Towards self-regulation in Web-based learning

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http://www.edu.helsinki.fi/iqform/
Abstract

The article focuses on students’ self-regulatory skills in Web-based learning environments. The IQ FORM project has created an interactive Web-based tool “The IQ Learn” to support learners’ self-regulation in virtual universities and other higher education settings. The project has applied Paul Pintrich’s Motivational Components of Forethought, Cognitive strategies and Learning Skills in the designing of interactive Web-based tests, tutoring sets and a learning diary. In the beginning of the project data was collected from different student groups in five universities, to identify students’ differences as self-regulated learners. The data revealed that there are big differences in students’ self-regulatory skills. The data was also used for validating dimensions of interactive self-evaluation tests and tutoring sets. The pilot use of the IQ Learn found out that students benefited from the virtual tutoring. According to the results, the IQ Learn tool is most useful for students who have difficulties in learning or who do not have stable learning strategies and skills, or who are at an early stage of their university studies. The IQ Learn tool best supports the students in learning when the teacher-tutor gives concrete assignments as how to use the tool, or guides the students to self-reflection and self-evaluation using the IQ Learn tool. Teachers have to learn how self-regulation can be integrated into the Web-courses and how to use the new tools on the WWW to support students’ learning.

1. Introduction

The article focuses on students’ self-regulatory skills in Web-based learning environments. The aim is to introduce a research project through which a new interactive tutoring tool (http://www.edu.helsinki.fi/iqform/) has been developed to support self-regulated learning in Web-based higher education settings. The article also presents how learners use this tool and learn self-regulation skills, and what results have been found in the pilot use of a new tutoring tool.

Kendall Hartley and Lisa D. Bendixen (2001) argue that learner characteristics have received too little attention in the educational technology research literature. There are some exceptions (e.g. Hannafin & Land, 1997; Land & Green, 2000; Jacobson & Spiro 1995; Anderson 2000), but the importance of self-regulatory skills and epistemological beliefs in computer-based open-ended learning environments would require much more research. Learners’ repertoire of strategies to monitor their learning processes, and their willingness to invoke such strategies, will dramatically affect their ability to manage the wealth of information found on the Internet. Highly self-regulated students are better equipped to take advantage of this new environment. In addition to self-regulatory skills and epistemological beliefs, other characteristics that need careful consideration include motivation, self-efficacy, ability, physical challenges and learning disabilities.

2. Theoretical and conceptual frameworks

Self-regulation, self-determination and self-efficacy are important psychological processes, which lead towards the empowerment of people (Fetterman 2001, 12). These concepts are based on the social cognitive view of motivation and cognition.
There is evidence that self-regulated learning consists of sub processes: Forethought, Performance or Volitional Control and Self-reflection (Pintrich 2000; Zimmerman 2000, 16). Forethought consists of cognitive and motivational orientations. Students can monitor and control their learning by using cognitive and motivational management strategies. They also have the capacity to manage external resources (e.g. time, social interaction and help seeking). Self-regulated learning requires an awareness of reflective processes, where a learner assesses his/her own acts and achievements.

Learning on the Web requires high self-regulatory skills. In order to develop Web-based learning, we must pay more attention to learners' characteristics and help learners to be more aware of their learning processes and give guidance as to how to develop strategic learning skills.

The IQ FORM project has created an interactive Web-based tool to support learners towards self-regulation in virtual universities and other higher education settings (Niemi 2002a; Niemi 2002b). The project has applied Paul Pintrich’s Motivational Components of Forethought, Cognitive Strategies and Learning Skills (Pintrich & Ruohotie 2000; Boekaerts & Pintrich & Zeidner, 2000; Pintrich & Garcia 1991; Pintrich 1999; 1995).

Forethought: Expectation of Success, Performance Anxiety, Task Value and Self-Efficacy

According to Paul Pintrich (2000) and Barry Zimmerman (2000) forethought includes the learner's own beliefs about his/her own ability to perform a task, his/her beliefs of self-efficacy and control, and his/her expectancy for success. These are related to the student's self-regulation and metacognitive control. Learners who believe in their ability to perform a task are more likely to evaluate their progress; and in conflicting situations, they may apply various cognitive strategies. Performance anxiety refers to learners' emotional reactions and disturbances, which may decrease their cognitive capacity. Highly anxious students do not use appropriate learning strategies, even if they study and try as hard as their peers. Task value consists of the intrinsic interest and utility of task or course. There is evidence that the components of the forethought consist of prerequisite skills and attitudes necessary for successful learning (Pintrich 2000; Zimmermann 2000).

Strategies in learning: Time management, Self-management, Persistency, Help seeking strategies

Resource management strategies assist learners in managing the environment and the resources available (e.g. time, own efforts and other people). Pintrich and McKeachie consider self-management as the most important learning strategy and as a nexus between motivation and interaction (Ruohotie 2000, 20; Pintrich & McKeachie 2000).

Learning skills: Rehearsal, Critical thinking, Finding essential points, Connecting newer and older knowledge, Keywords and advance organizers, Application of theories, and Self-assessment Learning skills may be called cognitive and metacognitive strategies. The dimensions are relatively broad and functionally complex processes of deep learning. Learners utilize these strategies in the acquisition, storage, and retrieval of information. In the IQ test battery, the strategies have been labelled as skills, because the aim is for the learners to become skilful in using these strategies; and they could even learn new skills to manage their learning (Ruohotie & Nokelainen 2000, 155-175).

