Supporting Self-Regulated Learning in Personalised Learning Envrionments

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***Abstract*. The advantage of Personal Learning Environments (PLEs) is to empower a learner in taking control over his/her own learning process. The shift from just being controlled by a teacher towards taking control by oneself in a self-regulated learning (SRL) way can be basically initialised by providing learning environments that can be personalised and individually adapted or created instead of using 'one size fits all' learning environments. A lot of research and development on this subject has been done in the EU-Project ROLE (role-project.eu). In this context extensive experiments have been conducted with widget-based PLEs. Scenarios have been created, implemented, tested and evaluated in real world settings. The contribution of this paper is the presentation of a) three widget-based PLE scenarios, b) evaluation results on comparing the value of the presented PLE scenarios and c) evaluation results on comparing students and teachers point of views against the presented PLE scenarios including SRL aspects.**

Keywords; personal learning environments, self-regulated learning, open educational ressources, widgets, evaluation results

I. INTRODUCTION

Responsive Open Learning Environments (ROLE) are based on the idea of Personal Learning Environments (PLEs) by exploiting Cloud Computing Technology (examples are presented in chapter III). Instead of using traditional learning environments which provide tools and content by one single provider and are often owned by one specific educational organization ROLE exploits all existing and developing open educational sources including all popular Web2.0 resources such as Wikipedia, YouTube or Flickr. Historically the idea of PLEs is based on the fact that most learning takes place informally, in different contexts and scenarios, and that content is not provided by one single provider. Following this idea ROLE provides a framework essentially consisting of "enabler spaces" on the one hand and tools, content, services on the other hand [1]. Using this equipment everyone is invited to individually create his/her PLE. In PLE research it is seen as essential to have a learner challenged by offering him/her to create their individually controlled and preferred learning environment in order to trigger and motivate more self-regulated learning. Moreover this approach has the potential to enable and facilitate both informal and formal learning.

The paper presents three PLE scenarios which have been developed in the ROLE project. In real world testbeds learners are confronted with new ways of learning by working with the provided PLE scenarios. While the use of any PLE should trigger self-regulated learning it is especially the third and last PLE scenario which has been implemented a consequent mechanism to support SRL.

This paper investigates the attitudes and reasons for acceptance of PLE technology by students and teachers.

II. THE CHALLENGES OF SELF-REGULATED LEARNING IN PERSONAL LEARNING ENVRIONMENTS

A. SRL in Technology-enhanced Learning Environments

In the field of self-regulated learning (SRL) research it is often pointed to the important role of learners' strategic use of cognitive and metacognitive strategies to regulate their learning [2], [3], [4]. Still many learners show difficulties in applying concrete metacognitive strategies such as planning, goal setting, monitoring, evaluating and as a result perform less successful [5]. For this reason, much work has been focused on the assessment of students' SRL strategies to support the learning behaviour accordingly. This work is usually bound to highly controlled learning environment such as intelligent (tutoring) systems [5], [6], [7]. However, understanding, scaffolding or/and facilitating students' SRL skills is especially important in (responsive) open learning environments. In such open environments goals are less clear and obvious; therefore students might not necessarily be able to predict the outcome of the learning activity or the optimal learning path.

Nevertheless, it could be found that PLEs provide opportunities to enhance SRL skills, especially metacognitive skills, but learners need additional help and guidance [5] during the learning process. In this regard the concept of freedom and guidance comes into play. The concept of freedom and guidance is important, because highly motivated learners attain a better learning performance if they have more control over their learning, but lower motivated learners attain better learning

performance if they get more guidance [8]. Issing noted that this is also applicable to hypermedia learning environments.

In this regard it should be envisioned to develop services and learning environments that can be adapted to the individually degree of guidance and freedom according to the learner's needs and therefore offer the learner an optimal balanced level of control and responsibility for his or her learning environment [9].

B. *A Self-Regulated Learning Process Model Procedure*

In PLEs learners are in the position to create their own learning environment and shape it to their personal needs and learning objectives. In order to provide support in such an open learning approach an underlying and psycho-pedagogical sound model which represents the theoretical backbone of open environment learning has been defined, the Self-Regulated Learning Process Model (SRL PM). The SRL PM builds on the cyclic self-regulated learning model proposed by Zimmerman [10], which describes the learning process via three learning phases, namely forethought, learning and self-reflection. In open learning environments this three learning phase model was extended to reflect the need of selecting web-based learning resources, mostly widgets, to build and mash-up a PLE.

