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Implementation and Evaluation of a Tool for Setting Goals in Self-Regulated Learning with Web Resources

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Abstract. Learning effectively and efficiently with web resources demands distinct competencies in self-organization and self-motivation. According to the theory of Self-Regulated Learning, learning processes can be facilitated and supported by an effective goal-management. Corresponding to these theoretic principles, a goal-management tool has been implemented in an interdisciplinary project. It allows learners to set goals for internet research and assign relevant web resources to them. An evaluation study is presented that focuses on short-term learning episodes and selected results are shown that reinforce the benefits of our approach.

Keywords: Goal-Setting, Learning with Web Resources, Self-Regulated Learning, Evaluation.

1 Introduction

The importance of the World Wide Web as a major source of information for knowledge acquisition is growing steadily. With the web browser being the gateway, both specifically designed learning materials (e.g. contained in Web Based Trainings) and web resources that have not been designed with the intention to provide learning materials (e.g. weblog posts, wiki articles or community pages) but contain valuable information are available at a large scale. The paradigm of using these resources as learning materials is also known as Resource-Based Learning. Often used in context of lesson-style teaching, we focus on a rather informal, self-directed way of learning.

However, major challenges for learners when learning in a self-directed way consist of stating their information needs, formulating search queries, estimating relevance of found resources, filtering irrelevant resources and keeping track of the state of the research, i.e. monitoring progress. These processes require high learner's competencies of self-organization and self-motivation, as a deep information research is not trivial. Additionally, challenges arise that are based on peculiarities of the internet's structure: information is out-dated, incomplete or targeted towards another

audience and web resources cannot be retrieved. Thus, even if relevant information is found, it has only a transient use for learners, as usually it is not archived or persisted appropriately (see [7]). Hence, planning, organizing, setting goals and monitoring the involved processes may ease the difficulties of learners and prevent informational disorientation [10].

In this paper, we present an evaluation study of our goal-management tool that has specifically been designed to address some of these challenges. Section 2 presents a basic overview of the theory of *Self-Regulated Learning* that adequately describes this self-directed process of learning with web resources. Further, we explicate the term *Scaffolds* that denotes support of this process. We describe the design and implementation of a tool that enables learners to set learning goals prior to internet research and assign relevant web resources to these goals in section 3. This tool has been implemented into the web browser Firefox[1], as web browsers are the gateway to most information on the web. Section 4 revisits the results of a previous study and section 5 presents a new study and evaluation of this tool with selected results. Section 6 concludes with a short summary and further steps.

2 Self-Regulated Learning and Scaffolds

Self-directed, resource-based learning with web resources is a process that is quite demanding for learners: they have to plan, monitor and reflect on their learning process in order to reduce disorientation and enhance quality of their learning achievements. In the following, we present particularities of this kind of learning and possibilities to support it using *Scaffolds*.

2.1 Self-Regulated Learning

It has been shown that supporting learners conducting the tasks mentioned above can improve the learning experience and the outcome [8] (e.g. by providing training or support learners writing a learning diary). For learning scenarios using web resources, i.e. hypertext documents, supporting self-regulated learning has shown to improve learners' understanding and conceptual knowledge of a topic [1].

Central to the theory of Self-Regulated Learning is the notion that learning is a process that is self-directed and needs regulation on the learner's side. According to Boekarts [3], three different systems have to be regulated in order to learn self-directed. The *cognitive system* is performing task editing strategies, the learner will choose a strategy that he deems to be effective and efficient. For example, a learner who is researching information on the internet has to think about search query words that are likely to lead to success, i.e. relevant result resources. In his *motivational system* the learner regulates his volitional and motivational state, so that he will for example start a learning episode, overcome procrastination or better cope with

[1] http://www.mozilla.com/en-US/firefox/ [online: 2009/04/16]

obstacles. Finally, in the *metacognitive system*, the learner sets learning goals, devises plans and strategies for executing the actual learning process, monitors his progress on his actions, re-adjusts them if necessary and reflects on his learning process, eventually leading to forming of strategies to enhance his learning processes.

Schmitz and Wiese [8] partition the learning process in three phases: before learning, during learning and after learning. Those phases may be combined with the three systems to be regulated [9]. As we focus on metacognitive processes in this paper, we will subsequently only consider processes that are executed in the metacognitive system.

