 3.2 Using the *DividingQuest* as a teacher...

On the teacher's side, participatory-design sessions with teachers led to the definition of the functionality to be present within the teacher's interface, presented here according to the teacher's needs:

**Following children's individual progression through the game:** The *DividingQuest* has been designed as a teaching-aid tutoring system providing teachers with a drill-and-practice application they could use in parallel to their teaching strategies to help their students grasp more concepts at their own rate. Teachers are presented with information concerning the child's performance, their level of engagement in the game, and an indication of their emotional state during one learning session as their learning evolves. The children's performance scheme illustrates the child's achievements during the learning session and the proportion of mathematical help requested of the software. The level of engagement of the child and its emotional state representation are currently under development using an adaptation of Beck's engagement tracing system [BECK 05], and the outputs of the emotional tests given to the child prior to, and following the learning sessions. Another part of the teacher's interface under development is the visualisation afforded to teachers of the child's learning strategies.

**Control over the child's learning sessions:** When adding a new child user within the *DividingQuest*, teachers have to specify the child's average level concerning divisions ("low", "average", "high"). The child is then attributed a "level profile" for its use of the application and the number of questions s/he has to answer correctly for each single activity of the game are initialised according to his/her profile [GIRARD & JOHNSON 06]. The teacher can then personalise this level profile for its students according to their accomplishment in the game by inspecting and interacting with their user-model.

**Following the learning evolution of the class:** Teachers expressed the need to have access to a "progress map" of their class, in order to adapt their teaching to their student's needs, concentrating on the concepts children have the most problems with. Teachers can visualise the class accomplishments through different views and over different periods of time.

### 4. Conclusion and Future Work

The research proposed in this article is concerned with the creation of educational software that provides useful information to teachers about their students' learning processes and performances. The *DividingQuest* presents researchers with an evaluation platform that enables studies to be coordinated investigating how useful for teachers to access and inspect their students' user-models.

Our next step is to deploy the *DividingQuest* into English schools for use by children of level year 6. This investigation will help us gain some insights on research questions such as: *Does the information given to the teachers within the DividingQuest reflect their needs? Is it presented in an appropriate way for use by teachers? To what extent do teachers access/interact with the information they are provided with? How does the information influence the way they plan and monitor their learning sessions?* Measures will be registered throughout the use of the evaluation platform to capture the teachers and children's interaction with the system. A qualitative and quantitative analysis will be performed from interviews with teachers as well as online questionnaires in order to assess the utility and usability of the information they are provided with.

One future version will include a teacher learning companion giving children advices as to their next choice of interaction with the game. Should the experiment reveal the teachers' willingness to follow more closely their student's development of learning strategies, we will then investigate the full potential for teacher's planning and monitoring learning sessions to gain more control over their student's user-model in future versions of the *DividingQuest*.

## 5. REFERENCES

- [BECK 05] Beck, J., « Engagement Tracing: Using Response Times to Model Student Disengagement. » *Proceedings of the International Conference on Artificial Intelligence and Education*, 2005.
- [BOUHINEAU & al 03] Bouhineau D., A. Bronner, H. Chaachoua, T. Huguet, (2003) Analyse didactique de protocoles obtenus dans un EIAH en algèbre. *Actes de la conférence EIAH 2003*, Strasbourg, avril 2003.
- [DIMITROVA et al. 99] Dimitrova M, J. Self, « The interactive maintenance of open learner models », In S. Lajoie, M. Vivet (Eds.), *Artificial Intelligence in Education* (1999), 405-412.
- [DRUIN 99] Druin, A. « Cooperative Inquiry: Developing New Technologies for Children with Children », *CHI 99*, p.592-599.
- [GIRARD & JOHNSON 06] Girard S., Johnson H., « DividingQuest: Using emotive interface personas in educational software », 2006, Technical Report CSBU-2006-20, Department of Computer Science, University of Bath. ISSN 1740-9497.
- [GIRARD & JOHNSON 07] Girard S., Johnson H. (to appear), « Towards promoting meta-cognition using emotive interface personas within Open-Learner Modelling Environments », To appear in the *Young Researchers' Track proceedings of the International Conference on Artificial Intelligence in Education 2007*, Los-Angeles, CA.
- [GORDON 96] Gordon, J., « Tracks for learning: Metacognition and learning technologies ». *Australian Journal of Education Technology*, 1996, 12(1), 46-55.
- [GRIGORIADOU & al 03] Grigoriadou, M., Tsaganou, G. & Cavoura, T. (2003). « Dialogue-Based Reflective System for Historical Text Comprehension », *Proceedings of Workshop on Learner Modelling for Reflection (Supplemental Proceedings vol 5)*, *International Conference on Artificial Intelligence in Education 2003*, 238-247.
- [HEDBERG & al 94] Hedberg, J. G., Harper, B., Brown, C., and Corderoy, R. M. 1994. « Exploring user interfaces to improve learning outcomes ». In *Proceedings of the IFIP Tc3/Wg3.2 Working Conference on the Seign, Implementation and Evaluation of interactive Multimedia in University Settings: Designing For Change in Teaching and Learning* (July 06 - 08, 1994). K. Beattie, C. McNaught, and S. Wills, Eds. IFIP Transactions, vol. A-59. Elsevier Science, New York, NY, 15-29.
- [HERAUD & al 05] Heraud J.M., Marty J.C., France L., Carron T., « Une aide à l'interprétation de traces : Application à l'amélioration de scénarios pédagogiques », in *Actes de la conférence EIAH 2005*, Montpellier, 25-27 mai 2005, p.237-248.
- [KAY 00] Kay J, « Stereotypes, Student Models and Scrutability », in G. Gauthier, C. Frasson, K. VanLehn (Eds.), *Intelligent Tutoring Systems*, Springer, 2000
- [MACKAY & FAYARD 1997] MacKay W., Fayard A-L, « Radicalement nouveau et néanmoins familier: les strips papiers revus par la réalité augmentée », *Actes des journées IHM'07*, 10-12 septembre 1997, Poitiers, France, pp105-112.
- [MÜLHENBROCK & al 98] Mühlenbrock, M., Tewissen, F. & Hoppe, H.U. « A Framework System for Intelligent Support in Open Distributed Learning Environments », *International Journal of Artificial Intelligence in Education* 9(3-4),1998, pp.256-274.
- [RUEDA & al 03] Rueda, U., Larrañaga, M., Ferrero, B., Arruarte, A. & Elorriaga, J.A. « Study of Graphical Issues in a Tool for Dynamically Visualising Student Models », *Proceedings of Workshop on Learner Modelling for Reflection (Supplemental Proceedings vol 5)*, *International Conference on Artificial Intelligence in Education 2003*, 2003, pp.268-277.
- [VINCENT & al 05] Vincent C., E. Delozanne, B. Grugeon, J-M. Gelis, J-Rogalski, L. Coulange, « Des erreurs aux stéréotypes : des modèles cognitifs de différents niveaux dans le projet Pépite », in *Actes de la conférence EIAH 2005*, Montpellier, 25-27 mai 2005, p.297-308
- [YACEF 05] Yacef, K. « The Logic-ITA in the classroom: a medium scale experiment », *International Journal of Artificial Intelligence in Education*, 2005, 15(1), 41-60.