This extension leads to the four phase SRL PM including the phases of: (1) learner profile information is defined or revised, (2) learner finds and selects learning resources, (3) learner works on selected resources, and (4) learner reflects and reacts on learning strategies, achievements and usefulness (see Figure 1) [9].

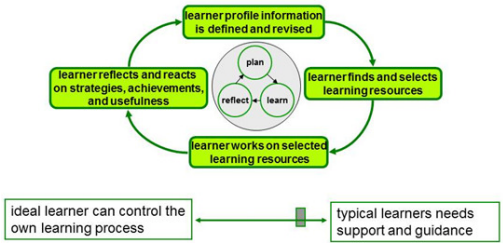

Figure 1: Self-Regulated Learning Process Model (SRL PM)

According to this model, especially meta-cognitive activities are supported by focusing on the recommendation of learning activities which can be performed through the usage of learning resources and therefore enhance self-regulated learning.

ROLE services such as the Mash-Up Recommender Widget (see Figure 7) offer guidance and help learners by presenting recommendations and according explanations, without limiting the degree of freedom, as the learner can freely choose between the recommendations made by ROLE services or other alternatives. This concept is based on an ontology that builds on a connection of learning phases of a SRL PM to learning strategies, techniques and activities [11]. In addition, it is shown how these SRL entities are linked to tool functionalities and therefore bridge psycho-pedagogical information and learning tools like widgets in our presented case studies.

III. SCENARIOS

This chapter describes three widget-based PLE scenarios which were evaluated (see chapter IV to VI).

In the ROLE project the basic equipment for creating PLEs has been developed according to the idea of an easy drag and drop system of widgets. Browser-based prototypes have been developed like sketched in Figure 2.

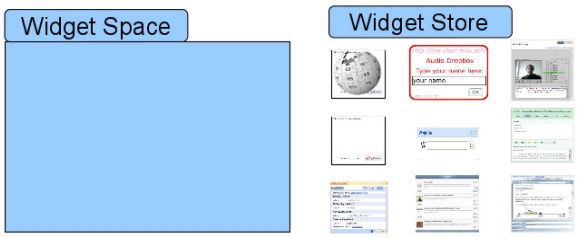

Figure 2: Browser- and Widget-based PLE concept

On the one hand a repository (widget store) is necessary to store and administrate useful widgets. On the other hand an enabler space (widget space) is necessary to have learners their individually preferred widgets integrated, used and managed in their personal style.

Starting from this provided prototype essentially consisting of Widget Store and Widget Space the creation of PLEs has been tested in real world use cases and scenarios which are described in the following sections.

A. *Scenario I*

In the first scenario learners were provided with the ROLE Widget Store [12] but they could also make extended use of widgets by using iGoogle gadgets [13]; (iGoogle gadgets: here the Google term for widgets). Furthermore, learners had the choice to either use iGoogle [14] or the ROLE sandbox [15] as an enabler space.

In the following the ROLE widget store is described as well as an example how ROLE widgets have been integrated and used in iGoogle.

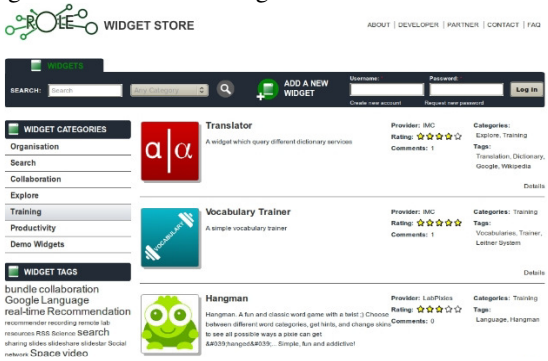

Figure 3: ROLE Widget Store

The ROLE Widget Store (Figure 3) is a living system and repository of open educational resources. It hosts and offers all kind of learning widgets. For registered developers and users it is possible to "add a new widget" (see icon on the upper navigation in Figure 3) whenever they have found or created a useful widget with pedagogical value. Everyone interested in these kinds of open educational resources can make use of it.

Figure 4: Widget Space iGoogle filled with ROLE widgets

Figure 4 [16] shows one example of a browser- and widget-based PLE. In this example the iGoogle environment hosts a PLE. The widgets were added from the ROLE Widget Store.

This scenario had already been tested by students in 2011 at an early stage of development. Results of this evaluation were already presented and discussed at PLE2011 conference [17], [18].

B. Scenario II

The following use case is not an implemented prototype, but a mock-up which has been created as a consequence of early stage evaluations [17]. A result of these early evaluations was the desire of some users to not be constrained to a browser-based widget-space, but to use single widgets wherever and whenever they want, e.g. on a desktop and offline.