According to the theory of Self-Regulated Learning, learners profit from different metacognitive processes performed in each respective phase (see Table 1): Before learning (*pre-actional phase*), the learner performs goal-setting and planning, whereas while learning (*actional phase*), the progress and course of actions are monitored and – if necessary – adapted to possibly changed circumstances. Finally, after having learned (*post-actional phase*), reflection processes are executed in order to optimize future learning processes.

Table 1 Overview of phases and respective metacognitive processes according to [2]

Phase	Metacognitive processes
Pre-actional	Goal-Setting and planning
Actional	Monitoring, adapting to changed circumstances (regulating)
Post-Actional	Reflecting, adapting goals and plans for next learning episode (modifying)

Further, [2] map the processes described above to learning episodes of different granularity. For example, an elementary task like a learner researching information on the internet is a rather fine-granular learning episode. For executing an efficient search process, the learner has to set his desired research goals, plan and monitor his process and finally evaluate, whether his learning goal has been met in the next minutes. However, a learner working on a bigger project (e.g. homework, a paper or a thesis) usually plans his approach, monitors and evaluates his process over several weeks. Still, a project will consist of several smaller, possibly related, learning episodes that are executed in the context of the project.

In our evaluation, we focus on a short-term learning episode of 45 minutes.

2.2 Scaffolds

Vygotsky [12] introduces the term *Scaffolding* as a “guidance provided in a learning setting to assist students with attaining levels of understanding impossible for them to achieve without external support”. Thus, scaffolds can be seen as learning aids that help learners to execute qualitative learning processes in order to achieve better learning results. In the long term, scaffolds should be designed to advance competencies, thus learners will not be dependent on the scaffolds.

According to Friedrich et al. [5], scaffolds can be implemented both directly and indirectly. Direct scaffolds communicate instructions (so-called *prompts*) that ask the learner to carry out a certain learning action. For example, setting learning goals before starting to learn is such a direct scaffold. Indirect scaffolds can be implemented by design of a learning environment, so that the learner has the possibility to use certain supporting functionalities if required. For example, providing a goal-setting functionality in a program without a dedicated prompt can be seen as an indirect scaffold.

The theory of Self-Regulated Learning postulates specific processes that contribute towards a high-quality learning process. The concept of scaffolding defines and describes different possibilities to realize learner supports. Combining both approaches, learning processes can be assisted and supported according to the presented theoretical principles.

3 The Goal-Management Tool

In this section we will derive the concept of a goal-management tool for internet research from the presented theoretical principles and present the implementation. Learners can enter goals, organize them into goal hierarchies (setting super- and sub-goals), move them via drag&drop and attach found resources relevant to the respective goals. Each goal can have an arbitrary number of sub-goals and resources, organizing everything in a tree structure with exactly one super-goal – analogue to the directory structure of a common file system.

3.1 Conceptualization

The goal-management tool is based on the partition of the learning process into the three phases *before learning*, *while learning* and *after learning*. We focus on the metacognitive processes of goal-setting, planning, monitoring, regulation and finally reflection and modification of the learning process. The scaffolds that support those processes are implemented indirectly, which means that the learner is not instructed to take direct action, but he may choose to use the functionality if he sees the need to.

Before beginning with the internet research, the learner chooses a goal-directed approach and plans his course of actions in the learning process. For example, if a learner has the task to research information for the topic “Classical antiquity”, he may begin to structure his approach with the goals “I need to get a general idea about the ancient Rome” and “I need an overview of the ancient Greece”. Each goal can be further subdivided into specific sub-goals, e.g. the ancient Rome may contain the sub-goals “Roman Republic” and “First Triumvirate”. This way, the learner organizes his research goals into a goal hierarchy. Thus, the tool supports processes of goal-setting and planning.

During the learning process the learner may attach found information in web resources to the set goals and rate their relevance for the respective goal. Monitoring the learning process is supported by multiple scaffolds, e.g. setting the progress of finishing a certain goal and displaying the goal hierarchy in combination with the

already found web resources. Both stimulate the learner to contemplate where in the learning process he is right now, which goals he has already achieved and what goals are still open. In order not to loose focus on the goal the learner is following right now, it is possible for him to activate one goal at a time. This goal is displayed prominently, giving a reminder not to go astray and antagonizing the well-known "lost-in-hyperspace" phenomenon (experiencing disorientation due to information overload and aimlessly following hyperlinks). Further, all goals and found resources can be displayed as a knowledge network and an overview, displaying all goals and resources. This enables the learner to reflect on already found information and the current course of action. Is the learner aware of his inefficient advance, he may alter his research behaviour according to his current situation – for example by defining new goals, re-structuring his goal hierarchy or focussing on other goals that are more promising at the moment. Hence, during the research the processes of monitoring and regulation are supported.

