A Navigation Tool for Adaptive Guidance and Orientation in Open Responsive Learning Environments

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Abstract:

This paper presents a tool which supports self-regulated learning in the context of open responsive learning environments. The context of this tool is a technical infrastructure which empowers learners to build their own learning environments by choosing from existing learning resources, such as content, learning tools, and learner networks. In order to provide support for learners in this complex environment, a tool has been developed which supports the learner in both taking advantages from this technical infrastructure and navigating self-regulated though the own learning process. This tool is based on psycho-pedagogical models, such as the recently elaborated self-regulated learning process model, competence model, and learning activity model. The purpose of that tool is to provide adaptive guidance and orientation in order to empower the learner to learn self-regulated and to adopt the concept of learn self-regulated learning.

1 Introduction

One of the main goals of the ROLE research project (Open Responsive Learning Environment, [ROLE, 2010]) is to empower the learners to build their own learning environment and to use them for self-regulated learning. These individually compiled learning environments should be open regarding learning content, learning tools, and learner networks. Furthermore, they should be responsive to the learners by providing feedback on the learners' actions and they should enable and support self-regulated learning. Therefore a technical infrastructure is being created which allows learners to choose and select their learning resources (content, tools, and peers) and to navigate through their self-regulated learning processes. It is aimed that a great number of learning resources will be available which the learner can include in the own learning environment. An example for language learning can be seen in [Renzel, 2010].

The ROLE infrastructure is powerful and flexible and is supposed to be of great benefit for learners who know how to use this environment in a psychological and pedagogical meaningful way. Self-regulated learners (learners who know how learn and can control their own learning process) in the context of ROLE should be able to set their goals and plan their learning process, to build their own learning environment, to use the individually compiled learning environment, and to reflect on their own learning process. Furthermore, they should be able to use the ROLE infrastructure for these purposes or performing at least part of them

without technology (for example goal setting has not explicitly to be done technology-supported).

However, if learners are not able to control their learning process perfectly self-regulated, they will need some guidance and help. In order to provide effective guidance for self-regulated learning in the context of ROLE, a tool is being developed which helps learners to navigate through their own self-regulated learning processes. The basic approach of this tool is to provide concrete recommendations for performing cognitive and meta-cognitive learning activities and for using learning resources, such as content object, learning tools, and peers for collaboration. For grounding these recommendations on a theoretical basis, a psycho-pedagogical framework is used which defines the self-regulated learning process and how it can be used for scaffolding strategies. This theoretical approach is described in Section 2.

For designing navigational support, a tool from a different context but with a similar purpose has been taken as a basis for analysing the requirements and usage scenario. When driving a car or bicycle and the route to the destination is unknown, then people often make use of a GPS navigation tool (see Figure 1). They drive freely through a network of streets and get recommendation in each moment dependent on their current location. They can accept recommendations or not to accept them and deviate from the proposed route. In both cases this navigation tool adapts its recommendations to the actual position.

Figure 1. A typical GPS navigation tool which provides adaptive guidance and orientation for reaching a defined destination.

The approach for designing a navigation tool for self-regulated learning can benefit from the usage design of GPS navigation tools. The reason for the expected benefit is the similarity of the purpose and situation. Drivers getting adaptive guidance for individually driving to a defined destination are in a similar situation as learners getting adaptive guidance for individually navigating through the learning process. Section 3 describes the design of the navigation tool, which takes into account the features of the GPS navigation tool.

2 Self-regulated Learning Process Model

The Self-regulated Learning Process Model (SRL process model) describes how self-regulated learning should take place in a ROLE context and how learners can be supported to learn in a self-regulated way and. moreover, how learners improve self-regulated learning abilities [Fruhmann et al, 2010]. It is also connected to a model of cognitive and meta-cognitive learning activities which typically are performed in these situations. Furthermore, it relies on a competence model which also takes into account abilities for learning with specific tools and for the abilities of self-regulated learning.

