Educational Technology Expertise Center
Open University of the Netherlands

Research project proposal

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

Tasks	3	Domain specific competence development
	3	Learner guidance & support
	3	Assessment of complex performances
Environments	3	Domain specific competence development
	■	Learner guidance & support
	■	Assessment of complex performances
Communities	3	Domain specific competence development
	3	Learner guidance & support
	3	Assessment of complex performances

1 Candidate

PhD Student

2 Project title

The Effects of Different Advisory Models on the Acquisition of Domain-specific and (P)Reflection Skills

3 Place in the organization

OTEC / NELLL

4 Synopsis of the research problem

Many modern instructional approaches in professional education are based on the use of real-life learning tasks, which are typically sequenced in a pre-planned order. Thus, the learning trajectory is identical for all students who enter the educational program. A problem of this approach is that it is insensitive to the learning needs of individual learners and does not provide any opportunities for learners to develop (p)reflection skills that enable them to set their own learning trajectory. The goal of the proposed project is to study three advisory models that aim to repair these shortcomings. Three experiments will be conducted to study the effects of (1) procedural, (2) strategic, and (3) feedback advisory models on the development of domain-specific skills and (p)reflection skills, that is, self-assessment of task performance and the selection of future learning tasks (i.e., task selection). Procedural advisory models (Experiment 1) provide learners with specific performance standards and task aspects to scaffold self-assessment and task-selection for domain-specific skill acquisition. Strategic advisory models (Experiment 2) guide learners to formulate points-of-improvement based on their self-assessment and to select tasks accordingly and, finally, feedback advisory models (Experiment 3) encourage learners to compare their self-assessments and task selections to assessments and selections made by others (e.g., teachers). Strategic and feedback models explicitly aim at the development of (p)reflection skills.

5 Research team

	Name and titles	Expertise / function	Dept.
a Chair	Prof. dr. van Merriënboer	Educational Technology	NELLL / OTEC

b	Team members	PhD student		OTEC / NELLL
c	Supervisor	Dr. Kester	Educational Technology	OTEC
d	Consultants	Prof. dr. Spector Prof. dr. Seel Prof. dr. Davidson	Educational Technology Educational Technology System Dynamics	ICLEPS

6 Length of the project

Begin date: February 1st, 2008
End date: January 31st, 2012
Total length: 4 years

7 Intended output

a Publications and conference presentations

Type	#	Planning
Conferences (scientific)	3	National: OnderwijsResearchDagen 2009, 2010 and 2011
	2	European: EARLI 2009 and 2011
	2	International: AERA , AECT or another relevant conference outside of Europe
Articles (SSCI journals)	4	Literature study (2009) Experiment 1 (2009) Experiment 2 (2010) Experiment 3 (2011)
Dissertation	1	December 2011

b Instruments and procedures

This project will yield an electronic learning environment for learning system-dynamic skills designed according to 4C/ID methodology with procedural support, strategic support, and feedback tools. Furthermore, it will yield measurements for (p)reflection skills.

8 Further elaboration

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

Nowadays, many instructional approaches in professional education are based on the use of real-life professional learning tasks. Van Merriënboer's 4-Component Instructional Design model (4C/ID-model; van Merriënboer, 1997; Janssen-Noordman & van Merriënboer, 2002; van Merriënboer & Kirschner, 2007) describes empirically based guidelines for the design and sequencing of such tasks. First, they are ordered from relatively easy to more difficult in so-called 'task classes', that is, categories with equivalent tasks that nonetheless differ from each other on dimensions on which realistic professional tasks also differ (i.e., high variability because tasks are dissimilar on surface features). Second, within each task class they are ordered from tasks with a high level of learner support to tasks without support. For instance, tasks within one task class may first require learners to study and evaluate worked-out examples of problem solutions (i.e., case studies with a high level of support), then ask them to complete incomplete solutions to given problems, and finally solve problems on their own (i.e., conventional problems without support). This sequence is known as the 'completion strategy' and has strong positive effects on learning (van Merriënboer & Sweller, 2005; see also Renkl & Atkinson, 2003). If learners are able to independently solve problems without support, they may continue to a more difficult task class. Based on these principles, a sequence of tasks can be designed for an educational program. Problematic, however, is that

(1) this sequence is not sensitive to the needs of individual learners and (2) does not provide good opportunities for learners to develop reflection skills (i.e., skills to self-assess performance and to formulate points-of-improvement), and preflection skills (i.e., skills to select tasks that actually help to improve performance and work on formulated points-of-improvement). Such skills enable learners to set their own learning trajectory.