The name “IQ FORM” refers to the idea that technological learning environments and platforms should be “intelligent” in supporting students with different abilities to grow as learners. The IQ FORM system is one of the services offered to members of the Finnish Virtual University, which is an alliance of all the universities in Finland. In the IQ FORM system, there are tools for an individual learner and teacher (the IQ Learn) and for a Web-course group (the IQ Team). The IQ Learn offers tools for a learner to develop his/her personal strategic learning skills, and the IQ Team
offers information about group processes and tools for collaborative learning and knowledge creation.

The IQ Learn is available in English, Finnish and Swedish and freely downloadable, and consists of three elements (http://www.edu.helsinki.fi/iqform/):

1. **The interactive test bank**, with three questionnaire sets for students' self-evaluation (see Appendix 2),
   - Motivational components: Forethought, Cognitive Strategies, and Learning Skills
2. **Tutoring sets**, with a hypertext structure for each sub component of the tests,
   - Tutoring students towards self-regulation
   - Additional guidelines for teachers
3. **A learning diary** for the reflection of learners' experiences and test profiles.

The main idea of the IQ Learn tool is to increase a learner’s self-knowledge and to raise the need to evaluate and develop one’s self-regulatory and learning skills. The tutoring texts and included assignments (Virtanen 2002), that encourage self-reflection, provide useful tools for learners to develop their self-regulation. When using the learning diary and discussion forum student’s skills of reflection develop. The personal learning diary can also be used in the evaluation process. A learner may email his or her learning diary texts to the teacher and get feedback about his or her development as a learner. Though in a process of becoming self-regulative, interaction plays an important role, the feedback may also come from a non-human source. In addition to teacher-tutor’s feedback, the IQ Learn system automatically gives the learner responses through the test results, offering information about how to enhance one’s learning to become more self-regulatory.

3. **Modes of inquiry**

The research design consists of several phases. Each of them has provided the basis for the next phase, to develop the Web-based tool for supporting learners.

3.1 **Phase 1: Collecting data from different universities' student groups to identify their differences as self-regulated learners**

**Data Source:** The questionnaire consisted of the questions concerning students’ demographic background, tutorial help received during the studies, and of the measurement of Metacognitive Learning Strategies based on Paul Pintich’s Motivated Strategies for a Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, and McKeachie, 1993). Its new version, developed for a vocational higher education context (Ruohotie & Nokelainen 2000), was modified for university settings (IQ-Research group 2001b). In January 2001, the data was collected from five universities in Finland. A total of 256 (127 male, 126 female students) responses were obtained. The students came from five different disciplines (Humanities and Art, Social and Behavioral Sciences, Teacher Education, Technology and Science, and Agriculture and Forestry), mostly 21 to 24- year old students (mean age 24.1; standard deviation 4.6). The respondents were mostly first or second year students, approximately 60 % of them had completed 20 to 60 study credits (160 study credits is usually required for a master’s degree). Most of the students reported having good study motivation and were satisfied with their major. Most of the students (60 %) also said that they had been proceeding well in their studies.
**Methods:** the data was analyzed using percentages, correlations with gender, age and motivation, and experiences of tutorial guidance.

**Results:** University students do not usually get much tutoring regarding their self-regulatory processes. 68.2% of all students had received little or no tutoring at all for their learning skills. Only 4.7% had received much and 27.1% some tutoring during their first two years of study. Students of Behavioral Sciences had received more tutoring than other students (see Table 1 in Appendix 1). Females seemed to benefit more from tutorial guidance than males (see Tables 1, 2, and 3 in Appendix 1). Older students used more developed learning strategies than younger ones. Critical thinking seems to increase with age (see Table 4 in Appendix 1). Students with more tutorial guidance used more advanced learning strategies than students who had received less or no tutorial guidance. Students with a higher study motivation used learning strategies more efficiently (see Table 3 in Appendix 1). Self-assessment skills are explained by study motivation, age and tutorial guidance. Students with high study motivation reflect on their own learning, and this may help them to maintain their study motivation (see Table 4 in Appendix 1) (Nevgi 2002a). Students of Behavioral Sciences and Teacher Education used more effective learning skills. However, students of the Humanities and Art or Agriculture and Forestry were found to have higher performance anxiety than the others (see more details of test validation in the next chapter). Students of Technology and Science used less self-assessment in their learning, compared to the others (see Table 1 in Appendix 1).

### 3.2 Phase 2: Validating self-regulative dimensions for interactive self-evaluation tests on the WWW

**Data Source:** The same empirical data, collected from five universities, was used in validating the structure of the tests.

**Methods:** The following methods were used: (1) an exploratory factor analysis Maximum Likelihood with Varimax rotation (4 – 10 factor models) in three sub scales, (2) Confirmatory factor analysis of factor solutions, based on theoretical frameworks, (3) an examination of each separate factor by using factor loading plots of two-dimensional principal component space, and estimating the goodness-of-fit using a chi-square ($\chi^2$) test and other goodness-of-fit statistics, and (4) an examination of the homogeneity of each factor, using Cronbach’s alpha (Nevgi 2001; Nevgi 2002a).

**Results:** After the validation process, three tests of self-regulated learning were accepted (IQ-Research group 2001). Their components and Cronbach's alpha scores are presented in Table 1.

<table>
<thead>
<tr>
<th>Forethought of Learning (4 x 5 items)</th>
<th>Expectations of success</th>
<th>.78</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Performance anxiety</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>Task value</td>
<td>.77</td>
</tr>
<tr>
<td></td>
<td>Self–efficacy</td>
<td>.62</td>
</tr>
<tr>
<td>Strategies in Learning (4 x 5 items)</td>
<td>Time management</td>
<td>.71</td>
</tr>
<tr>
<td></td>
<td>Self-management</td>
<td>.77</td>
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<tr>
<td></td>
<td>Persistency</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>Help seeking strategies</td>
<td>.74</td>
</tr>
</tbody>
</table>
Table 1. Factors in the validation process of the IQ Learn tests.