After learning, the learner has the choice between different alternatives of visualizing all goals and resources, basically the three visualizations already described: the goal hierarchy, the knowledge network and the complete overview. However, the theory of Self-Regulated Learning differentiates between the monitoring and regulation processes mentioned above and the processes of reflection and modification, as these occur after having finished the research. Here the visualizations enable learners to reflect on the finished learning episode, both from the view of the results and the taken approach. Further, if the learner decides to optimize his approach based on his reflection processes, modification processes are executed.

3.2 Implementation and Data Model

Research and learning using web resources mostly takes place in the web browser, as most web resources are represented as HTML mark-up. The browser is a virtual window to the internet, downloading and rendering web resources and displaying them to the learner. Therefore, the tool has been implemented as an add-on to the popular open source web browser Firefox.

Due to portability and extendibility reasons the core functionality has been realized in a Java applet. Data transmission with Firefox and the web resources is performed via an ECMAScript interface that both orchestrates the data flow and forwards user interaction within Firefox or the web resource to the applet. The graphical user interface and data storage has been implemented in Java. Applets as a technology were chosen, as they allow integration in HTML as well as in XUL (the Firefox-specific XML dialect for creating graphical user interfaces).

Because we focus on short-term learning episodes, we confine properties of goals to a title, a description (which may serve to outline a course of actions or additional information) and the level of progress (with the stages "not started", "25%", "50%", "75%" and "finished"). This level of progress can be set by the learner to keep an overview of his open and finished goals. Further, goals can be tagged (i.e. attaching freely chosen key words) for organization and display in the knowledge network. For longer learning episodes (which are not covered here), additional, mostly temporal, properties are planned, e.g. planned start, planned duration etc.

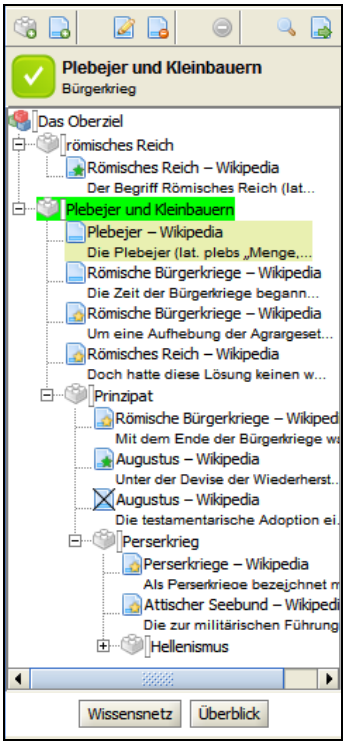

Fig. 1 The sidebar displaying the tree of goals and resources. The goal "plebs and peasants" is currently activated. At the bottom the buttons for displaying the knowledge network and the overview are located.

The web resources are inserted into goals by use of the “import” functionality, similar to the process of bookmarking in Firefox. Similar to goals, resources have a title, a description, a relevance rating and tags. As the information need a learner has is often quite specific, just bookmarking a whole web resource is often not enough. Instead, the possibility to extract only the relevant part of the information is more target-oriented towards the real learning goal. Thus, the selected fragment (called *snippet*) of an imported web resource is stored in the description; learners can access that relevant information later without having to access the original web page. Rating the relevance of a resource or the snippet with the stages “not rated”, “not relevant”, “a little relevant” and “relevant” is possible as well.

