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Evaluation on Students' and Teachers' Acceptance of Widget- and Cloud-based Personal Learning Environments

Sylvana Kroop
(Centre for Social Innovation, Department Technology & Knowledge, Vienna, Austria
kroop@zsi.at)

Abstract: Instead of using traditional learning environments which contain tools and content of a single provider that are often owned by one specific educational organization, the presented idea of Widget- and Cloud-based Personal Learning Environments (PLEs) exploits a variety of existing and developing open educational sources including popular Web2.0 resources such as YouTube, Flickr or Wikipedia. The main contribution of this paper is the analysis of teachers' and students' attitudes and reasons for acceptance of widget- and cloud-computing based PLE technology. A quantitative and qualitative comparison of three widget-based PLE scenarios reveals the benefits as well as barriers of the new PLE technology regarding a) learning outcome and b) (cognitive, technical, time-wise) ease of the personal learning process. Findings show that a systematic cloud computing approach - software as a service (SaaS) where users do not need to install and run tools locally - is preferred. It saves time and meets the needs to keep the personal environment flexible and up to date. But while users have to manage a broad range of tools and content their most essential request is to be efficiently supported by the system in regard to their individual learning needs, e.g. in the decision making process of selecting and evaluating relevant tools.

Keywords: personal learning environments, widgets, cloud computing, open educational resources, self-regulated learning, participatory research design, evaluation results
Categories: D.2, D.2.1, D.2.10, J.4, L.0, L.1.1, L.1.2, L.1.3, L.2, L.2.0, L.2.1, L.2.2, L.2.3, L.2.4, L.2.7, L.3, L.3.0, L.3.1, L.3.3, L.3.4, L.3.5, L.3.6, L.3.7, L.3.8, L.6, M.5

1 Introduction

In the EU co-funded IP project "Responsive Open Learning Environments" (ROLE) a framework for cloud-computing and widget-based personal learning environments (PLEs) has been developed and evaluated. Responsive Open Learning Environments are based on the idea of Personal Learning Environments (PLEs) by exploiting Cloud Computing Technology. 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 [Govaerts et al., 2011b]. 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 widget- and cloud-computing based PLE technology by students and teachers.

2 The Widget- and Cloud-based Approach of PLEs

The ROLE PLE concept follows a widget-based, cloud-computing approach which is here described and defined in more detail.

As already mentioned above the theoretical idea of PLEs is not a specific software application, a PLE is rather a concept based on the idea to have learner-centric Web 2.0 based environments individually designed. It is not a one size fits all learning environment but a personalised environment a learner takes control over his/her own learning process instead of being controlled by a pre-delivered orchestration of learning goals, tools, services, content. 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 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 1.

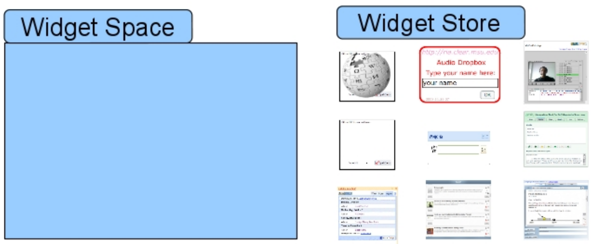

Figure 1: Browser- and Widget-based PLE concept

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.

From a user-perspective, ROLE is Software as a Service (SaaS) [Mell and Grance, 2011], [Vaquero et al., 2008] – the user does not install and run it locally. This **Cloud computing paradigm** affects three main aspects of the user-visible parts of ROLE:

- **Widget Space:** The widget space contains a number of personally selected learning widgets whereby all of them access and use already existing and established external open educational resources. It is the virtual environment where the user installs and uses its widgets.
- **Single Widget:** A single widget abstracts (accesses and uses) at least one single external resource. There are widgets accessing and using just one single external resource, e.g. a Wikipedia widget or a LEO dictionary widget, but there are also widgets which have been implemented the added value of cloud computing to an extensive degree. One example is the "ROLE translator widget" which accesses and displays the results of different popular resources such as LEO.org, dict.cc, Wikipedia, Google translator. The results of translating a specific term are used from all translating resources at the same time and displayed in the same place by using the ROLE translator widget. Thus a learner has a better and more critical overview by being able to quickly compare the provided Web2.0 based translation data. One more interesting example of a cloud computing based widget is "Binocs" which displays search results by using different external resources and depending from the used resources of a personal network of trusted friends, colleagues and experts [Govaerts et al., 2011a]. All widgets can be found in the ROLE Widget Store described in the following section.
- **Multiple Devices:** ROLE widgets and content can be accessed and used with different devices. Depending on the widgets and content it can be used by all kind of browser-based applications on notebooks, mobile phones, ipads, padphones as well as on ibooks.