3.2.1 Forethought of Learning

3.2.1.1 The factor model of forethought of learning

The exploratory factor analysis (Maximum Likelihood with Varimax rotation) was run in order to examine the factorial structure of the Forethought of learning scale with 26 items. The Four-factor and Five-factor solutions were compared (Nevgi 2001) and the Four-factor solution was selected for further analysis. The Four-factor solution explained 45.0% of variance. Homogeneity analysis with Cronbach’s Alpha showed that the factors were reliable and reasonable (see table 1). The examination of each separate factor by using factor loading plots of two-dimensional principal component space helped to determine the variables, which did not fit into the confirmatory model (Nevgi 2002a).

3.2.1.2 Dimensions of Forethought of Learning

The Expectation of Success factor describes the expectancy component in students’ motivation for studies. A student with high values in this factor is expecting to achieve good results in his/her studies and sees in advance himself/herself performing the task well. Examination of the factor revealed that it consisted of two dimensions: the expectation for good grades and the belief in his/her own ability to learn and to have study success (Nevgi 2001).

The Performance Anxiety factor represents the affective domain of a student’s personality. A student with high values in Performance Anxiety finds the test situation emotionally stressful, and due to this cannot concentrate on his/her performance freely. The factor had two complementary components: a) anxiousness due to a comparison of own performance with one’s peers' performance, and b) nervousness during the test situation. The comparison to peer’s performance is stressful because of feelings of inferiority. It is normal to be alert and experience a little nervousness in test situations, but this feeling can become so strong that it prevents the student from performing in way that is best for him/her. The homogeneity of the factor was found reasonable (Nevgi 2001).

Task value factor was separated as a third factor. It was originally called Meaningfulness of Studies, and the factor consisted of two dimensions: intrinsic and extrinsic motivation. According to Pekka Ruohotie (2000), the intrinsic and extrinsic motivation can be described as one dimension, where a person is both intrinsically and extrinsically motivated to studies. A student with high values on this factor is interested in his/her studies because s/he values both the career possibilities and
the knowledge s/he achieves by studying. The model of one-factor was tested by confirmatory analysis, using seven to ten variables in order to discover the most homogenous solution (Nevgi 2001).

The Self-Efficacy factor could be separated into two different dimensions: a) Self-efficacy as a belief in one’s own ability, and b) Self-efficacy as a belief in one’s own effort. The variables for the factor were selected to describe self-efficacy as a belief in one’s own effort. The factor will thus stress the meaning of intrinsic control beliefs. A student with high values in this factor trusts in his/her own abilities and believes that through his/her own effort, the goal of the studies can be achieved. The factor correlated highly with the Expectation for success factor revealing that there is a common attitude behind the two factors. Students who expect to succeed in their studies, also trust their abilities and do their best to achieve the learning goals. The homogeneity of the factor was reasonable (Nevgi 2001).

3.2.2 Strategies in Learning

3.2.2.1 The factor model of Strategies in Learning

The strategies in Learning scale was analyzed with an explorative factor analysis (Maximum likelihood). The four-factor model explained 39.1 % of variance and it was selected for further analysis. A confirmatory factor analysis model was applied to estimate the four-factor model of the Strategies in Learning scale (Nevgi 2001; 2002a). The statistical fit for the model was not very high, and based to homogeneity analysis some items were excluded and some reformulated (Nevgi 2002a). However, the factors were reliable (Cronbach’s Alphas changed from .71 to .77, see table 1).

3.2.2.2 Dimensions of Strategies in Learning

Time management factor describes a student’s ability to control and manage the time to be used for studies. Students with high values in the time management factor are effective in their use of time and they make realistic timetables for their studies. They can evaluate in advance how much time should be reserved for a certain study task. One item of the dimension differed from other variables comprising only one dimension, and it was reformulated (Nevgi 2002a).

Self-management in learning describes students’ ability to control and monitor learning processes and to change the amount of effort demanded for different study tasks. The homogeneity of the factor proved to be reasonable (Nevgi 2001; 2002a). Students achieving high values on this factor can evaluate the effort needed in their studies, and adjust their efforts flexibly, according to the degree of difficulty and complexity in study tasks.

Persistency is seen as a foresight and strength to continue studying facing difficulties and/or dull study tasks. A persistent student seeks the final goal of his/her studies. The examination of the factor loading plots, in two-dimensional space, showed that the factor was one-dimensional (Nevgi 2002a). This factor was not expected, according to the theoretical framework (Pintrich & Ruohotie 2000). However, students with foresight in their studies can cope with the inconvenience of a particular study period, and thus overcome the difficulties they meet.

The help-seeking factor represents a student’s social ability to ask for help from peers, regarding his/her study problems. This factor resembles Sternberg’s notion of practical intelligence (Sternberg et al 2000). A student with high values on this factor knows when he/she needs help and
can also identify the person/s to turn to for help. The analysis of factor loading plots in two-dimensional PC space revealed one of the items should be excluded from the factor (Nevgi 2002a).

### 3.2.3 Learning Skills

#### 3.2.3.1 The factor model of Learning Skills

For the Learning Skills scale, the seven-factor solution was examined. The reliability of the factors was examined with Cronbach's Alpha (see table 1). A confirmatory factor analysis model was applied to estimate the seven-factor model of the Learning Skills scale, and the statistical fit of this model was reasonable. After the reliability analysis of separate factors, the items with low correlation were excluded or reformulated (Nevgi 2001; 2002a).

