Educational Technology Expertise Center
Open University of the Netherlands

Research project proposal

This project falls in the following research topic(s):

Tasks	■ Domain specific competence development
	☐ Learner guidance & support
	■ Assessment of complex performances
Environments	☐ Domain specific competence development
	☐ Learner guidance & support
	☐ Assessment of complex performances
Communities	☐ Domain specific competence development
	☐ Learner guidance & support
	☐ Assessment of complex performances

1. Candidate / Researcher

PhD student (to be recruited)

2. Project title

Self-Assessment and Task Selection Training prior to Learner-Controlled Instruction: Effects on Self-Regulated Learning Competence, Learner Involvement, and Learning

3. Place in the organization

OTEC Research program

4. Synopsis of the research problem

Studies comparing learner-controlled with system-controlled instruction have mainly been concerned with the effects of the instructional methods on motivation/student involvement and learning outcomes, not with the mechanisms that underlie the learner-controlled process. Moreover, these studies assumed that students are capable of accurate self-assessment and appropriate task selection. However, since there is evidence that learners typically misassess their own competence, fair conduction of such studies requires training students on self-assessment and task selection beforehand. To be able to design such an assessment and selection training, this project first tries to uncover the cognitive mechanisms underlying the self-assessment and subsequent learner-controlled task selection process as a function of learner expertise. Next, it is investigated whether an assessment and selection training leads to more accurate self-assessment and task selection, as reflected by learning outcomes. Finally, two experiments (one single-session and one “longitudinal”) investigate the effects of an assessment and selection training and subsequent engagement in learner-controlled instruction on students’ self-regulated learning competence (SRLC) development, involvement, and learning.

5. Research team

	Name and titles	Expertise/function	Dept.
a Chair	prof.dr. Fred Paas	Educational Technology	OTEC
b Team members	PhD student	Educational/Cognitive Psychology	OTEC
			OTEC
c Others			
d Supervisors[16]	dr. Tamara van Gog	Educational Technology	OTEC
	prof.dr. Fred Paas	Educational Technology	OTEC
e Consultants[16]	dr. Remy Rikers	Educational/Cognitive Psychology	EUR/Psy
	dr. Katharina Scheiter	Educational/Cognitive Psychology	KMRC

6. Length of the project

Begin date:	October 2006
End date:	October 2010
Total length:	4 years

7. Intended output

a Publications and conference presentations (short dissemination plan with divided between scientific and non scientific publication)

- 4 SSCI articles (Experiments 1, 2, 3, 4)
- 4 International Conference Presentations (e.g., EARLI, AERA, CogSci)
- 2 National Conference Presentations (e.g., ORD)
- Dissertation

b Instruments and procedures

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8. Further elaboration

a Further elaboration of the problem and aims of the research project, including scientific framework

Instructional designers hold that students' learning and the transferability of their acquired skills to the job setting are facilitated by a curriculum that allows students to practice simplified but increasingly complex versions of the real-life, whole tasks they will encounter on the job, with varying levels of support (Van Merriënboer, 1997). Moreover, supporting students in developing self-regulated learning competence (SRLC; Van den Boom, Paas, Van Merriënboer, & Van Gog, 2004) is considered a major aim of many educational programs. This competence is required if individuals are to become life-long learners able to tailor their skill development in response to changes in business and society (see Van den Boom, Paas, & Van Merriënboer, 2006; Zimmerman, 2002). Research evidence is accumulating that for instruction to be optimally effective and efficient, it needs to be adaptive to the individual learner's needs (Kalyuga, Ayres, Chandler, & Sweller, 2003). Learner-controlled instruction has been proposed as a means to achieve a better fit with learners' needs, because it allows students to self-select learning tasks, rather than work on a predefined set of learning tasks and has therefore been advocated as a means to enhance students' involvement, learning outcomes, and SRLC (see e.g., Kay, 2001; Lawless & Brown, 1997; Niemic, Sikorski, & Walberg, 1996). However, empirical grounds for those claims are rather weak. It seems that although student involvement can indeed be enhanced by learner control, this does not necessarily result in enhanced learning outcomes (Steinberg, 1989; Uden, McGuiness, & Alderson, 2000). Results on learning gains are inconclusive; when positive effects are found, this tends to be mostly for students with more experience/expertise in the domain (Lawless & Brown, 1997; Niemiec et al., 1996; Scheiter & Gerjets, in press; Steinberg, 1989). This project argues that higher involvement will only result in higher performance when the right learning tasks are chosen given the learner's own needs. In addition, it argues that the idea that this ability to accurately diagnose their own needs for performance improvement and subsequently select activities that will contribute to improvement (i.e., to effectively self-regulate) will develop by providing learners with control over task selection will not hold for novice learners.