The mock-up scenarios presented in Figure 5 and Figure 6 have been used to discuss and evaluate taking into account teachers' and students' perspectives (see chapters IV to VI). Both mock-up scenarios are designed with the idea to be not restricted to use the widgets within a browser-based widget space like iGoogle. Moreover instead of using a collection of widgets at the same place it should also be possible to select and use only one very specific widget.

Thus, choosing between several means of (personalised) integrating and using the offered widgets should be one distinctive added value of all widgets in the ROLE Widget Store.

Figure 5 presents the use of the ROLE translator widget which accesses and displays the results of different popular resources such as LEO.org, dict.cc, Wikipedia, Google translator all at the same time for comparisons of translations [12].

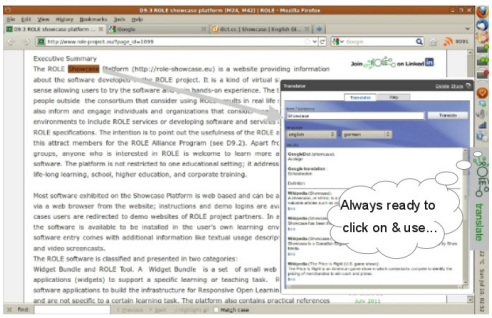

Figure 5: ROLE Translator Widget embedded in the Desktop-Sidebar

This kind of PLE is created to efficiently work on a text document. While reading or writing a text in a foreign language the ROLE translator widget is always visible and usable in the desktop-sidebar. A click on the sidebar-widget-icon will open the widget like sketched in Figure 5. The widget will stay in the front while copying a term from the document in the background to transfer this term to the translator widget. The translation is shown including the resource of translation (dict.cc, Wikipedia, Google, etc.). This mean of widget integration should ensure a very efficient way of learning and working. It enables the user to learn new terms by using the widget but without losing sight of the text document. Moreover, using several resources of Web2.0 based translations stimulates the user to have a more critical reflection of the offered translations.

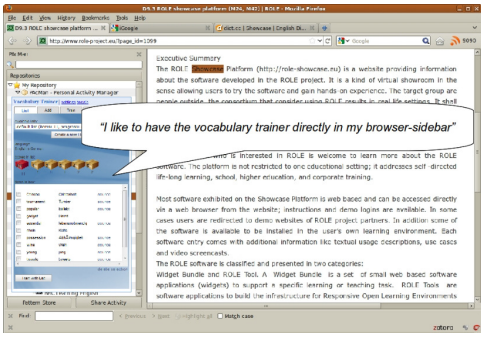

Figure 6: Vocabulary Trainer Widget embedded in the Browser-Sidebar

Figure 6 presents the use of a vocabulary trainer widget which can be opened in the browser sidebar right next to the text a user is working on. While reading the text in a foreign language terms might appear a user is not familiar with and wants to systematically train them. Then the terms can be added to the vocabulary trainer widget.

The widget has been implemented a slightly modified Leitner system [19]. Thus, vocabulary can be trained efficiently by using this widget. For translations the same Web services are used as in the mentioned ROLE

Translator widget. Moreover Flickr is used to suggest pictures for visualising the terms. The widget has four functionalities represented by four tabs: "Add", "List", "Train" and "Stats". A detailed description of this widget and further widget bundles can be found at the ROLE Showcase Platform [20].

Important for the presented evaluation is the fact that these mock-up scenarios give ideas of some other ways how to use the offered widgets from the ROLE Widget Store.

C. *Scenario III*

Scenario III presents an implemented prototype to mash-up PLEs which is called "Mash-Up Recommender" (MR, see Figure 7).

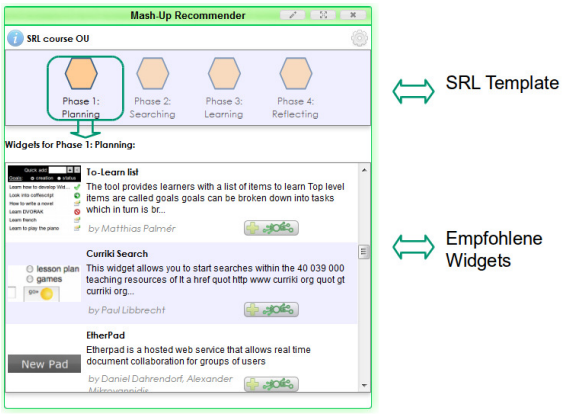

Figure 7: Mash-Up Recommender Widget (MR)

The unique aspect of the MR is the fact that it services as a gate and a guide to access the large number of widgets and gadgets available on the web in a reasonable self-regulated way. For this purpose the MR templates are based on learning activities related to the SRL Process Model described in chapter II.