#### 3.2.3.2 Dimensions of Learning Skills

**Rehearsal strategy of learning** is outlined as a basic cognitive strategy, with elaboration and organizational strategies of learning. Each of these strategies has a basic and a complex version, depending on the nature of the learning task (Pintrich & McKeachie 2000, 41). Weinstein & Meyer (1986, 137) have shown that rehearsal strategies are necessary at the beginning of a learning process, when a novice starts to develop towards gaining expert skills. The items of the factor were reformulated in order to achieve a more homogenous factor (Nevgi 2002a).

**Critical thinking strategy** is described as a students’ ability to solve problems, to make critical evaluations, and to make comparisons. Critical thinking appears different in physical sciences than in poetry or literature, and demands different qualities in thinking arising from the very nature of the subject (Pintrich & McKeachie 2000). Students with high values on this factor approach the subject they study evaluating the facts and pursuing the evidence-based knowledge.

**Finding the essential points strategy** describes how students concentrate and discover the essential and central ideas in their learning material. A good student does not only take notes of all the material s/he studies, but also organizes learning material into more important and less important areas. Weinstein and Mayer (1986, 322) describe the organizational strategies for complex learning as a student’s effort to identify the main ideas and important supporting details from the text they are studying. Ausubel (1978) has used the term advanced organizer when a student uses some beforehand given figure or orientating material to activate his/her view of the subject to be studied. In order to improve the homogeneity of the factor, one item was reformulated (Nevgi 2002a). Students with high values on this factor approach their study task, arranging it in advance into the essential and less essential subjects.

**Connecting newer and older knowledge strategy** means that a student is able to combine new knowledge with his/her previous knowledge and construct the meaning of studied subjects. Students with high values on this factor, for example, use their previous notes and compare the new knowledge with these. They attempt to understand how the previously-learned information is connected to the new things, and actively construct and develop their concepts of the subject.

**Use of keywords and advance organizers strategy** resembles the previous focus on essential strategy. However, the focus in this strategy is that a student clarifies the subject by using keywords, in order to organize the material to be studied both before and during the study period. A student achieving high values on the factor, for example takes notes of the central concepts and ideas and classifies them. S/he uses these keywords during the review period of the study process, and thus the review becomes more complex and leads to a deeper understanding in learning.
Application of theories strategy can be described as a student application of learned theories, new things, into different everyday situations, or as a comparison of theories. The transfer of learning resembles this factor. Students with high values on the factor approach their study tasks by testing the new knowledge in their work or life situation, trying to find out how pragmatic the new theory is.

Self-assessment strategy is used when a student concentrates on thinking over the learned things and asks questions, creates analogies, or explains the things s/he has learned. This strategy can also be described as an elaboration strategy. Students achieving high values on this factor tend to write learning diaries and actively reflect on their own learning process.

3.2.2. The IQ Learn tests and self-regulated learning

The dimensions described above form the basis of the interactive on-line questionnaires of the IQ Learn on the Web (Appendix 2). Zimmermann (2000) has presented the dynamic model for self-regulated learning. The first two of tests, Forethought of Learning, Strategies in Learning fit into that model very well. Forethought prepares the student for the performance activities, and student’s expectation for success and self-efficacy beliefs guide his/her approach to the studies. The anxiousness in performance prevents the student to achieve the learning goals. Task value refers to the student expectations for the utility of the course or task, and the importance and meaningfulness of studies. By using the IQ Learn tool a student can become aware of his/her approach attitude towards the studies and thus be able to control and manage own motives for learning. In Zimmermann’s model the next phase of self-regulated learning is performance or volitional control, in which the attention focusing, self-instruction and self-monitoring are included. In our test for Learning Strategies as resembling the performance control four types of resource managements were differentiated. In order to be able to manage own performance a student needs ability to manage time s/he has for studies, and to manage the efforts needed for learning. The interesting finding concerned persistence, which revealed to be a necessary resource for students in their learning management. The student should be also able to seek help from teachers and peers and recognize the need for help. Using the test for Learning Strategies students can become aware of their performance controlling strategies and how they cope with different learning situations.

Learning Skills Test includes the self-assessment strategy, which can be seen also in Zimmermann’s dynamic model, where the last phase of self-regulation is self-reflection. Learning skills tell also to the students how they study and the ways they tend to use in their learning. Learning skills refer to the deep learning approach, and by using the test a student can realize that there are also some other meaningful ways to study as the ones s/he has been accustomed to use.

3.3 Phase 3: Evaluation of the pilot use of the IQ Learn on the Web

3.3.1 The application of the results for the IQ Learn tool

All the dimensions described above formed the basis of the interactive on-line questionnaires (as shown in Appendix 2) and tutoring sets on the Web (http://www.edu.helsinki.fi/iqform/) (Virtanen 2002). Students may select one or more tests (see Figure 1). They get their test results online as visual profiles and with mean values and standard deviations of their virtual study group (see Figure 2). The graphics of the tool visualize an idea of empowerment through learning.
Students may compare their test profiles during different phases of their studies. All components of each test have a connection with tutoring sets. By clicking visual symbols of the test results (e.g., Coping with test anxiety), students get access to the hypertext tutoring sites (see Figure 3). Learners are encouraged to learn the skills of self-regulation. Tutoring packages are constructed on the same theoretical basis as the questionnaires. The IQ Learn provides teachers with information on how to support students to learn self-regulative skills. The teacher only has access to the group profiles.

![Figure 1. The example of the IQ Learn questionnaire set.](image-url)
Figure 2. The example of the IQ Learn graphic test result.

Figure 3. The example of the IQ Learn hypertext tutoring site for a student.
3.3.2 Pilot use groups

The research group collected data from the pilot use of the IQ Learn tool in the spring and autumn terms of 2002, to further develop the tool. The pilot groups were:

1. Learning Psychology Web course, Virtual Open University of Helsinki (N=35)
2. Communication Sciences Web course, University of Tampere (N=18)
3. Communication and Business on the Internet, Helsinki Business Polytechnic (N=18)
4. Orientation to University Studies Web course, University of Helsinki (N=37)

In addition to these courses, data was collected from several individual teachers and students who used the IQ Learn.