Just as students are not likely to acquire problem-solving skills from engaging in problem solving (Sweller, Van Merriënboer, & Paas, 1998), they are not likely to acquire SRLC merely by engaging in self-regulated learning. Their lack of prior knowledge of the domain results in high intrinsic cognitive load imposed by the learning tasks. Given that they also lack knowledge of the performance standards in a domain[1] (what constitutes poor, average or good performance both for the specific task at hand, and on the tasks they are ultimately expected to perform at the end of an instructional program), having to self-regulate will likely impose a cognitive overload (see Paas, Renkl, & Sweller, 2003; Sweller et al., 1998). Due to this overload, students will not acquire schemata for assessment and selection in relation to the performance standards, that is, this load is extraneous, (ineffective) for learning. Training novice students in self-assessment and task selection may reduce this extraneous cognitive load, and thus contribute to SRLC development.

Such training is also necessary to make a fair comparison of effects on student involvement and learning outcomes of learner-controlled and fixed or system-controlled instruction. Previous studies comparing learner-controlled with fixed or system-controlled instruction have mainly been concerned with the effects of the instructional methods on student involvement and learning outcomes (see Niemiec et al., 1996), not with uncovering the cognitive mechanisms underlying the self-assessment and subsequent learner-controlled task selection process. They relied on the implicit assumption that students are capable of accurate self-assessment and appropriate task selection. However, there is evidence to the contrary.

Most students are not very accurate self-assessors (Bjork, 1999). For example, Salden, Paas, Van der Pal, and Van Merriënboer (2006) asked students to self-assess their overall task performance on a rating scale ranging from 1 (very low) to 5 (very high) after each learning task, and used that self-rating in an adaptive task selection algorithm to select a next training task. After the experiment, they scored participants' performance based on the log files. Comparing the "objective" performance scores to the self-assessment scores, Salden et al. found that 67% of participants tended to overestimate their performance during training. From the literature on self-assessment in educational settings, it is known that this occurs even in test situations when students can base their self-assessments on lists of scoring criteria: Compared to teacher or peer assessments, self-assessments tend to be higher (Miller, 2003; Topping, 2003). Of course, the fact that learner and teacher or system assessments differ, begs the question: How can you be sure that the system/teacher is accurate and the learner is not? Indeed there is ongoing debate about this in the assessment literature (Miller; Topping). However, the findings by Salden et al. are interesting in this respect: They found positive effects on learning of students who were accurate self-assessors. That is, the students who

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[1] See the next paragraphs

self-assessed their performance during training in correspondence to how the researchers assessed them post-hoc, benefited from having learning tasks dynamically selected based on their performance score. This beneficial effect on learning (measured by test performance) gives some evidence that in this case most of the students indeed overestimated themselves instead of the researchers underestimating them.

How can students' difficulties with self-assessment be explained? Bjork (1999) has argued that the misinterpretation of the meaning and predictive value of certain objective and subjective indices of our own performance during training or instruction is at the root of the misassessment of ones own competence. Contrary to performance during training, competence has to do with learning, that is, relatively stable changes in performance as shown in retention and transfer tasks. Bjork characterized the types of illusions of comprehension and competence to which learners may fall prey. Not only may the objective level of one's performance during training be misleading as an index of one's competence, but also may subjective indices such as perceptual fluency and retrieval fluency lead to incorrect readings of one's current level of skill or knowledge. As indicated above, there is also some evidence that differences in assessments may be partially explained by differences in expertise. For example, students' preferred frame of reference, which influences interpretation of the scoring criteria, tends to vary as a function of skill acquisition (Ruble & Frey, 1991; Sheldon, 2003). Whereas students tend to make temporal comparisons to their own past performance, teachers and peers are more inclined to use the performance of other students or an absolute standard as a point of reference (Miller, 2003), but correspondence between teacher and self-assessed performance can 'naturally' increase over time (Topping, 2003) due to changes in the preferred frame of reference. Furthermore, as a function of skill acquisition, the need for strong guidance by the assessment criteria may be reduced and students may prefer more holistic rather than detailed, analytic criteria (Gulikers, Kester, Kirschner, & Bastiaens, 2006). Another explanation lies in the influence of learner characteristics on self-assessments of competence, such as self-efficacy beliefs (Obach, 2003).