The SRL process model consists of four learning phases which basically are the predominant activity groups that are supposed to be performed by learners in the context of the technical infrastructure of ROLE (see Figure 2). In short, these phases are (a) profile setting (including goal setting), (b) compiling the own learning environment, (c) using and learning with the individually compiled learning environment, and (d) performing self-reflective activities. This model is built upon the approach for self-regulated learning by Zimmerman [Zimmermann, 2002] which is based on three meta-cognitive phases (forethought phase (e.g. goal setting and planning), the performance phase (e.g. self-observation processes), and the self-reflection phase (e.g. self-reflection processes). In order to align these meta-cognitive phases with the ROLE infrastructure, learning activities have been defined which reflect both dimensions self-regulated activities on a meta-cognitive level as well as more concrete activities on a cognitive level which partly can be related to the technical infrastructure of ROLE. SRL activities are classified using SRL processes described in [Dabbagh, 2004] and more concrete activities are classified using the 8LEM model described in [Leclercq, 2009].

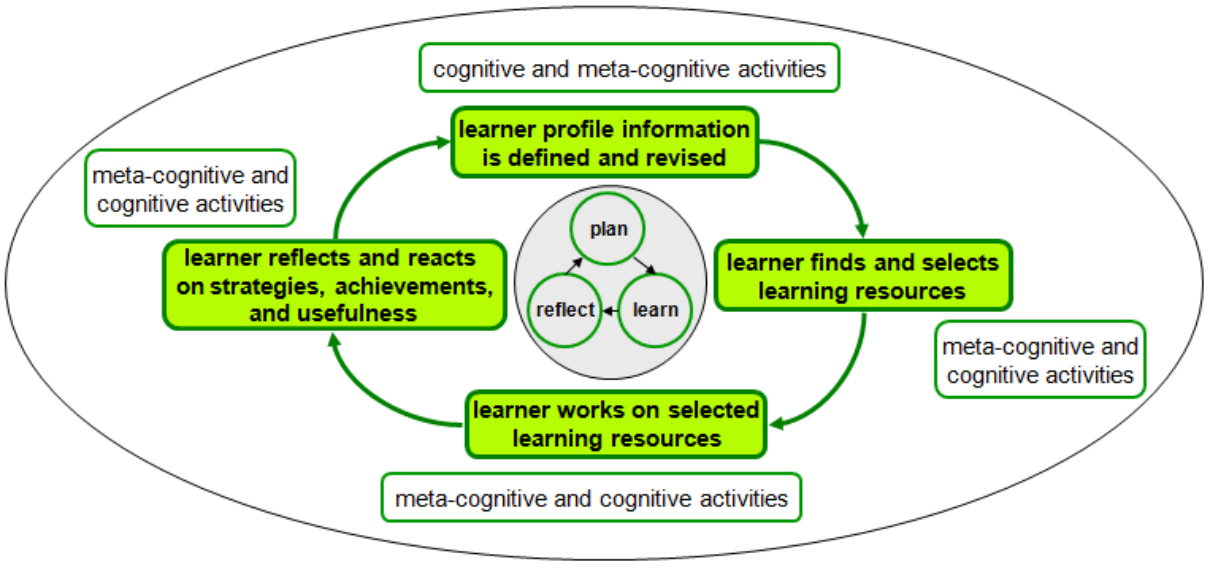

Figure 2. SRL Process Model. The diagram shows the four phases and indicates that each phase is made up of cognitive and meta-cognitive learning activities.

Furthermore, a competence model has been defined which includes self-regulatory competences and tool competences, besides the widely used competence definition regarding knowledge domains. A tool competence is regarded as the ability to perform a learning activity with a certain tool meaning the domain knowledge and domain competences can be obtained using this tool. Self-regulatory competences describe the abilities to perform certain

meta-cognitive learning activities associated with self-regulated learning. Both types of competences are important since they are prerequisite for certain recommendations. For example, goal setting activity should not be recommended to a person who is not able to perform goal setting.

The learner model contains the competences which a learner actually has available, where the three types of competences are taken into account. Furthermore, the learning goals are part of the learner model, whereby goals are structured hierarchically and can be assigned with competences (to be achieved). Goals can also be assigned with learning activities which should be performed to achieve the goal and with learning resources which should be used to reach the respective goal. The question how this user model is filled up with data is not focus of this paper. In short it can be stated that user model data can be set by learners themselves, by teachers or tutors, or created automatically by tracking and analysing learner behaviour.