Learning Psychology Web course and Communication Sciences Web course

Students of the Learning Psychology Web course and the Communication Sciences Web course were asked to describe their experiences of the IQ Learn by writing short essays. In addition teachers of these courses were interviewed through open discussions about their experiences of the main advantages and disadvantages of using the IQ Learn to support students’ self-regulated learning. The feedback of the students and interviews of the teachers were categorized using content analysis.

Students of the Learning Psychology Web course (N=35) explored their profiles, given by the IQ Learn, and commented on their learning processes in their learning diaries. They were asked to use the IQ Learn (freely), according to their own interests, while studying on the course and to write in their learning diaries how they used the IQ Learn assessing and tutoring tool. At the end of the course, they were asked to compare their comments in their diaries with their IQ Learn results.

Some younger students on the Learning Psychology Web course felt that the IQ Learn had helped them to find the reason for their lack in learning.

“Using the IQ Learn, I could test my learning skills and there I found the reason for my laziness. I lack time management, and when I run into trouble in my studies, I easily give up. So I can see that there is plenty to develop in my learning skills and strategies.” (female, age 24)

Most of the older students on the Learning Psychology Web course reported that the tests did not give them anything new.

”According to the IQ Learn test, my learning skills are quite as high as I expected.” (female, age 36)

Students of the Communication Sciences Web course (N=18) used the IQ Learn tool independently, without any kind of guidance or teachers’ recommendations. After the course they were asked to consider whether the tool gave support to their self-assessment skills.

Most students of the Communication Sciences Web course considered the IQ Learn tool as useful for self-assessment. Some respondents got new information about themselves as learners from the tests, and they recommended the tool for students in the early stage of their studies or to anyone who wants to develop his/her learning skills.

The pilot use of the IQ Learn gave evidence that young students benefited best from the IQ Learn. If students have a very fixed learning style, they do not want to change it. The concrete is-
sues of self-regulation, such as time-management and help-seeking strategies, were considered to be very useful. The teachers’ main feedback was that self-regulation should be integrated into the Web courses as an essential pedagogical aspect. Even though the aim is self-regulation, students need guidance and activation to use the tool, which supports their development towards self-regulation (Nevgi 2002b; Virtanen & Niemi 2002).

**Communication and Business on the Internet course**

In the Helsinki Business Polytechnic, students (N=18) described their experiences of using the IQ Learn by writing short essays. The tool was not in use on this course, but the students were asked to write about the visual, functional, and useful aspects of the tool. The teacher of this course reported about her findings while using the tool and she was also interviewed through open discussions.

The students gave positive feedback on the clearness and freshness of the looks of the tool. Navigation in the system was generally found clear and easy. One third of the respondents did not see the tests as useful for themselves. They had not familiarized themselves with the tutorial texts. In contrast, those who mentioned the tutorial as a helpful tool had found profitable links, tips and recommendations for learning, and new information about learning strategies. Also, the teacher of this course gave feedback mainly about the functionality of the IQ Learn tool. She found the IQ Learn tool to be rather functional, but made significant suggestions, for example how to develop the tool to become more usable for all the commonly used browsers. On the grounds of the feedback given by this pilot group, the IQ Learn tool’s technology was further developed.

**Orientation to University studies Web course**

The students of the Orientation to University Studies (N=37) were asked to fill in two tests: Learning strategies and Learning skills. Based on the test results, the students made a plan about which fields of their strategies or skills they wanted to develop. The assignment included the planning, implementation and reporting of the development work and how they succeeded in carrying out their plans. Nine students were interviewed after they had used the IQ Learn tool. The data from the interviews and the students’ reports were analyzed using qualitative methods, e.g. categorization.

Most of the students’ self-concept as learners had strengthened, as they viewed the results of the self-assessment tests. Six interviewed students had been studying at a university or a college before the course. The more earlier studies students had performed and the older they were, the less new information the tests gave them. The younger students had got new information about the components connected to learning, e.g. critical thinking, which they considered to be an important new skill needed in university studies. The interviewed students reported that the test results gave positive feedback, and encouraged them in general, and motivated them to develop their learning skills.

Those who had read the tutorial texts found them useful. They had obtained new information about the components that affect learning. One student said:

“The best use of it was that I started to analyze them. There are self-assessment and critical thinking components, etc. and I can observe these in myself. I know they are all right at the moment, but now I know I can develop them and have an effect on them. Before using this tool, I thought about these things as a whole… I as a learner… but now they have become divergent variables. The tool gave names for different things.” (female, age 25)
Besides the information about the components affecting learning, those interviewed mentioned several practical pieces of advice they found in the IQ Learn Tutoring tool concerning, for example, time management, coping with test anxiety, help-seeking strategies, critical thinking, and connecting new and old information. Also, the teacher’s tutorial was found interesting and useful for the personal growth of the students of Education.

The IQ Learn tutorial for a learner includes assignments where the learners are asked to think over their habits of learning. Some students mentioned that these assignments were encouraging while pushing towards an evaluation of one’s own learning skills and habits:

“It made me think more about myself, what I want to be and why and what I want to study. It became clear to me that thinking about these things is one learning skill. Now I can observe my learning skills; the IQ Learn brought forward different skills. Earlier I had been acting, but I had not been thinking about how I had been acting.” (female, age 23)

Most of those interviewed used the IQ Learn Tutoring texts when they planned and implemented the development of their learning skills, though the test results were the main criterion for selecting the skill to develop. The tutorial had clarified the dimensions used in the tests and given concrete ideas and encouragement to carry out their development plans. The interviews gave evidence that some students changed their learning habits or adopted new strategies based on the information given by the tool. A student who had studied all the tutorial texts reported she had changed her method of studying for exams and made a plan to develop her help-seeking strategies. Development plans for time management and planning were also mentioned. The youngest students had plans to develop their critical thinking skills, but they saw it as difficult. On the other hand they trusted that these may develop gradually when they become more experienced as students. Many of those interviewed planned to use the tool again later to develop their learning skills further.