The main aim of the proposed project is to study the effects of three advisory models that aim to repair both shortcomings. First, we will discuss system-controlled adaptive instruction and learner-controlled on-demand education as two ways to select tasks in a dynamic way, so that individual learning needs can be met. Second, the three advisory models - procedural, strategic, and feedback - are briefly presented. The basic research question of the proposed experiments is how the advisory models affect both learning in the domain and the development of (p)reflection skills.

Individual learning paths: The learning cycle
In order to make individual learning paths possible, the traditional linear model of instruction, in which all learners receive the same - sequence of - tasks, should be replaced by a cyclical model. The cyclical model consists of three processes: (1) the learner performs a task, (2) task performance is assessed, and (3) the next task is selected on the basis of the assessment results (see the inner loop in Figure 1). On a continuum from system control to learner control, two extremes of this model are system-controlled adaptive instruction and learner-controlled on-demand education.

System-controlled adaptive instruction. In adaptive instruction, the learner performs the tasks but another agent, usually the teacher or a computer system, is responsible for assessing the learner's performance and selecting the next task(s) the learner should work on. Adaptive educational programs using dynamic task-selection typically yield higher learning outcomes and transfer performance than non-adaptive programs (for recent overviews, see Salden, Paas, & van Merriënboer, 2006a, 2006b). In an adaptive task-selection program, a high-ability student may quickly proceed from easy to difficult tasks and work mainly on tasks with little support, while a low-ability learner may need many more tasks to complete the program, progress slowly from easy to difficult tasks, and work mainly on tasks with sizeable support.

Learner-controlled on-demand education. In a system of on-demand education with full learner control, learners take responsibility over the whole learning cycle, including assessing their own performance and planning their future learning trajectory (see outer loop Figure 1). It is a form of dynamic task-selection, in which the learner rather than the teacher or a computer-based agent is responsible for the assessment of performance and the selection of future tasks. With regard to assessment, the learner may either assess his or her own performance on the basis of a pre-defined set of relevant standards (i.e., self-assessment) or ask others to assess it (e.g., peers, teachers, employers etc.; Sluijsmans & Moerkerke, 1999). The assessment results in an estimation of overall progress, averaged over all standards, and in a specification of points-of-improvement pertaining to particular standards that have not yet been met. With regard to task selection, learners select a task from a database with descriptions of all available tasks. According to the 4C/ID model, each task is characterized by (1) the difficulty of the task (i.e., the task class it belongs to), (2) its level of support (e.g., worked example, completion task, conventional task), and (3) its other features (i.e., dimensions on which tasks differ in the real world). After a task has been selected, the learner performs it and uses available feedback to monitor performance (Butler & Winne, 1995; Van den Boom et al., 2004). When the task is completed, the learner judges the quality of own performance again, selects the next task given the assessment results, and so on.

Advisory Models: Helping learners to take control
Learner-controlled on-demand education gives learners the opportunity to set their own learning paths, but is not explicitly focusing on teaching skills that help learners set their own learning paths. The proposed project will study three advisory models and their effects on the development of domain-specific skills and (p)reflection skills (i.e., self-assessing performance, formulating points-of-improvement, and selecting suitable tasks). In the three experiments,

responsibility over assessment and task-selection is divided between an instructional agent (e.g., teachers or computers) and the learner in a model of 'shared control' (Corbalan, Kester, & van Merriënboer, 2006). Experiment 1 focuses on teaching domain-specific skills through a procedural advisory model that scaffolds self-assessment and task-selection. In Experiments 2 and 3, the focus is on teaching (p)reflection skills through a strategic and a feedback advisory model that, respectively, (a) guides learners to draw conclusions from their self-assessments for task selection and (b) encourages learners to reflect on their self-assessments and task selections by comparing them to those made by others.

