Self-directed lifelong learning in hybrid learning configurations

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Present-day students are expected to be lifelong learners throughout their working life. Higher education must therefore prepare students to self-direct their learning beyond formal education, in real-life working settings. This can be achieved in so-called hybrid learning configurations in which working and learning are integrated. In such a learning configuration, learning is typically trans-boundary in nature and embedded in ill-structured, authentic tasks. The goal of this study is to develop a set of design guidelines for an intervention that would strengthen students' capacity for self-directed lifelong learning within a hybrid learning configuration, a one-semester elective course at a university of applied sciences in the Netherlands. The research approach was educational design research. An intervention was designed, implemented and evaluated during two iterations of the course. Evaluation methods included interviews with students and the course facilitator, questionnaires, and students' logs and reports. We developed five intervention design guidelines that will promote self-directed learning. Our conclusion is that the intervention was usable and effective: at a basic level, the students did develop their capacity for self-directed lifelong learning. Further research is needed to investigate conditions for realizing higher levels of proficiency in self-directed lifelong learning throughout the curriculum and beyond.

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Introduction

Increasingly, students currently pursuing higher vocational education will have professions that do not yet exist (Hopkins 2010; Voogt & Roblin 2010). For example, the shift to a low-carbon economy will create many completely novel employment opportunities (Baumann, 2011). Hence, students must prepare themselves for a future that is to a significant extent unknown, both to themselves and to those who design and conduct higher education programmes (Barnett, 2000). These changing demands in the labour market will require current students to become lifelong learners who are able to direct, monitor and evaluate their own learning during their working life. Therefore, higher education must aid students in developing the capacity to learn beyond the academy, where the infrastructure of teachers, courses and formal assessment is no longer available (Boud & Falchikov, 2006). The European Union acknowledges this need and gives special attention to the enhancement of lifelong learning in the EU 2020 programme for education and training (European Commission, 2010).

Lifelong learning cannot be achieved merely by offering lifelong schooling (Billett, 2010; Kirby, Knapper, Lamon, & Egnatoff, 2010). Learning in work and everyday life settings takes place mostly through ordinary, practical activities. It is always socially constructed, highly situated, and embedded in a particular context. In order to prepare students for lifelong learning that will occur in work settings, educational institutions should give students the experience of learning through practice. Learning should be related to the kind of on-going, practical challenges and problems that students typically experience (Boud & Falchikov, 2006). One possible learning environment that offers students the experience of learning through practice is the so-called 'hybrid learning configuration' (Huisman, De Bruijn, Baartman, Zitter, & Aalsma, 2010; Wals, Lans, & Kupper 2011; Zitter 2010). In this study we define a hybrid learning configuration as a social practice situated at the interface of school and workplace in which working and learning are integrated. In such a configuration, learning is typically trans-boundary in nature (e.g. by transcending disciplines, traditional structures and sectors, and forms of learning (Wals et al. 2011)), and it is embedded in ill-structured, authentic tasks such as assignments for real-life clients or other stakeholders in the community. In such an interdisciplinary learning configuration students participate who are enrolled in different study programmes at different levels. They therefore vary in prior knowledge, interests and ambitions. Although they all aim to master similar professional tasks, each student encounters their own challenges and must learn from them in the process.

We know from experience (e.g. Cremers & Hekman, 2010), however, that the capacity for self-directed lifelong learning does not develop automatically as students work on authentic professional tasks. Individual learning that occurs as students work through such tasks often remains largely implicit or invisible. Evidence indicates that is difficult for students to make explicit both what they learned and (even more so) how they actively direct their learning during their work. Therefore, additional educational support is required in order to foster self-directed lifelong learning (Jossberger, 2011). Importantly, self-directed learning implies a move away from pre-determined and fixed

assessment goals and criteria that are set by the programme or the lecturer, and towards more emergent and dynamic assessment goals and criteria that are set by the students in dialogue with the teachers (Bolhuis, 2003; Boud & Falchikov, 2007). Unfortunately, the fact that such a shift is necessary might act as a barrier for any attempt to integrate self-directed learning into existing education programmes.

