Teacher Scaffolding of Students' Self-regulated Learning using an Open Learner Model

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Abstract. This paper describes a study of teacher scaffolding to support reflection and self-regulated learning (SRL) with an open learner model (OLM) in a geography based task on a touch screen. The study was carried out in 6 one-on-one sessions with students between the ages of 10 and 11. We present examples of teachers scaffolding students' SRL behaviours using the OLM, demonstrating how an OLM can be used to prompt the learner to monitor their developing skills, set goals, and use appropriate tools.

Keywords: Open learner model, Self-regulated learning, UCD

1 Introduction

Self regulated learning (SRL) is the meta-cognitive process where a student uses self-assessment, goal setting, and the selecting and deploying of strategies to acquire academic skills; the use of SRL strategies are significantly correlated with measures of academic performance [7]. Open learner models (OLM) externalise the model that the system has of the learner in a way that is interpretable by the learner or teacher. The aims of OLM include promoting reflection, to facilitate planning and decision-making, and raise awareness of understanding or developing skills [2]. Previous research has highlighted the importance that teachers have in support for reflective processes [6]. Research indicates adaptive or personalised scaffolding of SRL approaches by teachers leads to a greater adoption of SRL skills as compared to conditions where no scaffolding was offered [1]. We have also seen that a robotic tutor can increase trust, enjoyment, and understanding in explanations of an OLM as compared to on-screen feedback alone [3].

Our goal is to ultimately develop a robotic tutor that can scaffold SRL via an OLM. To this end, we present a user centred design (UCD) study to elicit how teachers personalise feedback using an OLM to scaffold reflection and SRL.

2 Approach

The aim of this study is to identify how teachers use an OLM to scaffold reflection and SRL in teaching a student. As a meta-cognitive interaction observed in a laboratory may not be valid in a school environment [4] we employ a UCD approach at the student's school.

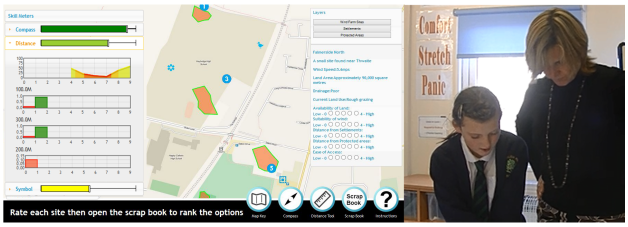

Fig. 1: OLM, Learning Activity, Learner and Teacher

We have developed a map based learning scenario that enables the learner to exhibit SRL skills and processes i.e. self-monitoring, goal setting, and help seeking. The learner has a choice of activities of varying difficulty that allow them to practice map reading skills for distance, direction, and map symbols. The learner also has access to tools which can provide help with the activity.

This study involves 3 teachers and 6 students, with each teacher assisting 2 students individually through the activity, resulting in 6 sessions in total. The students are of mixed sex and ability. Prior to the session the teachers were given an introduction to the task and the OLM. The teachers were asked to provide assistance using the OLM where possible but to also focus on helping the student acquire SRL skills and to avoid giving direct answers. The students were asked to use the learning activity to practice and develop their map reading skills. They were informed that they were in charge of their own learning and could choose the order of the activities and how long they wanted to do any activity for. This is similar to the adaptive content and process scaffolding (ACPS) [1], where students are provided with adaptive content scaffolding to ensure they are meeting the overall learning goal and adaptive process scaffolding to ensure they are using the key self-regulatory processes, such as reflection, planning, and using the tools available in the activity.