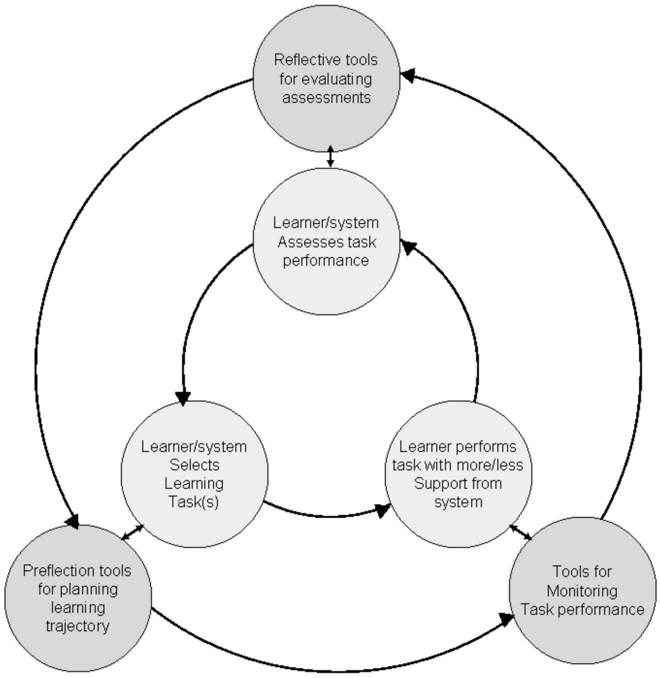

Figure 1. The Learning Cycle.

Procedural advisory models. These models basically provide students with the same rules that could be applied to implement a traditional adaptive system. Given their assessment results, learners may use the rules, which take the form of an 'algorithm', to decide on the difficulty, level of support, and other features of the next task(s) to work on. They provide straightforward advice and may, for instance, be implemented like a product comparison sheet for consumers who provide some basic data (e.g., maximum price, preferences, minimum requirements, etc.) in order to receive advice for a particular purchase. In our case, learners have to specify assessment results from previous tasks, as well as the characteristics of those tasks (i.e., difficulty, support, surface features), to enable a comparison of all tasks from which the next task(s) may be chosen. The procedural advisory model is expected to help the learners in their process of domain-specific skill acquisition. It serves as a 'thoughtless tool' that scaffolds self-assessment and task-selection and does not promote any form of generalization or abstraction through reflection.

Strategic advisory models. These models explicitly help students to apply cognitive strategies for assessing their own performance and keeping the scores, for interpreting assessment results, for matching assessment results with the characteristics of available tasks, and so forth. These models provide systematic approaches to problem solving (SAPs) and rules-of-thumb helpful to the development of (p)reflection skills (Van Merriënboer, Kirschner, & Kester, 2003). The 4C/ID model provides a good starting point for the design of such strategic guidance. The SAP presented in Figure 2 provides an example of how learners could be guided to deal with the principles of task classes, embedded support, and variability of practice:

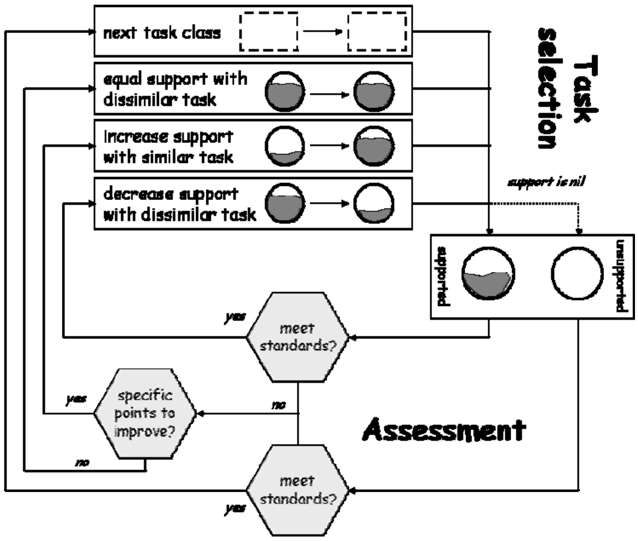

Figure 2. A SAP Presenting Rules-of-thumb for the Selection of Suitable Tasks.