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.

3 Three PLE Scenarios

This chapter describes three widget-based PLE scenarios which were evaluated in real-life settings (see chapter 4 to 7).

3.1 Scenario I

In the first scenario learners were provided with the ROLE Widget Store [© ROLE Consortium 2009-2012b] but they could also make extended use of widgets by using iGoogle gadgets [iGoogle gadgets 2012]; (iGoogle gadgets: here the Google term for widgets). Furthermore, learners had the choice to either use iGoogle [iGoogle environment 2012] or the ROLE sandbox [© ROLE Consortium 2009-2012c] as an enabler space.

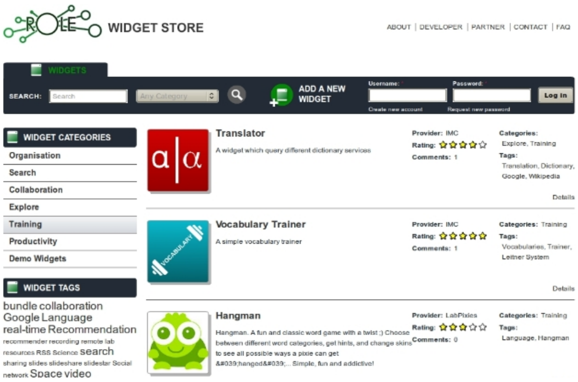

Figure 2: ROLE Widget Store

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

The ROLE Widget Store (Figure 2) 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 2) 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 3: Widget Space iGoogle filled with ROLE widgets

Figure 3 [Kroop, 2011b] 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 [Kroop, 2011a], [Kroop, 2011c].

One important result was the agreement that such a widget-based PLE can be assembled very easy and quick by drag & drop. This has been seen as a clear advantage of this scenario. Students stated: "The assembling of widgets is much more comfortable than expected.", "Technical expertise is hardly required; everyone can use it." Moreover students identified a number of widgets to be very useful by offering the added value of cloud computing; for example the already shortly described "ROLE translator" widget.

The ease of use and the technology supported efficiency in learning are key criteria in a learner's decision if a new technology is used. However, the easy use of a technology is a basic requirement but not enough to be accepted by teachers and students for their daily use. The need of such a technology and the (usability +learning) concept on a whole must be convincing and meet the individual requirements. In case of the provided widget space (e.g. iGoogle) the participants could handle it easily but most of them could hardly imagine using it in their daily learning activities.

Consequently another important result was the tendency that the students were not convinced by an iGoogle PLE. The students argued that the work on content within iGoogle was experiences to be uncomfortable, inefficient or in general not possible. A representative statement by a student: "At the moment I would not use it because I do not want to use iGoogle all the time. This kind of PLE is not corresponding to daily learning conditions." In sum iGoogle PLE was evaluated to be inadequate. The degree of freedom while learning with an iGoogle PLE is too restricted.

The overall conclusion of the early stage evaluation [Kroop, 2011a] is on the one side that the widget-based PLE use cases triggered learners to learn more self-directed regarding searching, selecting, testing, evaluating, deciding, aggregating, organising, assembling, designing and administrating web-resources and web-services, tools and content. But on the other side students are still uncertain if they like this new way of learning. Students were often overwhelmed by the challenge to efficiently manage the "ocean" of information and resources in a convincing quality. Accordingly there is a significant request of learners to be efficiently supported by personal learning environments in order to meet the challenge of self-regulated learning in context of Web 2.0 based cloud computing environments.

3.2 Scenario 2

The following use case is not an implemented prototype, but a mock-up which has been created as a consequence of early stage evaluations. 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 4 and Figure 5 have been used to discuss and evaluate taking into account teachers' and students' perspectives (see chapters 4 to 7). 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 4: ROLE Translator Widget embedded in the Desktop-Sidebar

Figure 4 [Kroop, 2011b] presents the use of the already described ROLE translator widget. 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 4. 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.