After the self-assessment of performance, an appropriate next learning task has to be selected that will contribute to further performance improvement. Very little is known about task selection processes, although there is some evidence that self-efficacy beliefs play an important role here as well, because people tend to seek out tasks that they are confident they can perform (Bandura, 1994). This can lead people with very high self-efficacy to select tasks that are too difficult and people with very low self-efficacy to select tasks that are too easy.

Given those findings then, fair comparison of the effects of learner-controlled vs. system-controlled or fixed instruction requires training students on self-assessment and task selection beforehand. To be able to design such an assessment and selection training, this project first tries to uncover the cognitive mechanisms underlying the self-assessment and subsequent learner-controlled task selection process. Diagnosing the need for performance improvement likely involves assessment of a number of factors, such as cognitive and/or physical effort invested, time-on-task, and different aspects of performance, and a comparison of the assessment to some reference point. This list of factors deliberately states "different aspects of performance", since not only the outcome of task performance, that is, the quality of the final solution should be taken into account, but other relevant aspects of performance (their nature being domain or task-dependent) should also be considered. For example, in technical troubleshooting, optimal performance requires a high quality final solution (i.e., optimally functioning equipment), with little or no wrongly diagnosed causes before the right cause was identified (i.e., good knowledge and reasoning skills), and no materials wasted during the process (replacing a component that turns out not to have been faulty may be very costly, which is not appreciated by employers). To design a good training, it is important to investigate which of those aspects and factors “good” and “poor” assessors and selectors will take into account during assessment and selection, how they will weigh them, and whether or not this is influenced by their domain expertise. After doing so, an experiment is conducted to investigate whether an assessment and selection training leads to more accurate self-assessment and task selection, as reflected by learning (test performance gains). Next, two experiments (one single-session and one “longitudinal”) investigate whether an assessment and selection training and subsequent engagement in learner-controlled instruction will positively affect students’ self-regulated learning competence (SRLC) development, involvement, and learning.

b Importance for the Open University of the Netherlands and the place of the research in the OTEC Research Program, as well as the relation with other OTEC programs

Life-long learning has become a key concept for the Open University. If individuals are to become effective life-long learners, they will have to be able to accurately judge their own needs for improvement and seek out appropriate learning tasks/environments in response. This project studies whether those abilities can be trained. By improving self-assessment and task selection abilities through training, it is expected that self-regulated learning competence is enhanced and that learner-controlled instruction is not only more motivating but also fosters expertise development.

This project is closely related to past and current projects in the OTEC Research Program on self-regulated learning competence, assessment (perceptions), dynamic task selection and learner-control (Gerard van den Boom, Dominique Sluijsmans, Judith Gulikers, Ron Salden, Gemma Corbalan & Wendy Kicken), and learner control/personalization issues are also addressed –albeit on a macro level- in the Technology Development Program (e.g., ASA, ROMA).

c Design & Methods

This project will focus on the domain of technical troubleshooting (cf. Van Gog, Paas, & Van Merriënboer, 2005, 2006). Participants will be secondary education students with technical subjects in their “profile” and/or technical higher professional education students. Given the variability in individual learner’s needs, a substantial task database has to be developed of simple to more complex tasks with varying levels of support within each complexity level (cf. Corbalan, Kester, & Van Merriënboer, in press).

Literature Study and Material Preparation

In the first phase of the project: a) the task database will be developed, b) a set of representative tasks will be created that can be used as pre- and post-test tasks to measure students’ expertise development in the experiments (such tasks are as yet too difficult for students, but call on all aspects of performance that they eventually have to master [see Ericsson, 2002], therefore, such tasks can function as an instrument for measuring students’ performance gains), c) criteria will be identified for assessing performance on such tasks, and d) based on a literature study a preliminary theoretical model and task-selection algorithm will be built, which are to be refined after Experiment 1.

Experiment 1:
Uncovering the Mechanisms Underlying Self-Assessment and Task Selection

Aim

The aim of this experiment is to identify what accurate assessors and selectors do differently from less accurate assessors and selectors as input for the development of a self-assessment and task-selection training to be tested in Experiment 2. The influence of domain expertise and self-efficacy beliefs is explored. A "natural" assessment and selection condition is implemented in which students have to reflect back on their performance without any memory aids, to identify which aspects/factors they "spontaneously" consider. To uncover how much relative importance students assign to aspects/factors they have been given (weighing), a condition is implemented in which students self-assess based on a summary of performance on several aspects.

Participants

100 participants; 2 conditions; 2 levels of expertise; 25 participants per cell.

Design

2 conditions: assessment with and without summary of performance.