In this example, learners may use tasks without support to make decisions on progress to more difficult tasks, that is, a next task class. If all relevant standards are met, the learner may proceed to the next task class. Assessment of tasks with support can be used to make decisions on an adjusted level of support or similarity for next tasks. If the learner meets all relevant standards, (s)he may select a next task with less support and dissimilar to previous tasks in order to warrant variability of practice. If the learner does not reach all relevant standards and there are specific points to improve, (s)he may select similar tasks with additional support directed at improving performance on those points. In case there are no specific points-of-improvement and merely additional practice is necessary, (s)he could select tasks with the same level of support but dissimilar from previous tasks.

Feedback Models. Procedural and strategic models help students to assess their performance, formulate points-of-improvement, and select suitable tasks. But they 'assess' rather than 'diagnose' performance, that is, they do not provide an explanation for shortcomings. Feedback models, however, provide cognitive feedback that should help learners to reach a diagnosis of possible causes of suboptimal performance. This reflection is conditional to understand the causes of ineffective behaviors. Only if these causes are understood, learners are able to modify their underlying strategies, mental models, attitudes, and related criteria in such a way that performance improvement occurs. One particularly powerful way to reach this type of reflection is inviting learners to critically compare and contrast their own assessment and task-selection processes with those of others (Butler & Winne, 1995). Such comparisons will stimulate learners not to use scaffolds as 'thoughtless tools', but to critically compare the tools as well as the results of using them with viable alternatives – yielding a process of mindful abstraction (Perkins & Salomon, 1989) and generalization.

Experiments and Hypotheses

The effects of the three different advisory models on the development of domain-specific skills and (p)reflection skills will be studied in the domain of system dynamics. In this domain, learners interpret, design and implement - runnable - system-dynamics models of complex non-linear processes (e.g., climate change, depletion of energy sources). This domain is chosen because it is representative of complex cognitive skills taught in professional education; tasks can be easily manipulated with regard to difficulty, support and surface features. It is hypothesized that procedural advisory models positively affect the system-dynamics modeling skills and strategic and feedback advisory models have increasingly stronger effects on the development of (p)reflection skills (i.e., to self-assess performance, formulate learning needs or points-of-improvement, and select suitable tasks).

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

Scientific importance
The proposed research builds theory around skill acquisition and transfer of knowledge. Furthermore, it will extend the 4C/ID model with empirically based guidelines to support (p)reflection skill development.

Importance for the OUNL
Based on the results of the proposed research, tools to enhance domain-specific and (p)reflection skill acquisition will be developed that could be implemented in OUNL learning environments to help life-long learners, who represent the student population of the OUNL, take charge of their own learning paths. Moreover, measurements for (p)reflection-ability will be developed that can be used to identify students that need extra support while steering their own learning.

Related OTEC-projects
This research is related to the current research projects of Gemma Corbalán, Wendy Kicken, Danny Kostons and Greet Fastré and the research carried out in Cluster 3 of the development program (WP7 in Ten Competence).

c Design & Methods
Three experiments are planned to test the procedural, strategic and feedback advisory models. They will be tested in the domain of system dynamics, using an electronic learning environment designed according to the 4C/ID methodology (van Merriënboer, 1997; van Merriënboer & Kirschner, 2007). This environment contains tasks that differ in (1) difficulty, (2) amount of embedded support and (3) dimensions on which tasks in the real world differ. Furthermore, it allows learners to set their own learning path: The learners perform a task, assess their performance or ask others (e.g., tutor, peers) to assess their performance, select the next task(s) to work on based on the assessment results and task information, and so forth until the end of the program. According to the 4C/ID model, when selecting a new task, the learners should ideally select a task at an appropriate level of difficulty, with a suitable amount of learner support, and with features that are different from the features of previous tasks in order to warrant sufficient variability of practice.

Each task will ask the learners to interpret and/or design a simple system-dynamics model. Three task classes will be defined, for instance, single-loop system-dynamics models, multiloop models with parameter changes that affect only one loop, and multiloop models with parameter changes that affect more than one loop. In each task class, tasks with different levels of support are available: (1) given system-dynamics models that must be interpreted and explained on the basis of self-explanation prompts (i.e., a high level of support; see Renkl, 2002); (2) partially given system-dynamics models that must be studied/interpreted and completed by the learners (i.e., ‘completion assignments’ that have a moderate level of support; van Merriënboer, 1997), and (3) conventional problems for which system-dynamic models must be designed by the learners from scratch (i.e., no support). The three planned experiments focus on self-assessment and task-selection scaffolds (Experiment 1; procedural advisory models); self-assessment and task-selection guidance (Experiment 2: strategic advisory models) and reflection prompts (Experiment 3; feedback advisory models).