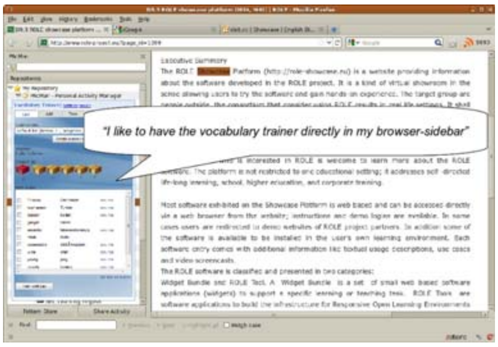

Figure 5: Vocabulary Trainer Widget embedded in the Browser-Sidebar

Figure 5 [Kroop, 2011b] 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 [Leitner, 2011]. Thus, vocabulary can be trained efficiently by using this widget. For translations the same Web services are used as in the described 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 [© ROLE Consortium 2009-2012a].

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.

3.3 Scenario 3

Scenario 3 presents an implemented Mash-Up Recommender Widget (MR, see Figure 7) which consequently exploits the concept of a Self-Regulated Learning Process Model (SRL PM, see Figure 6) created and developed in the ROLE project.

3.3.1 Self-Regulated Learning in Technology-Enhanced Learning Environments

In self-regulated learning (SRL) research a learner's strategic use of cognitive and metacognitive strategies to regulate his/her learning plays an important role [Boekaerts, 1999], [Mandl and Friedrich, 2006], [Winne and Hadwin, 2008]. Still many learners show difficulties in applying concrete metacognitive strategies such as planning, goal setting, monitoring, evaluating and as a result perform less successful [Bannert, 2006]. 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 [Bannert, 2006], [Conati and Vanlehn, 2000], [Azevedo et al., 2012]. 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 [Bannert, 2006] 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 [Issing and Klimsa, 2002]. 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 [Fruhmann et al., 2010].

3.3.2 A Self-Regulated Learning Process Model

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 [Zimmerman, 2002], 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 6) [Fruhmann et al., 2010].

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.

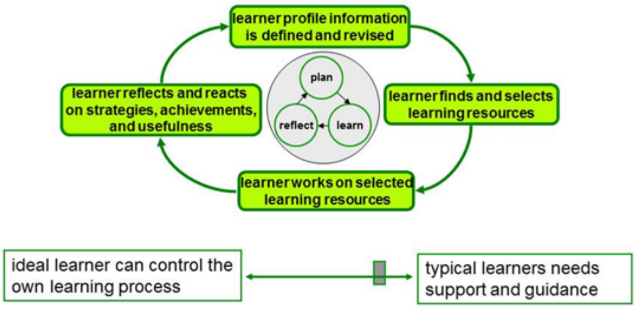

Figure 6: Self-Regulated Learning Process Model (SRL PM)

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 [Berthold et al., 2012]. 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.

3.3.3 Mash-Up Recommender Widget (MR)

Based on the presented SRL Process Model (SRL PM, see Figure 6) the Mash-Up Recommender Widget (MR) has been implemented as a well working prototype to mash-up PLEs (MR, see Figure 7). It provided the test application which has been evaluated by teachers and students as well (see test beds in chapter 4).

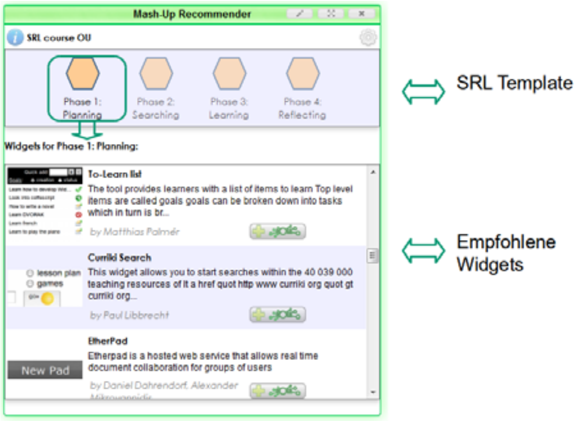

Figure 7: Mash-Up Recommender Widget (MR)

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. To support the self-regulation of learners in mashing up their learning environments is the main purpose of the MR. For this reason 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 service [Berthold et al., 2012] 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 [Nussbaumer et al., 2012b].