Materials

Learning tasks (database); pre- and post-test (representative tasks); Dutch version of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993; Van den Boom et al., 2006), which contains a self-efficacy subscale (8 items; see Van den Boom et al., 2006).

Procedure

Participants come to the lab individually. They first complete the pre-test and fill-out the self-efficacy scale. Then they work on a series of 10 tasks and their performance is recorded. The first task is set; the others will be selected by the participants based on self-assessments of performance on each preceding task. The self-assessment is done as follows: In both conditions, participants are provided with assessment criteria for the task they just completed and for the representative tasks (i.e., the level of performance they ultimately have to reach) on a PC monitor. In one condition, this is all they receive, and they are instructed to self-assess while thinking aloud and their eye movements are recorded. In the other condition, participants also receive a summary record of his/her performance on the PC monitor (containing different aspects of performance, time, effort, amount of errors, type of errors, etc.), and are instructed to self-assess while thinking aloud and their eye movements are recorded. Then, in both conditions, participants are shown the task database on the PC monitor. They are instructed to select a next learning task, again while thinking aloud, and their eye movements are again recorded. After they have completed ten tasks, participants are given the post-test.

Data analysis

Participants' performance gains are measured by subtracting the pre-test scores from the post-test scores. Differences in assessment and selection processes between participants with the highest and lowest performance gains are analyzed based on the think-aloud protocols and the eye movement records made during assessment and selection. It is explored whether or not there is a correlation with expertise and self-efficacy beliefs. The results will be used to refine the theoretical model and algorithm of which preliminary versions were made based on the literature study and to develop the training for Experiment 2.

Experiment 2:
Self-Assessment and Task Selection Training

Aim
This experiment will investigate whether students can be trained to more accurately self-assess and select tasks, showing by higher pre- to post-test performance gains.

Design
2 levels of expertise; 3 conditions: learner control with no training, system-control with no training (system-control based on the algorithm developed after Experiment 1), and learner-control with training. This training will be developed based on the findings of Experiment 1. It will incorporate expert-modeling examples of good assessment and selection (cf. Van Gog, Paas, & Van Merriënboer, 2004) and will also address causes of 'poor' assessment and selection (cf. Bornstein & Zickafoose, 1999; see also Schmidt & Ford, 2003).

Hypothesis
The learner-control condition with prior self-assessment and task-selection training will show the highest pre- to post-test performance gains. The condition with system-control and no training is expected to reveal higher gains than the learner-control condition with no training because this condition adapts better to the learners' needs, even though the learner-control with no training conditions may show higher student involvement.
We expect this to be the case both for students with lower and higher levels of expertise[2].

Participants
120 participants; 3 conditions; 2 levels of expertise; 20 participants per cell

Materials
Training; learning tasks (database); pre- and post-test (representative tasks); task involvement measure (Paas, Tuovinen, Van Merriënboer, & Darabi, 2005).

Procedure
Participants in the training condition receive the assessment and selection training prior to the learning phase and participants in the no training conditions receive a 'filler task'. All participants complete the pre-test prior to the learning phase. Then, in all conditions, participants work for 2 hours on self-selected tasks (learning phase) after which they complete the post-test.

Data analysis
The effects of training are analyzed by ANOVA on pre- to post-test performance gains. Via the system-control/no training condition, effectiveness of the algorithm for learning (pre- to post-test performance gains) is studied. If the algorithm is effective, it can also be analyzed how far students' assessment and task selection in the learner-control/no training and learner control/training conditions deviates from the assessment score they would have obtained and the task they would have received had the algorithm been used.

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[2] The aim lies primarily on identifying whether the low expertise students can be trained. Inclusion of a higher expertise group is necessary though: should effects of training for low expertise students not be found, this will allow the identification of expertise or quality of training as a cause.

Experiment 3: *Effects of Learner-Controlled Instruction after Self-Assessment and Task Selection Training on Involvement and Learning*

Aim
This experiment investigates the effects on involvement and learning (pre- to post-test performance gains) of fixed, system-controlled, and learner-controlled instruction[3].

Design
4 conditions; fixed task sequence (F), system-controlled (S), learner-controlled with no prior assessment and selection training (L), and learner-controlled with prior assessment and selection training (LT).

Hypothesis
It is expected that learner-controlled instruction will have positive effects on student involvement compared to fixed and system-controlled instruction (i.e., L & LT > F & S), and that it will have positive effects on performance gains only if students have received a self-assessment and selection training prior to the learning phase (LT > L, F, & S). Effects on SRLC are explored but are not expected to be significant given the short duration of the experiment (see experiment 4).