Learning resources (especially tools) are associated with learning activities. For example, if a specific concept mapping tool is associated with the 'goal setting learning activity', then this tool can be recommended to be used if goal setting is suggested earlier. To achieve a more structured assignment, tools are analysed regarding their inherent functionalities and the functionalities are associated with learning activities. All these associates lead to a chain of relations which can be exploited for recommendation: SRL process phase - cognitive or meta-cognitive key activity - concrete activity - tool functionality - tool.

Based on the SRL process model, the learner model, and the assignments of learning activities to tools, a recommendation strategy has been elaborated, which is the underlying basis for the navigation tool. Basically adaptive guidance is provided by offering adapted recommendations to the learner. The recommendation strategy is built upon three important questions: First, what can or should be recommended, second, what are the conditions and required information in order to provide recommendations, and third, what are the parameters that control the degree of recommendations. Regarding the first question, learning activities and/or learning resources (learning content, tools, and peers) can be recommended. Basically, learning activities are recommended based on the learning process model, so that activities regarding self-regulated learning or activities regarding the 8LEM model can be recommended. Learning tools can be recommended based on the relation of possible activities with tools. Content can be recommended based on the personal goals of learners. The second question is mainly related to skills and preferences of learners. If special skills needed to perform self-regulated learning activities or to use specific tools, then possible recommendations can be restricted if learners do not have these skills. Furthermore, preferences may restrict recommendations if learners have preferences for or against certain activities or resources. Regarding the third questions learners may also control the degree of recommendations. For example, they can control if they would like to get recommendations only for learning activities, but not for resources.

3 Design and Implementation of the SRL Navigation Tool

In the introduction section above the usage of a GPS navigation tool is shortly explained.
In order to benefit from this approach, the key features of a typical GPS navigation tool are listed from the perspective of user requirements:

(1) Users know their destinations and indicate them before their journeys by either choosing it textually from a structured address list or by picking it visually on a street map.

(2) The tool calculates a route and provides textual and visual support for achieving the aimed destination. Route and support is mainly provided by giving recommendation of concrete driving actions ('turn left')
(3) The current location is either determined automatically or the user enters it manually.
(4) The support depends on the current location and is adapted to the actual position in terms of recommending streets which are available in each moment. This does not require that the user followed the originally planned route.
(5) The tool provides orientation because it displays the current location with the respective local context. The user can create individual plans based on this orientation information.

Combining the features of typical GPS navigation tools and the theoretical basis described in the last section helps to outline the design of the SRL navigation tool. By mapping the concepts of the GPS navigation tool to the SRL navigation tool, the key features of the GPS navigation tool can be taken over and modified by mapping the respective concepts. The geographic destination can be mapped to the learning goal, the route is mapped to a learning plan consisting of learning activities and resources, the current geographic position is mapped to he currently performed learning activities and used learning resources, the street map is mapped to a network of related and sequenced learning activities and resources, and the recommended actions are mapped to learning activities. Following this mapping, features of the SRL navigation can be defined as follows:

(1) It should be possible to define learning goals (as outlined in Section 2) which are taken into account by the recommendation engine
(2) The recommender engine creates a plan to achieve a goal by sequencing learning activities and adding learning resources to them. Recommendations are given in terms of learning activities and learning resources.
(3) The current learning activities and used learning resources are either entered manually by the learner or tracked automatically by the system.
(4) The learning activities currently performed and the learning resources currently used are taken into account and the plan is adapted to them.
(5) The tool provides orientation by displaying the current learning activities and resources in their local context

By putting these features into a time sequence the guidelines for the usage design of the SRL navigation tool can be derived. First the learner or teacher sets a goal and probably assigns it with competences necessary to reach this goal. Then the learner requests a learning plan which is graphically listed as a structure. The plan may contain learning activities of different granularity levels and learning resources. Furthermore, the elements of this plan depend on the preferences and competences of the user. For each element, the learner gets more information if needed. This is especially important for meta-cognitive activities which are more difficult to adopt and to perform for some learners. Then the learner takes up certain activities or resources and performs or uses them. As far as possible this is automatically tracked and stored. For example, it can be tracked which tool a learner has used. Other elements, such as cognitive or meta-cognitive activities are hard to track, so it is expected, that the learner marks these activities on the plan. At each step the learner can request a new full plan or only a sub-plan. For the new request the history (performed learning activities and used resources) are taken into account. Furthermore the history is visually represented in the context of the actual plan, which should provide orientation to the learner.