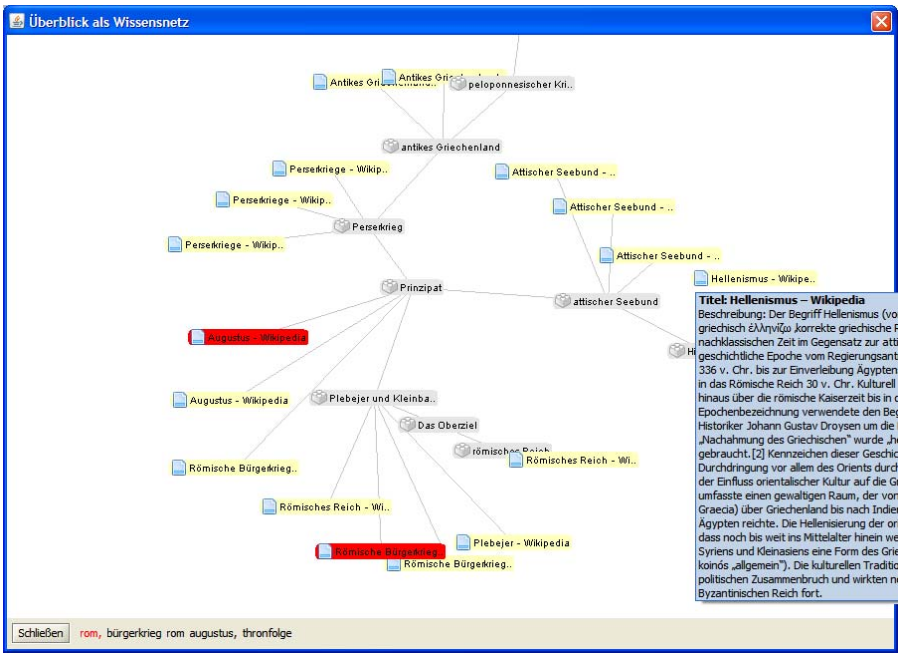

Fig. 2 An exemplary goal hierarchy displayed as a knowledge network. Resources with the same tag "Rome" are marked. A resource's detailed description (snippet) is shown in a tooltip.

On starting up the web browser, the goal-management tool is displayed in the sidebar. Its user interface shows an overview of the current goal hierarchy and resources (see Fig. 1). Alternative representations of goals and resources may be used, e.g. a display of the goal hierarchy as a knowledge network (see Fig. 2 and [4]). While browsing web resources, they can be imported into the goal tree at the current selection. Both goals and resources may be edited and reorganized later-on.

4 The Previous Evaluation

In 2008, we performed an evaluation focussing on the research questions, what differences learning online using different tools make and how explicit prompts are given in order to initiate goal-setting, planning and reflection processes [11]. We asked 64 participants (mainly psychology bachelor students) to answer a knowledge test about the topic “Classical Antiquity” (that we expected the participants to have little prior knowledge about) both before and after learning using Wikipedia for 45 minutes. We formed four different treatment groups: one group having pen and paper available as a means to persist findings, one group using the built-in bookmarking functionality of Firefox and two groups using our goal-management tool. The latter groups differed in the given instructions, one group just used the tool without any instructions, the other group was directly scaffolded to set goals, monitor their progress and finally reflect on their learning processes.

In conclusion, we found that scaffolds *do* influence learning processes. Still, we encountered several issues with the study design. First, we tried to emulate "realistic" environments for the learners, i.e. forming a control group learning using bookmark functionality and a pen and paper group. Therefore, the groups were not comparable in some ways, and we think that influenced the learning outcomes. For example, the pen and paper group did not have to learn using a new tool and could quickly outline information, setting relations between content that was not possible for the other groups. Additionally, the bookmarks group was missing the possibility to save web resource snippets, thus participants had to bookmark the whole page – which many participants thought to be futile, thus not using this functionality. Eventually, the groups using the goal-management tool were only briefly trained to using it before learning. This means that computer competence and experience in using comparable tools had a strong influence on the way students were able to handle the tool.

5 The Study and Evaluation

In our second study, we optimized our study design and chose a somewhat different scope. First, we provided sufficient training using the goal-management tool and altered the evaluation and control groups in some respects in order to make them more comparable.

Additionally, following research questions were of interest:

- What are the differences between learners that organize their found web resources with folders (the control group) and learners that set goals prior to learning (the treatment groups)?
- What are the differences between learners that are explicitly instructed to execute metacognitive processes (the control group and the first treatment group getting indirect scaffolds) and learners that are free to use the functionality to support their metacognitive processes (the treatment group prompted by direct scaffolds)? Thus, what are the benefits of providing direct scaffolds?

