How to Augment Simulated Environments by Services supporting Self-regulated Learning?

A Baseline Study

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This paper takes up the concept of self-regulated learning (SRL) and reports results of a baseline study on a simulation for medical training. This study has been conducted to provide benchmark data and evidence of the need for the development of intelligent services for learners, e.g. metacognitive scaffolding. These services aim at augmenting existing simulators in order to close the gap between virtual and real world experiences and to facilitate SRL. Follow-up evaluations on the simulator with integrated services are planned.

Keywords; self-regulated learning, technology-enhanced learning, service, simulation, augmentation, real world

I. INTRODUCTION

Self-regulated learning (SRL) is currently in the focus of psycho-pedagogical and technical engineering research. Many studies provide evidence of the effectiveness of this learning approach, e.g. [1, 2]. One of the most popular SRL models [3] distinguishes three cyclic learning phases: forethought, performance, and reflection. It has been shown that good SR learners achieve better learning results and are more motivated to learn [2] than weak SR learners. Technology-enhanced learning environments provide opportunities to enhance SRL skills, especially metacognitive ones; most learners need additional help and guidance [4] to become successful self-regulated learners.

In the EU project ImREAL (Immersive Reflective Experience-based Adaptive Learning) intelligent services are developed to augment simulated learning environments - among others to support SRL and metacognition. In this case the project's research addresses the question: (How) can ImREAL services improve users' SRL skills? The major goal of the work presented in this paper is to determine the need for those services and to provide benchmark data for comparison with future user trials.

II. BASELINE EVALUATION

The goal of the ImREAL project is to provide additional services for already existing simulators, to augment these systems and close the gap between the virtual and real world. In this sense, an existing simulator covering simulation scenarios in the medical interview domain and developed by EmpowerTheUser (ETU)[1] is used as a test-bed. Due to the mature state of the simulator before augmentation through ImREAL services, it was possible to collect benchmark data in a baseline study that could provide useful information for the design and development of ImREAL services and for later comparison with evaluation results on the augmented simulator in follow-up evaluation phases. Students of the Trinity College of Dublin (TCD) have been selected as evaluation participants to work with the existing ETU system and to respond to questionnaires and survey questions on different topics. Here, we only present methods and results regarding SRL.

A. Method

ETU simulator: In the web-based ETU system medical interview situations for different scenarios are simulated. The user is in the position of a clinical therapist and selects interview questions to ask the patient. Videos show the verbal interaction of the therapist with the patient and the verbal and non-verbal reaction of the patient. The number of attempts, duration time, self-assessment (confidence levels on one's own skills), notes taken, and interview performance were tracked by the simulator (*Log Data*).

QSRL: Self-regulated learning skills were measured by the *Questionnaire for Self-Regulated Learning* (*QSRL*; [5]). The QSRL consists of 54 items, which belong to six main scales (Memorising, Elaboration, Organisation, Planning, Self-monitoring & Time management) and three subscales (Achievement motivation, Internal attribution and Effort). On all scales higher values indicate a better result.

B. Procedure

The TCD students used the ETU medical training simulator during a university course as part of their curriculum of medical training. Use of the simulator was not mandatory, students were not graded on its use. Log data was recorded for each learner throughout usage of the simulator. The evaluation questionnaires were presented and filled in online after completing the learning period with the simulation.

[1] http://www.empowertheuser.ie

C. Results

In total 76 medical students (45 female and 31 male) from TCD participated in the baseline evaluation and filled in the QSRL. They were on average 23 years old (*M*=23.04, *SD*=2.85). None of the students had prior experience with the simulator. The time spent on the simulation scenarios was on average 39 minutes (*M*=38.80, *SD*=16.56).

With regard to SRL, a one-sample t-test (critical test value = 57.90) showed that participants report higher use of elaboration strategies compared to a norm sample (*N* = 457, consisting of students and pupils of an average age of 16 years (*M*=15.68, *SD*=1.41)) and that they report moderately frequent application of metacognitive strategies.

When contrasting self-assessments with actual performance scores as tracked by the simulator, it became evident that students underestimate their own skills and performance. Analyses of notes taken during the simulation revealed that learners are not sure how to use the reflection tool. The perceived relevance of the simulation for the real world activity was good, though, leaving space for further improvement.

D. Discussion

For ImREAL these results provided an information source and evidence of the need for appropriate services for SRL support. Such support may aim at improving users' metacognitive strategies, which have been shown to be used only to a moderate extent by students. Of course, this strategy type should not be the only one to be supported and addressed by ImREAL. For example rehearsal strategies help learners to select and remember important information, but may not represent very deep levels of cognitive processing. Metacognitive scaffolding should also try to support learners' knowledge awareness, such to help them to more realistically evaluate their own skills. In addition, interventions that prompt learners to reflect on their learning/thinking would be helpful to foster successful note taking and reflection.

III. ImREAL Services for Learners

In ImREAL services will be smoothly integrated in existing simulations in order to augment the learning environment to support learning and to close the gap between simulated learning and real world context. We focus here on services that address learners, in particular.

I-CAW: The Intelligent Content Assembly Workbench (I-CAW) service allows contributing and browsing social content on the real world activity of the learning domain (e.g. YouTube videos) [6], which contains authentic stories of people's experiences (e.g. interview situations) and provide a rich resource of real world activity descriptions. The service shall support learners in their forethought phase by helping them to think about their knowledge gaps and training needs.

Metacognitive Scaffolding: The Metacognitive Scaffolding Services (MSS) monitors and interprets user interaction with the system in terms of underlying metacognitive skills [7]. Based on this, prompts are provided in the different SRL phases in an adaptive manner to increase the use of metacognitive strategies, to foster reflection and to make students more aware of the SRL process.

IV. Outlook and Further Research

In the baseline evaluation it has been identified that the SRL phases and especially the reflection phase should be extended and supported by the ImREAL services. MSS will serve this purpose by guiding and prompting the user with intuitive, easily understandable metacognitive scaffolding interventions.

The I-CAW service is envisaged to support learners in their forethought phase, by the possibility of browsing real world user experiences and fostering awareness of real world activity aspects. In this way, the simulator's real world relevance shall be further enhanced.

Additionally, taking into account learners' individual goals and differences and their real world experiences, as documented in their social web traces, through services for user model augmentation is assumed to have a beneficial effect for appropriate adaptation.

To sum up, results of the baseline evaluation nicely reflect and confirm the need for ImREAL services for learners. In an upcoming trial the augmented ETU simulator with integrated ImREAL services will be evaluated and compared to the baseline data.

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