Experiment 1: Procedural Advisory Models
The main question of the first experiment is if procedural scaffolds that help learners in their process of self-assessment and selecting new tasks have positive effects on learning system-dynamics modeling. Simultaneously, it is explored how such scaffolds influence the development of (p)reflection skills. It is a full factorial experiment with two factors: self-assessment (scaffold, no scaffold) and task-selection (scaffold, no scaffold). In all conditions, learners receive beforehand (1) concrete standards for acceptable performance (i.e., specific criteria, values, and attitudes relevant for the different skills of system-dynamics modeling), and (2) concrete task aspects to make well-considered selections (i.e., the specific skills that

are addressed, the level of difficulty and support, and the surface features of a task). The self-assessment scaffold is a scoring rubric which provides only task-relevant standards and rating scales for these standards. In the scaffolded self-assessment conditions learners fill out this rubric. In the conditions without this scaffold, learners assess themselves without the scoring rubric. The task-selection scaffold is a list with relevant task aspects and rating scales for these aspects. In the scaffolded task-selection conditions learners fill out these rating scales to categorize the tasks. In the conditions without this scaffold, learners categorize tasks without the list. In all conditions, learners select their next task(s) based on their self-assessment and task categorization.

It is hypothesized that both scaffolds will have a positive effect on learning system-dynamics skills, thus, main effects are predicted for scaffolded self-assessment and task-selection. The self-assessment scaffold will focus the learners' attention on the specific criteria needed to evaluate their performance and the task-selection scaffold will help them to recognize relevant task aspects and subsequently, choose those tasks that optimally contribute to reaching these criteria (i.e., adaptation). This effect will be stronger for near transfer-tasks than for far transfer-tasks, because learners may not be familiar with the specific criteria relevant for far transfer-tasks (and they were not trained to identify those criteria by themselves). With regard to learning (p)reflection skills, it is less clear what effects may be expected. Probably, learners will be able to 'imitate' the working of the scaffolds after they completed the learning phase, that is, assess themselves and select a task in the same fashion as previously enforced by the scaffolds. This is helpful for (p)reflection skills within the system-dynamics domain, but not in other domains. Furthermore, the ability to assess own performance is prerequisite for meaningful task selection. Therefore, an interaction effect on (p)reflection skills in the system-dynamics domain is expected, with a disproportionate high performance for the scaffolded self-assessment/task-selection condition.

Method
At least 120 participants from business education, aged 17$^+$ years, will be randomly assigned to the experimental conditions (see Table 1).

		Self-assessment	
		Scaffold	No scaffold
Task-Selection	Scaffold	n = 30	n = 30
	No scaffold	n = 30	n = 30

Table 1. Design experiment 1.

The task database contains 54 tasks (i.e., 18 per task class, six per support level). In the training phase, learners select tasks from a subset of nine tasks (i.e., one task from each task class and support level that is randomly determined by the computer; see Figure 3). In this way, they work on a series of 18 self-selected tasks which will take two hours. In the test phase (two and a half hours), learners will be tested on their system-dynamics knowledge and skills and their (p)reflection skills.

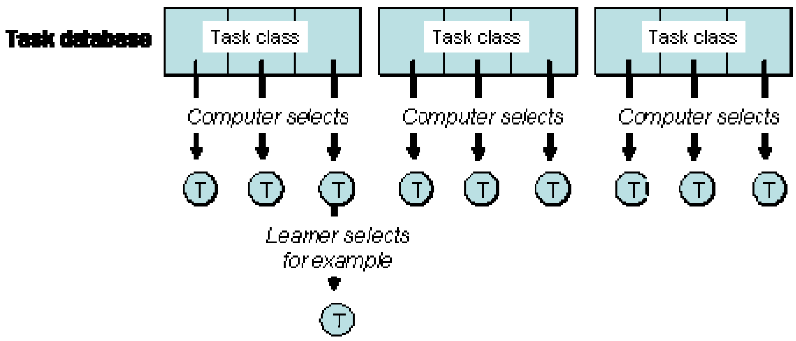

Figure 3. Shared Control over Task-selection.