The main purpose of the MR is to support the self-regulation of learners in mashing up their learning environments. Therefore, psycho-pedagogical information is transferred into applicable recommendation by using the MR widget. The MR widget can be seen as a filtering system that provides more or less widgets that can be added to the PLE depending on the used template. The MR contains a predefined template called SRL template. The SRL template can consist of the four basic SRL phases "Planning", "Searching", "Learning" and "Reflecting" which are displayed in the upper navigation of the MR (see Figure 7). Each category contains a number of relevant widgets, e.g. the category "Reflecting" contains widgets such as recording tools, writing tools, mind map tools etc. To have the SRL template adequately working according these four SRL phases a ROLE ontology [11] service has been implemented for the respective functionalities of the SRL entities (learning strategies, techniques and activities). The ontology predefines associated widgets which will be returned by the ROLE Widget Store. Instead of the four SRL phases, the template can also consist of learning activities on a finer granularity level, namely learning strategies and learning techniques. Such templates can be created using a special authoring tool [21].

The MR can be used to provide guidance on different levels and for different stakeholders (e.g. teachers, workplace learners, students, beginners, and advanced students or experts). A high level of guidance is necessary for instance for beginners and can be prepared by a complete predefined PLEs based on a specific template by a teacher or tutor. Later the tutor can share this PLE with her students who can use it or modify. A lower level of guidance can be provided if the teacher just shares the template with the students, so that they have to create their own PLE. For example, a teacher could select the SRL entities goal setting, resource searching, note taking, and reflecting for a template. Teachers or learners using this template could easily search these SRL entities for widgets and include them in a PLE. In this way the PLE consists of widgets for each SRL entity. Learning strategies are on a higher abstraction level, which results in an increased number of widgets that can be recommended. Learning techniques are on a lower abstraction level, which leads to a smaller number of related widgets that can be recommended. While in the first case the learner gets more widgets recommended and thus less guidance, in the second case the level of guidance is higher because of the smaller number of recommended widgets. For a detailed description of the MR and its technical background see [22].

IV. Focus Groups and Evaluation

The evaluation took place equally in two **focus groups**:

- **Teachers:** The three scenarios were presented, tested and evaluated in a teacher workshop taking place at the Aha-Conference 2012 in Vienna [23]. In total 8 participants (4 male, 4 female) from Austria and Germany took part. The age ranged from 27 to 55 (Average age: 40.43). Most of them were teachers at schools or universities. But there were participants who also worked as consultant or technical support at higher education institutions.
- **Students**: The three scenarios were evaluated in the same way in a test bed at the University of Vienna within a course called "Didactical Design" (Sylvana Kroop). The course was for 25 Master at the Faculty of Informatics in summer semester 2012. 22 students (11 male, 11 female) regularly participated in the prototype evaluation. The age of students ranged from 23 to 48 (Average age: 28.48). They all studied in the field of computer science. Some of them were teachers who already taught at schools but still enjoyed their academic training. Thus, in the discussion some students evaluated the scenarios from a teacher's point of view.

Although quantitative as well as qualitative data were collected in the evaluation with both focus groups this paper only presents the quantitative results due to page limits of this paper.

Quantitative data were essentially collected by a short questionnaire in the end of testing and discussing the three scenarios. To investigate the main research question if and why these PLE scenarios will be accepted or rejected by students and teachers two more concrete questions were ask to think about while testing and discussing each of the three scenarios:

- The first question was on *worsening / improvement of learning outcome*;
- the second question on the technical including cognitive and time-wise *burden / ease of personal learning process*.

The answer categories ranged on a six-point-Likert-scale from 1: worsening to 6: improvement resp. 1: burden to 6: ease, which means: the higher the value the better the acceptance of the respective scenario.

V. Results Obtained by Teachers

Figure 8 presents the results obtained through the questionnaire teachers filled out after finishing the group discussions at the end of the workshop.

