

Up and Down the Number-Line: Modelling Collaboration in Contrasting School and Home Environments

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Abstract. This paper is concerned with user modelling issues such as adaptive educational environments, adaptive information retrieval, and support for collaboration. The HomeWork project is examining the use of learner modelling strategies within both school and home environments for young children aged 5 – 7 years. The learning experience within the home context can vary considerably from school especially for very young learners, and this project focuses on the use of modelling which can take into account the informality and potentially contrasting learning styles experienced within the home and school.

1 Introduction: The HomeWork Project

The user modelling problem being explored by the Homework project is how to build a learner model for young children that takes account that they will be working in diverse contexts (home and school), in diverse groups (on their own, in groups at school, with carers and siblings at home), across a range of technologies (PC tablets, interactive whiteboard) and compiling information from a variety of sources (teachers, parents and log files of system usage).

The main aim of the HomeWork project is to provide adaptive, personalised learning experiences to pupils aged 5 – 7 years of age. The main content material being used by the project is based on the Number Crew, a popular mathematics television series developed by Open Mind Productions for Channel 4 Learning. This consists of broadcast quality video from 60 TV programmes. All this material is divided into chunks, each of which is tagged with meta-data according to the schema we have developed as an extension to SCORM. The HomeWork system helps the teacher select the material for a lesson so that activities, such as the interactive games, that are more suitable for children to use individually or in small groups, are deployed to a child's wirelessly connected tablet PC and material that is more suited to whole class activity will be displayed on the class interactive whiteboard. As well as using the system within the classroom, the project is aiming to test the technology within

the home by enabling the teacher to also select individual homework to be supplied to each child's tablet PC and taken home. This will enable us to examine the use of the system within a less formal home environment. It should be noted that whilst at the moment we are concentrating on these young learners many aspects of the system would be equally applicable to material for older learners too.

In order to address this need the HomeWork project team are building up a detailed model of each child's needs and abilities (including any special educational needs: SEN) and extending the descriptors provided within SCORM in order to classify the resources in such a manner that they can be optimally mapped to each learner. In other words it is the evolving description of our learners that is driving the way we describe the learning resources.

2 Pedagogical Adaptation, Collaboration and Context Sensitivity

The learner model used for the HomeWork project has been extended from the Broadband Learner Model (BLM) developed earlier [5, 8] and has also been influenced by teachers who attended a design workshop [11]. It was considered important to develop a user model that was not only comprehensive, but also practical and accurately reflected the needs perceptions and interests of practising teachers. For example, the teachers were interested in including categories, such as "concentration", which would directly impact on their teaching and the kinds of resources available to them in the classroom, rather than 'academic' categorisations of learning styles which were of limited practical use. The categories identified by these teachers informed many of the fields used in the HomeWork model.

The specification of the HomeWork learner model and associated meta data schema evidences the emphasis we have placed on two main areas: Context: in particular, the formal and informal learning contexts of classroom and home; and Collaborative learning with which we associate social and affective issues. This emphasis upon collaboration is a logical progression of our previous work. There is a large literature on the benefits of peer collaboration in general [4], in paired reading [13] and in learning through interactive multimedia [10]. In the design of Interactive Learning Environments much attention has been paid to the notion of Scaffolding, a term coined by Wood [16, 17] from the ideas of Vygotsky [14, 15] to account for how a more knowledgeable partner can assist the cognitive development of a less able one, and gradually foster the development of successful independent task performance. Examples of systems using scaffolding techniques can be found in [6, 10, 17]. In some systems scaffolding is provided through support for peer collaboration, in others it is provided through graded interventions by the system. More recently, emphasis has also been placed upon learners' metacognitive skill development (see [1, 9, 16] for example). In addition to attending to the cognitive aspects of learning, we are also concerned with "affective" aspects and recognize the influence of a student's emotional state. Again there is increasing attention to these issues, see [2, 3, 7]. For these reasons we have created a learner model profile which allows collaborative skills and context of use to be monitored.

2.1 Outline of the Learner Model

Selected parts of the learner model are illustrated in the Table 1 below. The fields have two representations, *formal* (for school-based learning) and *informal* (for home-based). To save space only some the informal representations are shown.