5.1 Evaluation Design

104 students (mostly students of Psychology (74.5%) and Education (13.2%), more than 90% being in their first to seventh semester and being between 19 and 28 years of age) could be won for participating in our study. Due to the field of study a majority of the participants were women (72.6%) and 88.7% speak German as first language. The participants were randomly allocated to three groups:

The *Control Group* (CG, n=34) was using a stripped-down goal-management tool that didn't exhibit the goal-setting functionality. "Goals" were coined "Folders" and could not be activated or attributed progress. Still, the CG was able to put resources and snippets thereof in a folder and access the different displays of the collected data.

Fig. 3 Example of a prompt, requesting the learner to reflect whether the imported web resource is relevant for the current research goal.

The *First Treatment Group* (TG1, n=35) used the goal-management tool with the complete functionality but was not given instructions on how to organize their research. Hence, this group realized indirect scaffolds as given in section 2.2. The *Second Treatment Group* (TG2, n=35) used the same tool with integrated metacognitive prompts aimed to activate and support the metacognitive processes "defining relevant goals", "keeping the active goal in mind", "finding relevant pages", "importing relevant information", "assigning relevant information to the relevant goal" and "learning relevant information". For example, before beginning the research (i.e. actional) phase, the learners were instructed to set goals for the research. Further, during search, instructions to reflect on whether the found information was relevant for the currently followed goal were given (see Fig. 3). Five minutes before the end of the evaluation, this group was instructed to reflect on their results.

The overall study was performed in two sessions for each participant. The first session was exclusively for training with the respective tool variant and the second was the research task. The first session was always held the day before the research task and gave the participants a possibility to get to know the handling of the respective tool variant they would use on the research task. First, they watched an introduction in the respective tool, showing common tasks and the functionality of the tool. Then, the participants were presented a small research task in a topic they were confident with, where they could apply the functionality of their tool variant. Further, demographic data and data about the participants' self-conceptions about their computer (estimation of their familiarity in using computers and knowledge about relevant computer- and internet-related concepts) and skills of self-regulated web search (i.e. the competencies to plan and structure their learning processes, based on items of a standardized questionnaire according to [13]) were collected.

The second session was designed to be approximately 1.5 hours in length. Participants were given a first achievement test (multiple-choice) about the “Classical Antiquity” – a topic that is well-covered in Wikipedia and, as we knew from the previous study, students do not have a lot of detailed prior knowledge about. An example for such a question is “Which event led to the end of the Roman Kingdom?” After each question the participants were asked to state how certain they were with answering this question (from the extremes “I guessed” to “I know and I am sure” in four steps). There were ten different versions of the test, which differed in the order the questions were provided. Participants were given the hint that they would receive exactly the same test again after the learning episode. Each participant received a feedback on his individual test performance. Ten questions which were either answered incorrectly or with uncertainty were provided for the first five minutes of the learning episode. This enabled competent learners to identify knowledge gaps in the achievement test and to re-formulate these into research goals in order to finally answer them correctly. During the research, participants were given updates about the time left. Eventually, the achievement test was administered to the participants a second time. Finally, the participants were asked to answer some questions about their learning and their experiences during the web search, their emotions according to PANAS [6] (a standardized questionnaire aiming at measuring positive and negative emotions), their usage of the goal-management tool and its functionality. Between all the phases of this second session, data about the current motivation and self-efficacy were collected.

Besides the questionnaires, further data was collected: all participants’ actions during research were recorded using screen-capturing software and on client side, the click path – a list of all sequentially opened URLs – was stored including timestamp of access. In each session, psychometric tests were executed. Further, all actions the learners performed in the goal hierarchy were logged so we could reconstruct the process later.

5.2 Results of Evaluation

For evaluating this study, we needed a topic for the students to research that they were not familiar with, thus we chose “Classical Antiquity”. In order to estimate their prior knowledge in this topic, the students were asked to state how much they knew about the Roman Antiquity (83% stated they have only "rather marginal" or "little" background, whereas only 2% said to have a "very good" knowledge about this subject) and Greek Antiquity (where only 1% of the participants claimed to have a "very good" knowledge about, in contrast to 86% of the participants stated to have a "rather marginal" or "little" background).

Due to the topicality of given tasks, goals were usually set in a topic-oriented way, process-oriented goals (e.g. “I need to get an overview of …”) were rarely set.

The results presented below are all based on the log files and the questionnaires.