It became obvious that it is not an easy process to change one’s learning habits. All the students interviewed had realized there were components they could develop to get deeper into their studies. To develop one’s learning skills was found difficult, but the IQ Learn had given students practical advice on how to carry out their development plans. The greatest obstacle to overcome was the lack of time and persistency. A student related:

“There are good pieces of advice, but it is complicated to follow them through in practice. I am like a slave to my habits - I always make the same mistakes, even though I know I should act in another way.” (female, age 27)

3.3.3 Common trends

According to the pilot studies, the IQ Learn tool is most useful for students who have difficulties in learning or who do not have stable learning strategies and skills, or who are at an early stage of their university studies. The tool gave the greatest amount of new information to young students. All the respondents mentioned the concrete issues of self-regulation. Time-management and tips to cope with test anxiety were considered as very useful to their development as learners. Most university students in their 30s and 40s had much experience in studying and working, and they were well aware of their learning skills and habits – both strengths and weaknesses. Their habits were rather fixed and in most cases they did not see any reason to change them. But most of the respondents of this age mentioned they would have benefited a lot if this kind of tool had been available at the early stage of their university studies. Students with stable and effective learning strategies felt the system strengthened their understanding of their learning. The youngest students, who did not have experience in higher education, had the most superficial attitude towards learning. They also had a very outer-regulated approach to the IQ Learn tool. They strictly followed the assignments given by the teacher and did not go deeply into the tool. The youngest students gained most from the system when they were guided in to use it, e.g. by giving clear assignments.
It became obvious that students gain more from the tool with the guidance of a teacher-tutor. The assignments helped the students to use the tool more extensively and intensively. The guided use of the IQ Learn tool helped students to use the tutorial texts more meaningfully while they tested their strategic learning skills. Students need guidance and activation to begin to learn their self-regulative skills. The teacher can help students by introducing the IQ Learn and integrating it as a part of the course.

4 Summary and conclusions

In this study we discovered out that students in higher education differ in their self-regulation and receive little or no tutoring for their learning skills. We have used Pintrich’s and Ruohotie’s, and Zimmermann’s theories of self-regulated learning as a theoretical framework to build the measurement for self-regulated dimensions of an interactive self-evaluation test on the WWW.

After the validation process, three tests of self-regulated learning were accepted for the IQ Learn tool. These tests are Forethought for Learning, Learning Strategies, and Learning Skills. The validation revealed that the tests for Forethought in Learning and Learning Strategies needed to be developed further. Some items for factors were reformulated in order to get more homogeneity factors for the IQ Learn tool.

After the validation process, the IQ Learn tool was created and used in different pilot courses in order to find out how students benefited from the virtual tutoring. According to the pilot studies, the IQ Learn tool is the most useful for students who have difficulties in learning or who do not have stable learning strategies and skills, or who are at an early stage of their university studies. The self-assessment tests give young students new information about their learning strategies and skills, and strengthen more experienced students’ understanding of their learning when they already have stable and effective learning strategies. The IQ Learn tool best encourages the students to develop their learning skills towards self-regulative learning when the teacher-tutor gives concrete assignments on how to use the tool, or guides the students towards self-reflection and self-evaluation, using the various parts of the IQ Learn tool. Developing one’s action towards self-regulative learning is a long and demanding process and not many higher education students get through it alone. A technological tool, like the IQ Learn can obviously enhance learning especially at the beginning of this process.

Tutoring towards self-regulation is highly needed in higher education. There is too little guidance for study skills and learning strategies in both campus-based and virtual studies. The teacher's role and pedagogical understanding are very important, even in the Web-based courses. Further research is needed in order to help teachers to integrate theoretical knowledge of self-regulation into Web-courses. Teachers need also knowledge how to use the new tools on the WWW to support students’ learning.
References


IQ-Research group (2001). Three MSL test sets adapted from motivation and self-regulation learning tests developed by P. Pintrich and P. Ruohotie, A test about the students view on herself as a student, a test of learning strategies and a test about cognitive functions, Department of Education, University of Helsinki.


## Appendix 1 University students and self-regulation in learning

### Table 1. Means and Standard Deviations on Forethought, Strategies in Learning, and Learning Skills referring to different majors. F-test.