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 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 [Nussbaumer et al., 2012a].

4 Test Beds and Evaluation Design

This chapter describes how the three widget-based PLE scenarios presented in chapter 3 were evaluated.

4.1 Description of Test beds

Mock-up and prototypes were evaluated 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 [Kroop and Berthold, 2012]. In total 8 participants (4 male, 4 female) from Austria and Germany took part. 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. Due to the time constrains of the conference workshop some steps of evaluation were skipped liked sketched in Figure 8.
- **Students**: Beside the teacher workshop the three scenarios were evaluated in a test bed at the University of Vienna within a course called "Didactical Design". The course was for 25 Master students (incl. 2 doctoral students) 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: 28,5). 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. In contrast to the workshop with the experienced teachers at the Aha-Conference the evaluation with students could be conducted over several weeks and thus in more detail. Consequently the evaluation of the three scenarios with students provides more data and insights gained from the different steps sketched in Figure 8.

4.2 Evaluation Design

The evaluation is based on a participatory research design which means that important end-user groups of PLEs such as teachers and students have been involved at different stages of conceptual and technological development (mock-up and well developed prototypes). This allows the involved teachers and students not only to participate in the research process but also to essentially influence further developments. Their attitudes and judgements while testing the provided prototypes and mock-up are of high value to establish certainty to reasonably adjust the direction of research and development.

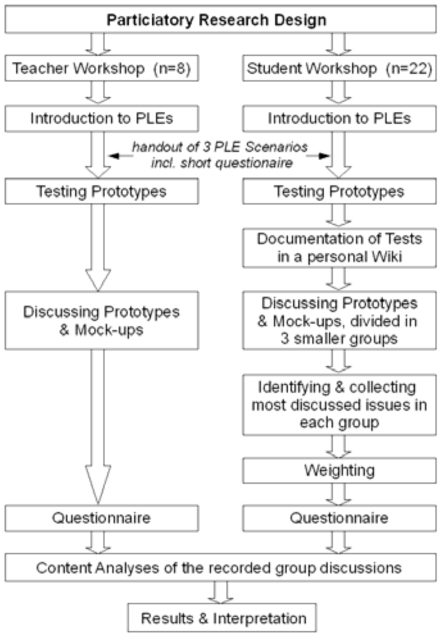

Figure 8: Evaluation Design

Figure 8 sketches the steps how the two focus groups were involved in the research process.

As already mentioned in the description of test beds there were different time constraints in the two focus groups. Thus the evaluation process in the two focus groups was designed with a different degree of intensity like sketched in Figure 8. While teachers only participated in the main evaluation steps (*introduction, testing, discussing*, and *questionnaire*) students were provided with additional time and additional tools (such as a *personal wiki* for documentation and reflection as well as a *weighting* instrument where a certain number of points could be individually added to most discussed issues regarding the provided and tested scenarios). Altogether compared to the involved teachers the students had a better chance to explore and discuss the PLE scenarios in detail.

However, both focus groups (teachers and students) were provided with the same introducing information and the same evaluation material (handouts and questionnaire). To assure a comparison between the teachers and students point of views this paper only presents the qualitative and quantitative data and results of the main data collections steps (group discussion and individual questionnaire) which were conducted in both workshops.

5 Data Collection

Based on the participatory research design the data collections used for the results in this paper are here described in more detail.

5.1 Quantitative Data

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.

As indicated in Figure 8 this short questionnaire including an attached hand-out on the three scenarios was distributed to the participants at the beginning of testing the prototypes. Thus, these questions were leading the participants' thoughts in all steps of evaluation.

5.2 Qualitative Data

Qualitative data were essentially collected by group discussions and a subsequent content analysis (a la Mayring and Flick) of the recorded and minuted discussions.

- Teacher workshop: All 8 teachers plus 2 instructors and moderators were discussing in one group.
- Student workshop: The 22 students were divided in 3 groups to discuss their prototype tests, experiences, impressions and opinions on the three evaluated scenarios. Each group was asked to designate a moderator.