Development of the tool has been performed along this scenario which is reflected in the user interface (see screenshot in Figure3). It is split into an orientation and a recommendation area.

In the orientation area, the current state is given in terms of the SRL process phase and explanation is given for each phase. In the recommendation area the current learning plan is displayed and the learner can choose an element of the plan. Furthermore, goal setting can be done in an extra area. Adaptive guidance is realised by providing recommendations based on the current location in the learning plan. The strategy for recommendation is done as described in Section 2.

The learner can use this tool to navigate through the learning process in the ROLE environment by choosing learning resources available in ROLE. It is aimed that this tool helps learners to get an understanding of the self-regulated learning process model, so that they can apply it by their own without the help of personalised recommendations. In this sense they should become perfect self-regulated learners who are able to control all parts of their learning process.

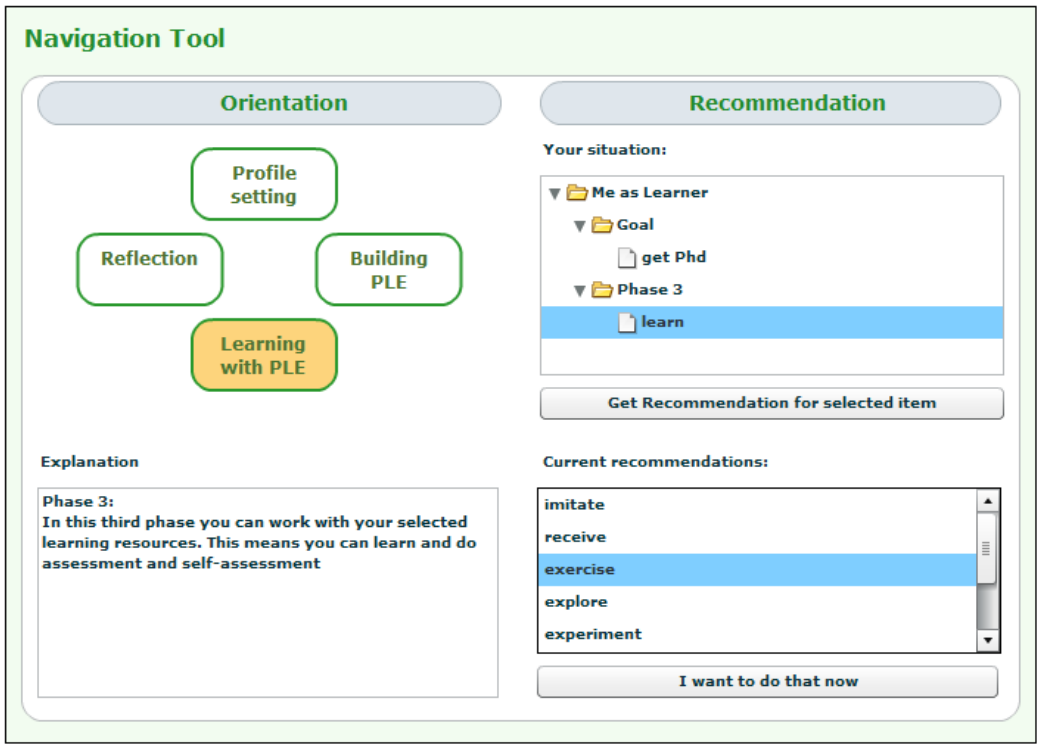

Figure 3: Screenshot of the Navigation Tool

4 Conclusion and Outlook

This paper presented the initial development of a navigation tool which supports learners to navigate through their own self-regulated learning process in a complex environment consisting of a great amount of learning resources. For providing guidance this tool takes into account preferences and competences of the learner as well as the current state in the learning process. Guidance is realised by providing personalised recommendation of learning activities and resources and by providing orientation regarding the current state.

Further work will focus on two important but missing features. First, a strategy for recommendation of content will be elaborated and developed. Since goals are mostly related to attaining competences regarding certain subject domains, this must also be reflected in the

recommendation strategy. Second, the integration of the SRL navigation tool in the ROLE infrastructure will be necessary to include the tool in the distributed environment of ROLE. This requires of having available the recommender service, the user profile service, and resource repository services on the Web. Furthermore, the navigation tool has to be adapted as widget which can be used in the widget container together with the other widgets of the personal learning environment.

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