5.2.1 Selected Group differences

To analyze the differences between all three groups including differences within specific phases of action, we conducted one way ANOVAs (Analysis of Variance

between groups, comparing group means with each other) with quantitative log data as the independent variables. Table 2 presents some selected significant results. These show that, as presumed, in the pre-actional phase the three groups differ in terms of numbers of goals/folders created and edited, links followed, as well as number of imported, viewed and edited resources. Further, the number of viewed resources and links followed in the post-actional phase varied between groups. A difference between groups over all phases was encountered for moved goals/folders. These results in general indicate different approaches of web search for learners of different groups. Some learners seem to have searched in a very structured manner by first defining their search goals instead of already browsing and persisting resources. These learners also seem to have reduced distracting activities at the end of the learning phase in order to prepare for the post-test.

Table 2 Significant Group Differences based on Participants' Actions

Category	**Phase of action**	**ANOVA[2]**
Creation of Goal / Folder	Pre-actional	F(2, 102)=7.729, p<.01, r=.36
Editing Goals / Folder	Pre-actional	F(2, 102)=3.801, p<.05, r=.26
Moving Goals	All	F(2, 102)=3.600, p<.05, r=.26
Following new Link	Pre-actional	F(2, 102)=6.280, p<.01, r=.33
	Post-actional	F(2, 102)=6.885, p<.01, r=.34
Import Resource	Pre-actional	F(2, 102)=5.106, p<.01, r=.30
View Resource	Post-actional	F(2, 102)=3.827, p<.05, r=.26
Editing Resource	Pre-actional	F(2, 102)=3.105, p<.05, r=.24

As these results show only the *presence* of significant group differences, we further investigated specific differences between the respective groups defined in our research questions and contrasted them.

In order to analyze our first research question, we contrasted the two experimental groups (TG1+TG2) that were provided with the goal setting function, versus the control group (CG) that applied folders. As hypothesized, TG1 and TG2 significantly set more goals, specifically in the first phase before learning (t(102)=-2.068, p<.05 (1-tailed), r=.20) and opened less new web pages in the browser during the pre-actional and post-actional phase (t(102)=2.018, p<.05 (1-tailed), r=.20 resp. t(102)=2.887, p<.01 (1-tailed), r=.27) spending more time with the processes of planning and reflection. This means that they first organized their course of actions before starting to learn. Additionally, they restructured their goal hierarchy more often while planning (t(102)=-2.783, p<.01 (1-tailed), r=.27), which we think to be the result of a detailed planning process. Further, the treatment groups updated their goals and performed more searches in Wikipedia during the actional phase (t(102)=-2.768, p<.01 (1-tailed), r=.26, t(102)=-1.790, p<.05 (1-tailed), r=.17) more often than the control group, showing that they monitored their progress and based on the current state altered the data they had already researched. We think this may be due to a more goal-oriented approach, identifying and re-evaluating knowledge gaps and acting on those new or changed information needs. Finally, the treatment groups more often re-

[2] F=F-Value, p=niveau of significance, r=correlation coefficient

visited the collected relevant resources after learning (t(102)=-1.964, p<.05 (1-tailed), r=.27, t=.027*), distilling the relevant information and memorizing it for the post-test.

To analyze our second research questions, we contrasted TG2, which had received direct support during learning versus TG1 and CG, which were only indirectly supported. TG2 set more goals, especially in the pre-actional phase (t=.000**), whereas later they actually set less goals (t(102)=4,296, p<.01 (1-tailed), r=.31), meaning they took more time to plan their course of action, approaching the research task in a more goal-directed way and performing the research more efficient. Another figure supporting this is that TG2 opened less web resources while researching (t(102)=-1.792, p<.05 (1-tailed), r=.17), having previously identified their knowledge gaps and looking specifically for relevant resources. Participants in TG2 were more often re-organizing their goals, regulating the current state (t(102)=2.253, p<.05 (1-tailed), r=.22) and opened significantly less new pages before (t(102)=-3.866, p<.01 (1-tailed), r=.36) and after learning (t(102)=-3.415, p<.01 (1-tailed), r=.32), meaning they acted more efficiently and kept closer to their set goal. Further, after having learned, they more often reflect on found relevant resources (t(102)=2.200, p<.05 (1-tailed), r=.21). Participants using the tool with metacognitive prompts (TG2) used the goal activation functionality far more frequently than the group without prompts (t(69)=3,463, p<.001). This means that learners in TG2 significantly monitored their progress more often than TG1.