To measure system-dynamic skills, participants will perform four test tasks in the same learning environment as used during practice. These tasks are identical for all participants and not self-selected. Two tasks are near transfer-tasks for which participants must design system-dynamics models that are very similar to practiced models; two tasks are far transfer-tasks for which participants must design models that are different from practiced models. In addition, participants receive a multiple-choice test with 24 items measuring factual knowledge and comprehension of system-dynamics modeling. To measure (p)reflection skills, participants first receive a (p)reflection test in the same learning environment as they practiced in. Without any scaffolds or help, they must perform, assess, formulate their points-of-improvement and select a task from a set of nine new tasks that addresses these points. This cycle is repeated two times. During the process they are required to think-aloud. Two independent observers will use an observation scheme to rate the protocols which will be used to determine the quality of (p)reflection skills in the system-dynamics domain. Second, the (p)reflection test and the scoring procedure is repeated in a new learning environment with tasks in a new domain (e.g., learning a foreign language) to measure the quality of the (p)reflection skills outside the system-dynamics domain. Third, the participants fill out a questionnaire with items asking for their perceived (p)reflection ability.

Control measures will be taken both before and during the learning and test phase. First, learners will fill out a prior knowledge test on system dynamics. All actions taken in the learning environment (e.g., selected tasks, generated system-dynamic models) will be logged. This also allows for the monitoring of time-on-task. In addition, invested mental effort will be measured for each (test) task using a 9-point rating scale developed by Paas et al. (2003). Finally, with regard to their perceptions of the learning environment, learners will fill out an evaluation questionnaire.

Experiment 2: Strategic advisory models

The second experiment builds on the previous experiment, under the assumption that the found results are in line with our hypotheses. The main question of this experiment is if strategic guidance that helps learners draw conclusions from their self-assessments for suitable task-selection has positive effects on the development of (p)reflection skills. Simultaneously the effect of guidance on learning system-dynamics modeling is explored. A full factorial experiment with the factors self-assessment (guidance, no guidance) and task-selection (guidance, no guidance) will be carried out. As in experiment 1, all learners receive concrete standards for acceptable performance, and concrete task aspects to make well-considered selections before they start working on the tasks. Moreover, all learners use the self-assessment and the task-selection scaffold during practice. In addition, they all receive guidelines that help them interpret the outcomes of the self-assessment and to relate them to specific task aspects (see for example Figure 2). In the guided self-assessment conditions, learners receive a fixed format that stimulates them to interpret the scoring rubric used for their self-assessment and summarize their points-of-improvement. It dictates them to indicate the difficulty level, the amount of support, and the similarity of to-be-selected tasks and explain their decisions. In the conditions without self-assessment guidance, learners should describe their points-of-improvement and explain their decisions without guidance. In the guided task-selection conditions, learners receive a fixed format that helps them to make a short list of suitable tasks. It prescribes them to organize suitable tasks according to difficulty, level of support and similarity and explain their final decision. In the task-selection conditions without guidance, learners select and organize suitable tasks and explain their final decision without guidance.

It is hypothesized that guidance will have a positive effect on the development of (p)reflection skills, thus, main effects are predicted for guided self-assessment and guided task-selection. Guidance helps learners to interpret the results of the scaffolds. Consequently, positive effects of guidance are predicted for both (p)reflection skills in the domain of system dynamics and (p)reflection skills as shown in a new learning domain. With regard to learning system-dynamics skills, it is less clear what effects may be expected. Probably, guidance on assessment and task-selection will not have a 'direct' effect on learning about the domain. An 'indirect' effect, however, may be mediated by the assumed increase in (p)reflection skills.

These skills might allow learners to better cope with new, unfamiliar situations which would have a positive effect on especially far-transfer tasks.

Method

See the previous experiment for the description of measurement instruments.
At least 120 participants from business education, aged 17^+ years, will be randomly assigned to the experimental conditions (see Table 2).

		Self-assessment	
		Guidance	No guidance
Task-Selection	Guidance	n = 30	n = 30
	No guidance	n = 30	n = 30

Table 2. Design experiment 2.