As mentioned above the discussions were essentially driven by the two questions resp. discussion criteria provided on the hand-out. Moreover, it was recommended to discuss one scenario after another against the two questions and in comparison to the respective other two scenarios.

Beside the structured and moderated group discussions there were spontaneous reactions and upcoming comments from participants while testing the prototypes. Participants' feedback was expected to be unstructured and unprompted and reflected individually or in smaller teams. The workshop organisers and moderators were listening to the discussions, explained certain aspects if necessary and took notes on such spontaneous feedback.

Independent of group discussions and their consensus participants could provide their feedback individually in a comment field at the end of the final questionnaire.

6 Results obtained by Teachers

This chapter presents the evaluation results of the three scenarios according to the evaluation with teachers.

6.1 Quantitative Data

Figure 9 presents the results obtained through the questionnaire teachers filled out after finishing the group discussions at the end of the workshop.

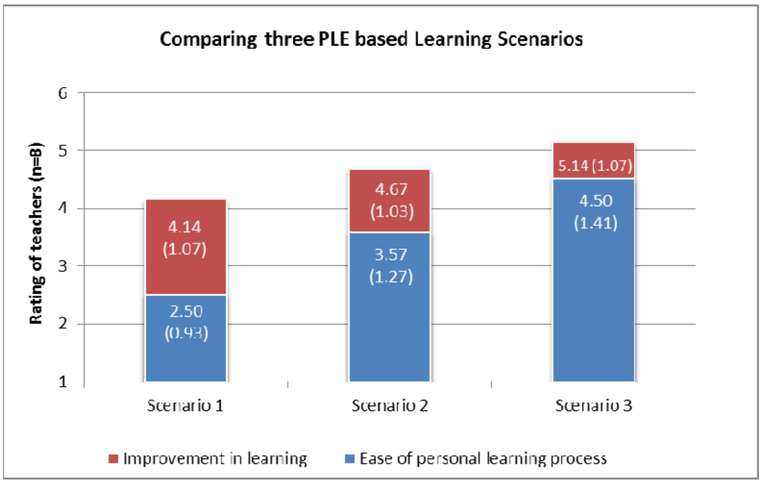

Figure 9: Results of Teacher Workshop (n=8)

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 5. 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 (in brackets) 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.

6.2 Qualitative Data

After and while testing the PLE prototypes teachers enthusiastically discussed the usefulness of the presented PLE scenarios. While the involved teachers were in general very interested in the widget based PLE approach they spend most time on testing, understanding and discussing scenario 3. Reason for this might be the fact that only scenario 3 was introduced to explicitly support self-regulated learning by an implemented SRL model (see Figure 6). Indeed was the idea to offer SRL-guidance while selecting individually most useful learning widgets most attractive for teachers. However, most concerns teachers raised was the time-wise burden in several aspects:

- to get in general used to the new PLE technology
- to create a useful PLE in order to use it for the content taught in school

and - for the most ambitious request:

- to create and provide own SRL templates (see Figure 7) which are adapted to a specific course or specific learning content.

This time-consuming effort could be a barrier for the uptake of the new technology. In regard of creating own SRL-templates teachers reported the least agreement. It would need additional competencies to handle an authoring tool. Thus most effort would be needed to use the Mashup-Recommender (scenario 3) in this very course-individually adapted and provided way.

Altogether the discussion with teachers revealed that although there might be an additional effort compared to traditional learning and teaching the idea of scenario 3 was most accepted and recommended. At the end of the workshop the involved teachers strongly expressed their wish to try out a PLE in their daily activities and thus created a mailing list in order to be informed and provided by further material, tutorials, online courses or upcoming workshops on this topic.

7 Results obtained by Students

This chapter presents the testbed results of the three scenarios described in chapter 3 according the evaluation described in chapter 4-5.

7.1 Quantitative Data

Figure 10 presents the results obtained through the questionnaire which was filled out by 19 students after finishing their group discussions.

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.