In conclusion, these results show that using our tool for setting goals affects the way learners approach research using web resources: they execute more meta-cognitive processes, plan in a more-detailed way, monitor their progress better and react on changed circumstances and more often reflect on their learning outcomes and found web resources.

In a group comparison, we could not find significant differences in terms of performance (i.e. more correctly answered questions). We think this is due to the short scope of this evaluation and that we did not include third variables (e.g. certainty when answering questions or the relevance of found resources) in this evaluation.

5.2.2 Selected Correlations between the Variables

To investigate further dependencies between variables we calculated several correlations accounting for different patterns within different groups and phases of action. A selection of significant correlations is presented in Table 3.

Table 3 Selected Significant Correlations, *:p<.05, **:p<.01

Group	Variable 1	Variable 2	Correlation r (1-tailed)
CG	Computer Competence	helpful in e-learning would use it snippets useful	.364* .445** .472**
All	Goals created	Computer Competence	.356**
TG1+TG2	Goals created	Search Competence	.292*; .304*
CG+TG2	Goals created	PANAS „active“	.325*; -.331*
All	Opened page	Positive emotions	-.256**
TG2	Opened page	Negative emotions	.436**

In the Control Group (CG), the higher the participant's computer competence was rated by himself, the more he thought e-learning with web resources to benefit from using the tool, the better he liked the goal-management tool and the more valuable he estimated the snippet functionality for e-learning. In both treatment groups, computer competency was not correlated to those variables. This might indicate that participants of the CG implicitly knew how to use the stripped-down version of the tool if they had a high computer competence. Participants of the other groups, however, were supported in setting goals, monitoring them and reflecting on the learning process. Therefore, giving them that much support might have neutralized the influence of computer competence on organizing their research process.

Further, creation of goals correlated with computer competence in all groups, meaning participants describing themselves as competent in using computers set more goals. Moreover, participants of the treatment groups set more goals the more confident they were of their ability to perform a good web research. These results indicate that the ability and to use technology are major predictors for efficient use. Curiously, there were clear correlations between the emotion to be "active" and the amount of goals/folders created – for the CG, it was positive, meaning that participants in this group felt themselves to be more active when setting more goals, whereas for the TG2 it was negative – the more goals a participant of this group set, the less active he felt. This might indicate that a strong direct support, among all the positive impact, might cause learners to feel less active. To be provided with more freedom, however, might cause the feeling of activeness in terms of being in charge of ones' own actions.

Eventually, the more web resources were opened, the less positive emotions the participants in all groups had and the less activated the participants felt. Additionally, for TG2, negative emotions (PANAS) were correlated to the number of opened resources. This means that browsing the web resources for information aimlessly (thus browsing a lot of different web resources, eventually becoming "lost in hyperspace") affects the emotions of learners negatively. Still, participants in the Control Group didn't have negative emotions when browsing more pages. This might be due to the fact that learners who did not set search goals did less encounter their browsing of many resources as being ineffective and accordingly experienced less negative emotions.

6 Conclusions and Further Steps

In this paper, we presented a goal-management tool that is based on theoretical principles of Self-Regulated Learning. We introduced the term *Scaffolds* for functionality supporting meta-cognitive processes during learning episodes. The implemented functionality was well received by the participants of our study: nearly all of them (91%) saw the need to being able to store only small, relevant snippets of a web resource in learning with web resources.

We evaluated the goal-management tool with a study. Results show that using our tool for setting goals affects the way learners approach research using web resources: they execute more meta-cognitive processes, plan in a more-detailed way, monitor their progress better and react on changed circumstances and more often reflect on their learning outcomes and found web resources. Although we did not find significant performance differences between the groups, we expect results in further evaluations when taking into account other variables, like the certainty of a learner answering a question or the resources' relevance.

Further, we only present results that base on quantitative evaluation of log files capturing the actions the participants executed and the questionnaires. Additional evaluations based on qualitative evaluation of screen captures, further questionnaire data and relevance analysis of web resources will follow.

The presented study has been designed to evaluate short-term learning episodes. However, we aim to focus on long-term learning episodes eventually, supporting learning over a longer time span, e.g. several months. Additionally, as learning often is embedded in a social context (be it learning groups, in an organizational setting or just in communities of interest), we will provide the means to have learners share and communicate their collected information within their community. This will be achieved in a knowledge network as described in [4]. The role that goals and the presented Scaffolds will play in this community-driven application is still a field that demands further research.

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