Table 1. Selected parts of the Learner Model

Record name	Details	Purpose
SEN. formal	checkbox list for SEN categories: learning difficulties (4 levels); behaviour, emotional & social diffs; speech, language and comms. needs; hearing, visual or multi-sensory impairment; physical difficulties; autistic spectrum disorder; other	ensures that system sends appropriate material to student tablet – e.g. severely deaf student would have no use for voice-over software, a statemented student may have LSA support
SEN. informal	As above but within a home context	Certain SEN altered by environment e.g.a deaf child may have access to a signing parent/sibling
friendships/ collaborators	if entered by user then names (auto updated to IDs by system), system updated entries will be user IDs	allows teacher and/or system to establish (un)successful groupings of workers. +ID = good pairing, -ID = avoid pairing
confidence level formal	3 level system: high, average, low.)	establish whether learner would aid in peer teaching or be prepared to tackle work above their current attainment level
collaborative skills formal	3 level scale (see confidence level) connected to number of positive/negative collaborators in collaborators record	students with high collab. skills would be more likely to be included in larger groups during interactive activities. Those with low levels may require further help
collaborative skills informal	as above but for home context	some children will not have any home-based collaborators (only child/busy parents)
concentration skills formal	3 level scale (as above)	useful for younger learners. those with a low level would require material of a shorter duration than others

2.2 Adaptive Learning Environment: Formal and Informal Education

Whilst most projects of this kind have been focussed exclusively on the school context (see e.g. [12]), the HomeWork model is designed with both the school and less formal home contexts in mind. A number of pedagogical categories were felt to vary between formal and informal environments, especially for very young learners who have far less control of their environments. For example, the confidence of a child with a non-English home language may well be considerably lower within the school context compared to the home where they can discuss their work with a native speaker. Conversely, the collaboration potential would be far lower for a child with

no siblings within the home compared to the classroom setting. Such variations require consideration when designing a single user model profile for each child. The question: “How can the profiles for these two contexts be combined into a single learner profile?” is one which is currently under consideration.

2.3 Interaction: Support for Collaborative Learning

The second area of emphasis for the learner model is that of collaboration. Whilst each child can work on his/her own tablet at an individual task there is also considerable scope for collaborative learning. The HomeWork project is developing a number of collaborative tools and games which will allow children to learn through shared tasks. The games are designed to require all parties to work together towards a goal. Children can work in small or larger groups to develop a particular strategy. The players can also be in different locations, from close proximity in neighbouring seats, to different classroom locations, to the extreme instance in which resources can be used over the internet from home settings — particularly useful for children in isolated home circumstances.

3 Summary and Conclusions

The basic fields defined by SCORM do not contain much pedagogical information to inform potential users or to ensure that the most pertinent choices are made for a particular learner and/or lesson. In earlier work we described how we had extended SCORM categories in order to identify mutual pedagogic relationships between resources [5]. If the rich information designed to be modelled in the user profile is to be adequately exploited it is vital to ensure there is optimal mapping between the model and the classification of the resources available to each user. The HomeWork project has therefore expanded the pedagogical areas of SCORM to improve the fit between the user and the resources. The project has mapped between pertinent SCORM fields and the learner model (as well as the lesson planning stage and the underlying system when appropriate).

We have argued that special care needs to be taken to model both context and collaboration so as to maximise the effectiveness of educational resources used by children. We have set out the mapping between the Learner Model (LM) and Lesson Planning (LP) as being used in the development of the HomeWork system. The proposed learner model will go some way towards addressing the balance between formal and informal educational profiling for young learners, in particular taking account of the fact that children often evidence different capabilities and attitudes in home and school settings. By emphasising the specific context and the differing kinds of collaborative learning available in these contrasting settings, enjoyable and successful resources can be made available by the system to provide a good start to the learning experience. The design of the overall architecture of the system has been completed and some parts of the system are about to be evaluated in two school settings. Detailed interactions have already taken place with parents to ascertain their current use of technology (if any) and how they would like to engage with the work brought home by the children.

Acknowledgements. We thank the teachers, parents and children for their help with this study which is funded by an EPSRC/ESRC/DTI PACCIT grant

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