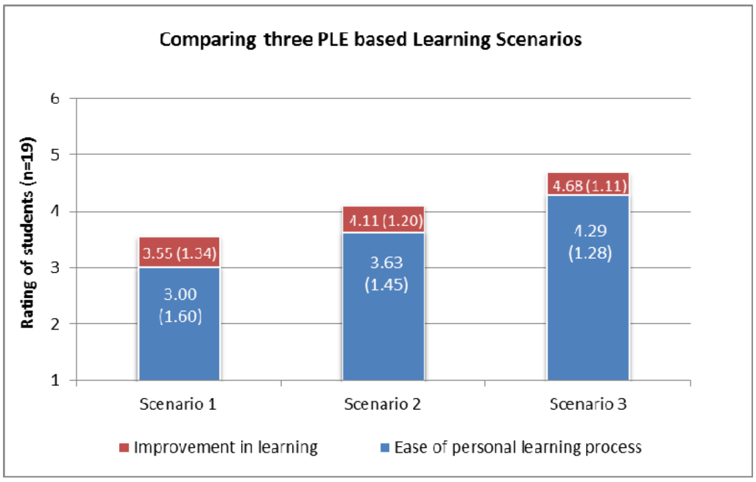

Figure 10: Results of Students Workshop (N=19)

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*: $F2,36 = 5.48$, $p=.008$; *Ease*: $F2,36 = 4.52$, $p=.018$). 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 by students scenario 3 clearly tends to be accepted by students in this comparison of PLE scenarios.

7.2 Qualitative Data

A better understanding of Figure 10 can be reached by the content analysis of the group discussions which led to these final quantitative ratings. The analysis of group discussions reveals the aspects which were discussed and thus determining the final ratings. The analysis moreover reveals in which aspects the assessment of scenarios was predominated by a broad consent within one group discussion or between the three different and parallel running group discussions – and in which aspects the three groups as well as the participants within a group were divided by distinct divergences.

The following sections describe the summarised results of all three group discussions subdivided by the three scenarios.

A) Scenario I

Neither change for the worse nor improvement in learning is seen by students in scenario 1. On the one side the widget approach was perceived as attractive on the other side it raised the question: "*Why do we need widgets for learning?*" The concept of using widgets for learning in general was a bit unclear, especially for a widget that is just a gate to an existing website or search engine such as leo.org or wikipedia.org. But students also recognised some useful widgets: *"For foreign language learning there are some really good widgets which can be used with less effort, e.g. the vocabulary trainer."* The quality but also the quantity of widgets was an important issue while judging the usefulness of this scenario for learning. The improvement in learning depends on the quality of single widgets, the functionality they provide, as well as the number of available widgets.

On the one hand the ROLE Widget Store was partly perceived to not provide a sufficient amount of widgets and thus was assessed to not support the individual learning needs (although the students were aware of the prototype status and thus reduced number of available widgets when judging scenario 1 after the group discussions – see Figure 10). On the other hand students were overwhelmed by the number of widgets when using additional widget stores such as iGoogle Gadget Store [Anon, n.d.]. Once students experienced the problems of finding appropriate widgets in other high volume stores, they judged the ROLE Widget Store positive based on the perception that it just provides specialized widgets which fulfil a certain learning purpose.

iGoogle in general was seen sceptical: *"Most iGoogle gadgets are not made for learning. iGoogle is more for just working with PC or for entertainment but not for learning per se."* While testing scenario 1 students had the choice to use iGoogle or a provided ROLE sandbox [Anon, n.d.] as an enabler environment to test this browser-based learning-scenario. The provided sandbox has been proved to be appreciated by students a lot because they did not need to login to Google.

The self-regulated learning attitude and motivation of a learner dealing with scenario 1 was an extensively discussed issue. In all three groups independently of each other they raised the challenge of being motivated to work with such a learning environment: *"Am I intrinsically motivated? Only then it can work. You are hopeless after a short while if it does not work. The intrinsic motivation of a learner must be really high otherwise you are straightaway on Facebook or surfing somewhere else. If you are not intrinsically motivated you should forget about it."*

In general the playful character of widgets was attractive for students. They judged it as enjoyable for learning. But on the other side there was wide agreement that it is difficult to manage the offered widgets and gadgets: *"You need luck to find a suitable widget. You need a lot of time to test widgets. If you have several widgets the space is overloaded very soon. Scenario 1 is browser-based meaning that you always depend on access to the Internet which is bad."* In this sense the challenge to create a PLE based on scenario 1 was perceived to be an additional burden.