We build a learner model of the student's map reading competencies using constraint based modelling. This is an approach whereby competency values are calculated by checking the learner's actions against a set of relevant constraints [5]. Distance and direction are evaluated based on the learner identifying a point on a map that is a particular distance and/or direction from a starting point. Symbol knowledge is tested by selecting a particular symbol from a bank of symbols or from a choice on a map. It is possible for the learner to provide a partially correct answer by meeting the distance constraint but breaking the direction and symbol constraint, this is reflected in the model with distance competency increasing and the direction and symbol competency decreasing. Time taken to answer is also taken in to account; the competency can only reach the highest level when time taken to answer is low which indicates that the learner is proficient. To ensure that the competency values are current we use a weighted average so that recent evidence is given a higher weighting than older evidence in determining the overall level of the competency.

The OLM shows skill meters for each competency and is visible at all times in the top left of the screen. Changes to the skill meters are made visible with animation and there are indicators to show the previous values. The learner can inspect a history of the most recent 10 pieces of evidence for each individual competency by clicking on the corresponding skill meter. For example, if the learner expands the skill meter for distance then they will see evidence broken into north, east, south, west; e.g. they may see that they have met the north and south constraints correctly but not the west and the east constraints. This enables the user of the OLM to see exactly in which aspect of the competency their strengths and weaknesses lie.

3 Examples of SRL Process Scaffolding with an OLM

Our initial analysis concerned whether the teachers used the OLM to scaffold SRL process. Video and task logs were reviewed and coded by a single coder. The coding scheme is based on Zimmerman's SRL phase and sub-process [7]. Our results revealed that the teachers used the OLM to scaffold the following SRL processes:

Self-reflection phase. We see that the teachers use the OLM to prompt the learners to reflect in a number of ways, including prompting the learner to self-evaluate and attribute causes for the changes in the model of their developing skills: "What is that showing us then?" and "It's good because you got everything right, what do you think would happen if you got something wrong?". We also see that the teachers show satisfaction as the competencies increase: "Oh well done! It has shot right back up again now!".

Forethought phase. The teachers then build upon the learner's awareness of their developing skills to help set goals and strategies. When the OLM is showing that the student has a high level of competency the teachers use the OLM to suggest moving on to a new activity: "I think you are pretty good on that, do you? So what about the inter-cardinal directions?" and "look at that! Now, do you think that was a bit easy for you? Do you want to try out some of the others?". If the student has not mastered a skill the teacher will suggest continuing the activity until they have: "This is really good, but this is wrong (referring to one element of the OLM), let's continue it so that we can get 100%".

Performance phase. The teacher also used the OLM as a basis for task strategies. If the learner is being overly cautious and double checking each answer with a tool the teacher will encourage them to be more confident and efficient: "Oh that's it, you are on a roll now (indicating OLM increase), you might not need to use the tool any more, you might have worked it out, what do you think?". When there is an issue with the learner's understanding, the OLM was used to highlight this: "Oh what happened to the meter, did you get that one right? *I think I went west.* Yeah, you can see here that the last attempt at east was wrong", the learner then proceeds to use the compass tool. Another example: "Why has it gone dark? That's interesting, what do you think that tells you there? *That I got it wrong*", the learner then proceeds to use the map key to identify the correct symbol.

Previous studies have suggested that prompts used to highlight errors to encourage self-reflection and reasoning can be effective in leading the learner to self-correct those errors [2] [4]. In addition, prompting reflection on skill levels can lead to improved problem selection [5]. These are the prompts we see the teachers using with the OLM to scaffold SRL behaviours.

4 Discussion and Conclusions

We see this study as the first step in investigating if scaffolding students' SRL behaviours using the OLM can be used to produce an environment in which students would experience greater learning gains through developing their SRL processes. From this study we are able to identify how teachers use our OLM to demonstrate reflection and SRL learning techniques. The teachers do this by drawing attention to the learner's developing competencies using the OLM, then encouraging reflection on why the competencies are changing and using this as a basis to suggest appropriate tools, goals, and strategies for the learner. We aim to use these findings as a basis for developing robot interactions.

The strength of this study lies in the fact that we have seen the OLM being used by experienced teachers and students in a natural school setting. However, the study is limited due to the small number of participants and short duration.

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