Participants
100 participants; 4 conditions; 25 participants per condition

Materials
Assessment and selection training (cf. Experiment 2); learning tasks (database); pre-and post-test (representative tasks); task involvement measure; MSLQ

Procedure
Participants are randomly assigned to one of the conditions. Prior to the learning phase they fill out the MSLQ and complete the pre-test. Participants in the LT condition receive the assessment and selection training prior to the learning phase, and participants in the other conditions are given a ‘filler task’. Participants work for 2 hours on self-selected tasks (learning phase) after which they complete the post-test and fill out the MSLQ again.

Data analysis
ANOVAs are used to analyze differences between conditions in task involvement during the learning phase and pre- to post-test performance gains.

Experiment 4: *“Longitudinal” Study of Effects of Learner-Controlled Instruction on SRLC, Involvement, and Learning*

Aim
This experiment aims to investigate the same question that was addressed in Experiment 3 over a longer period of time.

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[3] We expect that low expertise students can be trained and will participate here, should Experiment 2 show that this is not the case, then this experiment as well as the next will either use participants at a higher level of expertise or include expertise as a variable.

Hypothesis

See Experiment 3. Additionally gains in SRLC are expected for the LT condition.

Participants

100 participants; 4 conditions; 25 participants per condition

Design

4 conditions; fixed task sequence (F), system-controlled (S), learner-controlled with no prior assessment and selection training (L), and learner-controlled with prior assessment and selection training (LT).

Materials

Assessment and selection training (cf. Experiment 2); learning tasks (database); pre-and post-test (representative tasks); task involvement measure; MSLQ

Procedure

Participants are randomly assigned to one of the conditions. Prior to the first learning phase they fill out the MSLQ and complete the pre-test. Participants in the LT condition receive the assessment and selection training prior to the learning phase, and participants in the other conditions are given a ‘filler task’. Then participants engage in 4 sequential 2-hour sessions (one per week; learning phase) after which they complete the post-test and fill out the MSLQ again.

Data analysis

ANOVAs are used to analyze differences between conditions in task involvement during the learning phase, pre- to post-test performance gains, and MSLQ gains.

d Literature

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9. Work program and planning

Detailed planning first year: October 2006 - September 2007:

Month	Activity
10/2006	Orientation in OTEC / Formulate training and supervision plan
10/2006-1/2007	Literature study
1/2007-4/2007	Write literature review
4/2007-6/2007	Prepare Experiment 1; Develop learning task database
7/2007-1/2008	Experiment 1: Set up, analysis and report the results

Global planning: October 2007 - October 2010

Month	Activity
2/2008–9/2008	Experiment 2: Set up, analysis and report the results
10/2008–8/2009	Experiment 3: Set up, analysis and report the results
9/2009–4/2010	Experiment 4: Set up, analysis and report the results
5/2010–10/2010	Dissertation.

10. External partners

Dr. Remy Rikers from the Erasmus University Rotterdam and dr. Katharina Scheiter from the Knowledge Media Research Center (Tübingen, Germany) will act as consultants to this project, and some of the studies might be conducted in collaboration.

11. Motivation for external partner

Involvement of dr. Rikers and dr. Scheiter in this project continuates the long-standing research collaborations with the Erasmus University and the KMRC. In addition, some (parts) of the studies might be conducted at the Erasmus University Rotterdam.

12. External financial support for the project

Not applicable.

13. Budget (internal and external staff)

Person	To the account of	Hours/ week	Period	Cost in k€
PhD student	OTEC	38	48 months	160
dr. Tamara van Gog	OTEC	4	48 months	14.4
prof.dr. Fred Paas	OTEC	2	48 months	24
Student assistant*	OTEC	20	2 months	4.5
Programmer**	OTEC	38	2 months	10
			Total	**212.9**

* will assist in verbal protocol transcription and analysis of first experiment (100 participants x 10 verbal protocols)

** for taskdatabase

14. Budget (material)

Materials and apparatus	Cost in k€
Participant fees experiment 1: 100 x € 10	1
Participant fees experiment 2: 120 x € 10	1.2
Participant fees experiment 3: 100 x € 10	1
Participant fees experiment 4: 100 x € 40	4
Software license TINA Pro (or comparable)*	2.8
Total	**10**

15. Explanation / justification of material costs

* for task creation

Participants will receive 10 euro for their participation in a single experimental session (experiments 1-3), hence 40 euro for participation in the "longitudinal" experiment (4).

16. Budget (travel)

Purpose/justification	Cost in k€
2 National conference visits	1
4 International conference visits	6
Total	**7**

17. Appendices attached

No