Students from a teacher perspective commented: *"I as a teacher would not use widgets. It is too distracting and confusing, always new widgets and gadgets – news, wikis, weather report, chats, etc.; I would use widgets for teaching only to a certain degree, e.g. dictionary widget to teach French."* Another student: *"I would allow widgets but pupils have to learn how to become autonomous learners. They have to learn how to assess the usefulness of widgets – to which degree can I benefit from using widgets and gadgets?"*

In sum scenario 1 provides the freedom to individually choose favourite (learning) widgets to be assembled in a browser-based PLE. But it does not support important pedagogical aspects (e.g. goal-orientation, scope, support of individual needs). Thus this scenario is insufficient to ensure a meaningful learning outcome. Motivation and SRL are basic prerequisites of a learner's attitude to be successful in learning. But this scenario does not seriously support SRL. Beginners and inexperienced learners will be over-challenged and fail in this learning environment.

B) Scenario 2

Although in sum Scenario 2 has been evaluated better than scenario 1 the discussions in the three groups were not leading to a homogeneous overall result like in scenario 1. Scenario 2 was discussed very controversial. The reason for this might be that the learning environment was only available as a mock-up. There was no possibility to test it. Consequently the judgements were much more hypothetical than judgements regarding scenario 1 (which could be tested as workable and basically well-performing prototype).

The task to discuss the usefulness of scenario 2 for learning based on the mock-up presentation (without the possibility to test) was not easy for some groups. In one group it turned out to get stuck in technical questions on implementing the widgets, e.g. *"If you have installed the widget on one device you have it not automatically on another device as well."* The participants in this group discussion assumed that a learner needs to install one widget on several devices and consequently has additional efforts for getting the widgets running. The students came to conclusions such as: *"Scenario 2 is an additional burden because of distributed widgets. A learner has to care for the organisation and installation of the widgets by oneself."* Compared to those assumed technical barriers scenario 1 was perceived much more comfortable to have all widgets centralised in one space where the widgets can easily (by drag & drop) be integrated and administrated.

A less technically-based discussion and assessment of scenario 2 was performed in another group. Here the discussion was dominated by usability aspects. Presumed a learner is not loaded with more technical effort (installation, administration, etc.) than in scenario 1 and just working as the usability in this mock-up scenario shows it was judged very positive: *"The usability is very smart because you can position the widget very discreet. The learning space is not overloaded with a lot of widgets like in scenario 1. You can select your favourite widget and position wherever it is most comfortable for you to use while learning."; "It is a big advantage to have both possibilities browser-based as well as desktop-based widgets. The dictionary or vocabulary trainer could also be used offline."; "You can hide a widget in a sidebar – so it does not bother you all time. But if you need the widget (e.g. dictionary) the icon is present all time - so you do not waste time by searching, finding, open and activating the widget each time again. You even do not need to leave the space you are just using, e.g. text editor."*

Only in one group the discussion was not only driven and limited by technical and usability issues but was highlighting pedagogical thoughts as well. Students explicitly raised the question: *"Is this scenario learning-oriented?"* Answers were: *"Scenario 2 is less distracting than scenario 1. It appears more serious and better personalisable. Scenario 2 makes more sense. It can be designed and shaped more individually."*

In sum the group discussions on scenario 2 revealed that there are the same offered widgets like in scenario 1 but the usability can be seen as an improvement to ease the personal learning process. Thus it will support learning improvements as well.

However, discussions on assumed technical barriers influenced the final ratings of scenario 2 in both criteria (see Figure 10) in a negative way. The mock-up condition is reason that the final result of scenario 2 is comparatively hypothetic.

C) Scenario 3

Unlike scenario 1 and 2 the most obvious and outstanding characteristic of scenario 3 is the existing pedagogical learning model in conjunction with the offered widgets. It offers a consequent model on self-regulated learning strategies and techniques. Consequently this characteristic was the dominating basis in all three group discussions and the most important reason why the final judgement of scenario 3 was the most positive one in regarding both aspects: ease and improvement of learning (see Figure 10).