<table>
<thead>
<tr>
<th></th>
<th>A N = 45 M (SD)</th>
<th>B N = 46 M (SD)</th>
<th>C N = 117 M (SD)</th>
<th>D N = 35 M (SD)</th>
<th>All N = 243 M (SD)</th>
<th>F-test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forethought</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectations of success</td>
<td>3.64 (0.74)</td>
<td>3.85 (0.66)</td>
<td>3.58 (0.70)</td>
<td>3.50 (0.81)</td>
<td>3.63 (0.72)</td>
<td>2.07 n.s.</td>
</tr>
<tr>
<td>Performance anxiety</td>
<td>2.61 (0.99)</td>
<td>2.15 (0.87)</td>
<td>2.28 (0.80)</td>
<td>2.61 (0.93)</td>
<td>2.37 (0.88)</td>
<td>3.38 *</td>
</tr>
<tr>
<td><strong>Task value:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>3.78 (0.70)</td>
<td>3.92 (0.53)</td>
<td>3.65 (0.72)</td>
<td>3.58 (0.81)</td>
<td>3.72 (0.71)</td>
<td>2.35 n.s.</td>
</tr>
<tr>
<td>Utility value</td>
<td>4.05 (0.76)</td>
<td>4.13 (0.64)</td>
<td>4.09 (0.61)</td>
<td>3.79 (0.83)</td>
<td>4.04 (0.69)</td>
<td>1.95 n.s.</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>3.85 (0.65)</td>
<td>3.94 (0.59)</td>
<td>4.01 (0.63)</td>
<td>4.02 (0.65)</td>
<td>3.97 (0.63)</td>
<td>0.82 n.s.</td>
</tr>
<tr>
<td><strong>Strategies in Learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time management</td>
<td>2.87 (0.96)</td>
<td>2.76 (0.83)</td>
<td>2.80 (0.80)</td>
<td>2.81 (0.81)</td>
<td>2.81 (0.83)</td>
<td>0.14 n.s.</td>
</tr>
<tr>
<td>Self-management</td>
<td>3.29 (0.72)</td>
<td>3.12 (0.67)</td>
<td>3.15 (0.67)</td>
<td>3.26 (0.68)</td>
<td>3.19 (0.68)</td>
<td>0.74 n.s.</td>
</tr>
<tr>
<td>Persistency</td>
<td>3.39 (0.68)</td>
<td>3.40 (0.83)</td>
<td>3.15 (0.77)</td>
<td>3.16 (0.84)</td>
<td>3.24 (0.78)</td>
<td>1.84 n.s.</td>
</tr>
<tr>
<td>Help seeking strategies</td>
<td>3.19 (0.84)</td>
<td>3.53 (0.65)</td>
<td>3.25 (0.78)</td>
<td>3.41 (0.94)</td>
<td>3.31 (0.80)</td>
<td>1.96 n.s.</td>
</tr>
<tr>
<td><strong>Learning Skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehearsal</td>
<td>3.08 (0.81)</td>
<td>3.22 (0.86)</td>
<td>3.08 (0.78)</td>
<td>3.10 (0.69)</td>
<td>3.11 (0.78)</td>
<td>0.36 n.s.</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>3.18 (0.80)</td>
<td>2.98 (0.87)</td>
<td>2.73 (0.70)</td>
<td>2.89 (0.96)</td>
<td>2.88 (0.81)</td>
<td>3.78 *</td>
</tr>
<tr>
<td>Finding essential points</td>
<td>3.87 (0.85)</td>
<td>3.87 (0.76)</td>
<td>3.54 (0.73)</td>
<td>3.79 (0.71)</td>
<td>3.70 (0.77)</td>
<td>3.31 *</td>
</tr>
<tr>
<td>Connecting newer and older knowledge</td>
<td>4.13 (0.73)</td>
<td>4.12 (0.66)</td>
<td>3.85 (0.67)</td>
<td>3.99 (0.77)</td>
<td>3.97 (0.70)</td>
<td>2.67 *</td>
</tr>
<tr>
<td>Keywords and advance organizers</td>
<td>3.59 (0.90)</td>
<td>3.83 (0.82)</td>
<td>3.09 (0.83)</td>
<td>3.14 (0.83)</td>
<td>3.33 (0.89)</td>
<td>10.4 ***</td>
</tr>
<tr>
<td>Application of theories</td>
<td>3.43 (0.79)</td>
<td>3.55 (0.76)</td>
<td>3.32 (0.67)</td>
<td>3.31 (0.89)</td>
<td>3.38 (0.74)</td>
<td>1.18 n.s.</td>
</tr>
<tr>
<td>Self-assessment</td>
<td>3.05 (0.83)</td>
<td>3.10 (0.68)</td>
<td>2.76 (0.68)</td>
<td>2.92 (0.77)</td>
<td>2.90 (0.73)</td>
<td>3.37 *</td>
</tr>
</tbody>
</table>

Scale: 1 = describes well … 5 = does not describe well.
n.s = non significant, p< .05 = *, p< .01 = ** p< .001 = ***
A = Art & Humanities and Behavioural Sciences
B = Teacher Education
C = Technology and Science
D = Agriculture and Forestry
**Table 2.** University students and self-regulation in learning: the gender, age and tutorial guidance explaining Forethought in Learning

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gender</th>
<th>Age</th>
<th>Tutorial guidance</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectation of Success</td>
<td>.07</td>
<td>.13*</td>
<td>.13*</td>
<td>.45***</td>
</tr>
<tr>
<td>Performance Anxiety</td>
<td>.05</td>
<td>-.07</td>
<td>.00</td>
<td>-.24***</td>
</tr>
<tr>
<td>Intrinsic Motivation</td>
<td>.15*</td>
<td>.09</td>
<td>.09</td>
<td>.41***</td>
</tr>
<tr>
<td>Utility Value</td>
<td>.02</td>
<td>.06</td>
<td>.09</td>
<td>.50***</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>-.07</td>
<td>.08</td>
<td>-.16**</td>
<td>.11</td>
</tr>
</tbody>
</table>

**Table 3.** University students and self-regulation in learning: the gender, age and tutorial guidance explaining the Learning Strategies.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gender</th>
<th>Age</th>
<th>Tutorial guidance</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Management</td>
<td>.05</td>
<td>-.07</td>
<td>.18**</td>
<td>.28***</td>
</tr>
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<td>Self-management</td>
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<td>.07</td>
<td>.14*</td>
<td>.29***</td>
</tr>
<tr>
<td>Persistency</td>
<td>.11</td>
<td>.01</td>
<td>.17**</td>
<td>.40***</td>
</tr>
<tr>
<td>Help-Seeking</td>
<td>.10</td>
<td>-.08</td>
<td>.15*</td>
<td>.09</td>
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</tbody>
</table>