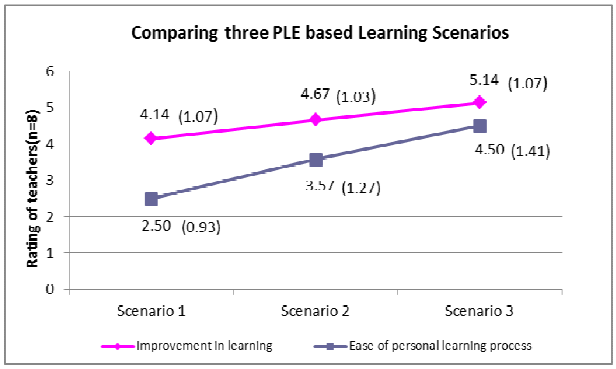

Figure 8: Results of Teacher Workshop (n=8)

The graphic shows the mean values and the standard deviation (in brackets) for the three scenarios. Each of the scenarios was rated by eight teachers according to the two evaluation criteria described in chapter IV. Due to the small number of participants no inference statistical analyses were conducted.

The question regarding a possible *improvement in learning* was answered most positive in scenario 3: Mean value of improvement of learning increased from 4.14 in scenario 1 to 4.67 in scenario 2 up to 5.14 in scenario 3. The standard deviations show that respondents do not differ very much in the assessment of the three scenarios concerning improvement in learning; it ranges from 1.03 to 1.07. It tends to be consensus in this question.

The question regarding a possible *ease of the personal learning process* was altogether also rated most positive in scenario 3: The mean value is 4.50. But at the same time there is also the highest standard deviation of 1.41 revealing a wider disagreement among the respondents in this question. In contrast to scenario 3 the worst result is displayed for scenario 1 with a mean value of 2.50. Moreover in this case respondents do agree most indicated by the lowest standard deviation of 0.93. In other words: While the teachers come to the agreement that scenario 1 will tend to be an additional burden instead of easing the personal learning process scenario 3 is rated much better by teachers but with a broader variance of opinions.

Altogether the results in both questions show a coherent picture for the three evaluated scenarios: While scenario 1 can be assumed to be potentially rejected by teachers scenario 3 tends to be accepted.

VI. Results Obtained by Students

Figure 9 presents the results obtained through the questionnaire which was filled out by 19 students after finishing their group discussions.

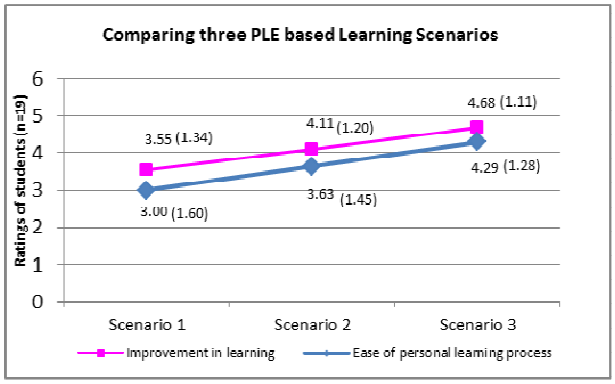

Figure 9: Results of Students Workshop (N=19)

The question regarding a possible *improvement in learning* was again rated best in scenario 3: The mean value increased from 3.55 in scenario 1 to 4.11 in scenario 2 up to 4.68 in scenario 3. The standard deviation (sd) shows that the respondents differ most in rating scenario 1 (sd=1.34) followed by scenario 2 (sd=1.20) and scenario 3 (sd=1.11). In other words: Students not only rated scenario 3 best but also agreed in the answers of this question in scenario 3 most.

The question regarding a possible *ease of the personal learning process* was also rated best in scenario 3 with a mean value of 4.29. Students also agreed in the answers of scenario 3 most (sd=1.28) while they had the broadest variance of opinions in scenario 1 (sd=1.60) which was rated lowest with the mean value of 3.00.

Considering a significance test scenario 3 is significantly better than scenario 1 in both questions (*Improvement*: F2,36 =5.48, p=0.008; *Ease*: F2,36 =4.52, p=0.018). Due to the small sample this can be randomly and thus is not further discussed.

Altogether the results in both questions show again a coherent picture for the three evaluated scenarios: While the results of scenario 1 neither show a clear tendency to be rejected nor to be accepted scenario 3 clearly tends to be accepted by students in this comparison of PLE scenarios.

VII. CONCLUSION

The use of widgets within a widget space such as iGoogle was evaluated positive in its easy technical handling but negative in the challenge to efficiently support daily learning activities. Thus there is neither acceptance nor a clear rejection of scenario 1.

Better accepted was the use of single widgets wherever and whenever learners wants them to use (e.g. in a desktop-sidebar or browser-sidebar, online and offline) sketched in scenario 2

Best accepted was the idea to support self-regulated learning (SRL) by using a four-phases activity model while learners are challenged to select widgets from a wide variety (scenario 3). The idea to connect different stages of SRL (Planning, Searching, Learning, Reflecting) with corresponding widgets was seen most needed and most useful.

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