Nevertheless scenario 3 was also carefully dissected regarding its learning effect. A positive impact on learning was seen in the provided strategy on self-regulated learning (SRL):

- Getting started with a learning task in a meaningful way.
- Keeping track of the own learning progress by following the provided learning strategy.
- Improved time management and reflection.

Moreover the recommender widget (MR) was seen to lead learners in a certain direction or to stimulate the involvement with certain content. Like in scenario 1 and 2 a learner again has the chance to select useful or favourite widgets for a certain learning task but unlike scenario 1 and 2 within a certain learning strategy. Similar to scenario 1 and 2 the recommender widget concept was seen to be positive and workable only if there are enough high quality widgets.

There were also doubts on the learning improvement:*"If a learner is motivated it will work and improve efficiency as well as outcome of learning. But if someone is very motivated, the recommender widget is not needed."* There was no discussion about learners who are not motivated at all. Could the recommender widget be motivating for them? During the discussion it was assumed that scenario 3 is not working for weak learners. Unfortunately this assumption was not reasoned. It is a surprising assumption because the MR was created to especially support weak learners. Thus this issue has to be intensively discussed in further evaluations.

In sum the recommender widget was perceived to support self-regulated learning but not to motivate learning in general or to guarantee learning success. To be successful an intrinsic motivation has been seen as a prerequisite. In general the recommender widget was perceived to just keep the learner on the right track while willing to learn self-regulated.

8 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. In regard to support daily learning activities a consequent support of cognitive and metacognitive strategies such as planning, goal setting, selecting, filtering, monitoring, evaluating in a way to be able and supported to learn self-regulated has been seen essential. The support of SRL in scenario 1 can only be seen in the freedom a user has to select widgets by his/her own; but this does not differ from the open access to internet resources in general. SRL in this scenario is more a precondition of a learner's attitude to be successful in learning than something which is supported by the technology concept. Beginners and inexperienced learners will be over-challenged and fail in this learning environment. However, the overall results show that 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. However, reason for no better acceptance was the possible effort to have it locally installed. This would be needed to have the widget working offline or as a desktop integration. Especially the discussion among students revealed that a consequent cloud computing approach in sense of SaaS (see chapter 2) is basically preferred.

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. The potential to improve and ease learning by using the recommender widget (scenario 3) has been seen more optimistic by teachers than by students.

Altogether, both evaluation results - teachers as well as students – indicate the tendency that the cloud-computing based mash-up recommender widget including the support of self-regulated learning (scenario 3) would be an improvement in the development of Personal Learning Environments.

9 Future Discussion

There is one issue that needs further discussion: Often it can be observed that on the one side learners do not feel challenged and addressed enough in their individual preferences, skills, abilities and needs when being provided with one-fits-all learning content, tools and environments. But on the other side these learners quickly feel overwhelmed and over-challenged when being provided with a broad range of optional learning content and tools like in PLE approaches.

These problems also appeared in the presented evaluation results of this paper: On the one hand the ROLE Widget Store was partly perceived to not provide a sufficient amount of widgets and thus was assessed to not support the individual learning needs. On the other hand students were overwhelmed by the number of widgets when using additional widget stores such as iGoogle Gadget Store.

First of all this implies the need of educationally-focused widget and app stores. While the ROLE widget store only provides selected widgets with pedagogical value iGoogle Gadget Store does neither have an educational focus nor does it have a quality assurance and selection system for its widget-collections. Thus learners can spend a lot of time for testing and might be cognitively overloaded soon by searching for useful widgets. However, there might be a "goldilocks zone" of viability of educational resources all over the internet.

In fact the interesting question which appears here is: How is it possible that a learner does not need to relinquish the broad range of available content and tools but instead is being supported by the personal learning system in the individual decision making process of selecting and evaluating relevant tools and content?

Starting in the 1980ties there was a discussion about interesting scenarios centering around how to individually serve a person by using artificial intelligence systems. The current state of personal learning environments still seems to be far away from these early "future" scenarios. The most advanced systems in this regard (support for the individual use and selection of open educational resources) currently seem to be the Google ranking system as well as the Wikipedia quality assurance system. Both are based – more or less – on crowdsourcing.

To further discuss the above described problem and resulting question in context of crowdsourcing currently seems to be the technically and socially most intelligent approach.

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