**Table 4.** University students and self-regulation in learning: the gender, age and tutorial guidance explaining the use of Learning Skills.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gender</th>
<th>Age</th>
<th>Tutorial guidance</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehearsal</td>
<td>.08</td>
<td>.17**</td>
<td>.00</td>
<td>.20***</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>.04</td>
<td>.15*</td>
<td>.12</td>
<td>.10</td>
</tr>
<tr>
<td>Finding essential points</td>
<td>.16*</td>
<td>.08</td>
<td>.16*</td>
<td>.22***</td>
</tr>
<tr>
<td>Connecting newer and older knowledge</td>
<td>.19**</td>
<td>.14*</td>
<td>.20**</td>
<td>.33***</td>
</tr>
<tr>
<td>Keywords and advance organizers</td>
<td>.32**</td>
<td>.14*</td>
<td>.19**</td>
<td>.24***</td>
</tr>
<tr>
<td>Application of theories</td>
<td>.08</td>
<td>.08</td>
<td>.21**</td>
<td>.23***</td>
</tr>
<tr>
<td>Self-assessment</td>
<td>.11</td>
<td>.20**</td>
<td>.15*</td>
<td>.26***</td>
</tr>
</tbody>
</table>
Appendix 2 The IQ Learn tests in the IQ Learn tool (http://iqform.edu.helsinki.fi)

1. Forethought of learning,
2. Strategies in learning
3. Learning skills

1. The test of Forethought of learning

EXPECTATIONS OF SUCCESS

I trust that I can learn even the most difficult theoretical issues and perform well in my studies.
I am certain that I shall succeed well in my studies.
I know that I will learn well the topics taught in the university courses.
I believe that I will achieve excellent grades.

PERFORMANCE ANXIETY

In performance situations I am preoccupied by possible failure and its consequences.
I am very anxious in exams.
Noticing that an exam includes tasks I cannot answer affects (disturbs) my concentration on the other tasks.
A stressful situation significantly decreases my performance.

MEANING OF STUDIES

If I can choose the assignments or literature, I choose the ones from which I can learn new things, even though I may not then get the best grade.
I am very interested in my major subject and the new knowledge related to it.
I get satisfaction when I have a chance to study some issues in-depth.
In my studies gaining new understandings is intrinsically rewarding to me.
In my opinion, university studies are always worthwhile.
I believe studying at university will benefit my future.
I am certain that a university degree creates possibilities to succeed in life.
I believe that my studies in the university will benefit me later.

SELF-EFFICACY AND SELF-CONFIDENCE

I will learn the issues, which are required by the university, if I only work hard enough.
In my studies, gaining new understandings is intrinsically rewarding to me. I can learn even the most difficult topics, if I only do my best. I know I can achieve the goals that are set for me.

2. The test of Strategies in learning

TIME MANAGEMENT

Even in a tough situation I can stick to the schedule I have made for myself. I stick to a certain timetable when I'm studying. I use the time that I have reserved for studying efficiently. I always stick to the study schedule that I have made.

SELF-MANAGEMENT

I try to accommodate my own style of studying so that it would match with the requirements of each course. Before a study assignment, I often go through its different steps in my mind. I set learning goals to be able to direct my studies. After a study assignment I often think about how I did and how I could improve my performance.

PERSISTENCY

I often feel so lazy or bored studying course literature that I quit before finishing. I often give up when I'm studying difficult issues and focus on the easier ones. I have no difficulties in motivating myself to complete the study tasks even if they are not particularly interesting to me. I work really hard to do well in my studies, even if I don't like all the tasks or the material I am reading.

HELP-SEEKING STRATEGIES

I seek help from my fellow students if I have difficulties in understanding something. Even if I have difficulties in my studies, I try to cope on my own, without help from others. I strive to cooperate with my fellow students when doing assignments. I often discuss with other students experiences related to learning.
3. The test of Learning skills

REHEARSAL

When studying I often revise things.
To master the things to be learnt I repeatedly return to the things I learnt earlier.
I read the texts several times to learn effectively.

CRITICAL THINKING

When some kind of theory or conclusion about the phenomenon studied is presented in the course, I try to find further arguments to support it.
I almost always evaluate the reliability of the information I have read about or heard.
I often ask questions about what I have heard or read so that I can be certain about the accuracy of the facts.

FINDING ESSENTIAL POINTS

When reading literature, I first try to have an overview of the whole subject matter and then decide what I will focus on.
When taking notes, I make a clear distinction between the more and the less important issues.
When I'm studying the literature related to my studies, I try to distinguish the most important things from the less important ones.

CONNECTING NEW AND OLD KNOWLEDGE

When I read the literature related to my studies, I combine information that I have read from different kinds of sources (for example notes, textbooks, conversations, and working experience).
I make good use of my earlier knowledge/experience in my studies.
I try to relate new information to things I have learnt earlier.

KEYWORDS AND ADVANCED ORGANIZERS

I study and memorize thoroughly the key concepts which will help me remember the broader issues.
Before reading a new text in depth, I first run through it and study how it is outlined.
When I'm reading literature, I make notes about the most important things.
APPLICATION OF THEORIES

When studying, I ask myself questions and consider the relation between theory and practice. I often develop my own conclusions or "theories" based on the things I have learned in the courses. I try to deepen what I am learning by looking for examples and applications.

SELF-ASSESSMENT

To make sure I understand deeply the subject matter of lecture series, I ask questions, for example, and participate in the discussion. I often analyze my learning experiences. I reflect on things thoroughly and think through what I have really learned.