Experiment 3: Feedback models

The third experiment builds on the previous experiments, under the assumption that the found results are in line with our hypotheses. The main question of the third experiment is if reflection prompts for self-assessments and self-selected tasks have positive effects on the development of (p)reflection skills. In addition, the effects of these prompts on learning system-dynamics modeling is studied. Again, it is a full factorial experiment with two factors: reflection on assessment (prompts, no prompts) and reflection on task-selection (prompts, no prompts). In all conditions, learners are both scaffolded and guided as in Experiments 1 and 2. In the prompted assessment conditions, learners are required to critically compare their self-assessments with one or more assessments made by others (e.g., their tutor, their peers). In addition, they must carefully formulate the results of their comparison. In the non-prompted assessment conditions, learners receive no assessments from others. In the prompted task-selection conditions, learners are required to critically compare and contrast their own task selections with the task selections suggested by others and they must carefully formulate the results of their comparison. In the non-prompted task-selection conditions, learners receive no alternative task selections from others.

It is hypothesized that reflection prompts will have a positive effect on the development of (p)reflection skills, thus, main effects are predicted of 'reflection on assessment' and 'reflection on task-selection' in favor of the prompted conditions. Positive effects of reflection prompts are predicted for both (p)reflection skills in the domain of system-dynamics and (p)reflection skills as shown in a new learning domain. With regard to learning system-dynamics skills, we also assume an ‘indirect’ effect (see Experiment 2). The (p)reflection skills might allow learners to better cope with new, unfamiliar situations which would have a positive effect on especially far-transfer tasks.

Method

See previous experiments for a description of measurement instruments.
At least 120 participants from business education, aged 17^+ years, will be randomly assigned to the experimental conditions (see Table 3).

		Self-assessment	
		Reflection prompts	No reflection prompts
Task-Selection	Reflection prompts	n = 30	n = 30
	No reflection prompts	n = 30	n = 30

Table 3. Design of experiment 3.

d Literature

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65*, 245-281.

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Van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*, 147-177.

9 Work program and planning

Detailed planning first year: February 2008 - January 2009:

Activity	Action
1	Orientation in OTEC / Formulate training and supervision plan
2	Literature study: 4C/ID model, (self-)assessment, self-directed learning, adaptive learning environments, learner control
3	Write literature review
4	Prepare experiment
5	Adjust learning environment (within ICLEPS in particular Pal Davidson at the University of Bergen)
6	Set up experiment 1

Global planning: February 2008 - January 2012

Month	Action
2/2008 - 1/2009	Literature review; Experiment 1: Set up
2/2009 - 10/2009	Experiment 1: Analysis and report the results
11/2009 - 10/2010	Experiment 2: Set up, analysis and report the results
11/2010 - 6/2011	Experiment 3: Set up, analysis and report the results
7/2011 - 1/2012	Dissertation

10 External partners

ICLEPS

The International Center for Learning , Education and Performance Systems (ICLEPS) is housed in the Learning Systems Institute at Florida State University. Cooperating partners and collaborators include faculty and researchers located at the Open University of the Netherlands, the University of Freiburg, the University of Bergen, University of Sydney, the University of New South Wales, SUNY-Albany, Syracuse University, the Learning Development Institute, the University of Central Florida, and the International Board of Standards for Training, Performance and Instruction (http://www.lsi.fsu.edu/center5.aspx)

11 Motivation for external partner

Embedding this research project in ICLEPS enables a fruitful exchange of insights in instructional design guidelines (OUNL), development of human learning and performance systems (LSI/FSU), measurements of knowledge and expertise (University of Freiburg), and system-dynamics learning (University of Bergen).

12 External financial support for the project

None

13 Budget (internal and external staff)

Person	**To the account of**	**Hours/ week**	**Period**
PhD student	OTEC	38	48 months
Liesbeth Kester	OTEC	4	48 months
Jeroen van Merriënboer	NELLL	1	48 months
Programmer	OTEC	38	12 months

14 Budget (material)

Materials and apparatus		**Cost in keuro**
Participants: 360 participants à 50 euros per experiment		18
Software licenses etc.		5
	total	**23**

15 Explanation / justification of material costs

See Table

16 Budget (travel)

Purpose/justification		**Cost in keuro**
3 Conferences in the Netherlands		1,5
2 Conferences in Europe		2,5
2 Conferences in the US		2,5
Travel expenses to ICLEPS partners		5,0
	total	**11,5**