Several recent studies have focused on facilitating students' self-directed learning in authentic learning environments (e.g. Blokhuis, 2006; Poortman, 2007; De Bruijn & Leeman, 2010; Jossberger, 2011). Most of these learning environments, however, are situated in senior secondary vocational education, where the available learning tasks and learning goals are usually well defined and structured. Thus, much less is known about how to facilitate the development of self-directed lifelong learning when students are working on ill-structured, authentic professional tasks. In order to address this concern, an educational design research project was carried out in the context of an existing hybrid learning configuration at a university of applied sciences in the Netherlands. An intervention for developing the capacity for self-directed lifelong learning within the learning configuration was designed, implemented and evaluated in order to develop a set of guidelines underpinning such an intervention.

Three issues are central to this study: What is the nature of the capacity for self-directed lifelong learning in real-life situations? In which ways might the development of this capacity be facilitated within a hybrid learning configuration? What are possible obstacles to integrating self-directed lifelong learning in an existing learning configuration?

First we introduce the educational design research approach used in this study. Next we describe the study context and the main research question. Then we present the theoretical underpinnings for the design of an intervention the aim of which is to develop the capacity for self-directed lifelong learning. After evaluating this intervention, we draw several conclusions about design guidelines for such interventions, and we discuss the intervention's effectiveness and usability.

Educational design research

Educational design research (EDR) is the systematic study of educational intervention design, development and evaluation with the goals of solving complex educational problems for which no ready-made solutions are available, and gaining insights about key design principles (Nieveen, 2009). The first step in EDR is the analysis of the relevant problem as it occurs in practice. Next, a tentative solution is designed by combining existing theory, practical knowledge, experience and creative inspiration (McKenney & Reeves, 2012). The solution is then implemented in practice and evaluated. Since EDR takes place in the natural setting for which the course or intervention is intended, it is usually necessary to refine the initial design over a plurality of iterations of implementation and evaluation. Thus, EDR may be characterized as interventionist, iterative, process-oriented, utility-oriented and theory-oriented (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006).
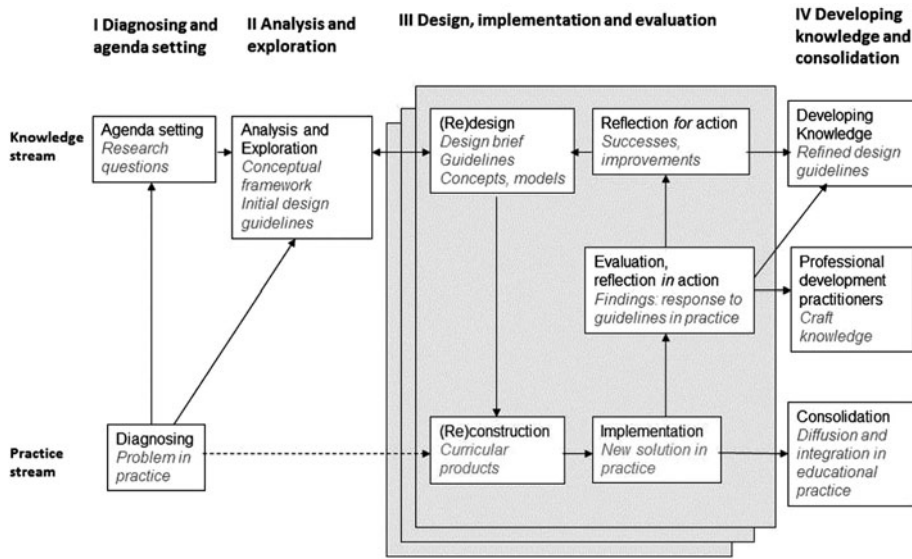
Figure 1.   Model of Educational Design Research

EDR usually has dual outputs: contributions to practice (such as curricular products) and contributions to educational theory. These outputs are the results of the 'practice stream' and the 'knowledge stream', respectively. The theoretical output of EDR can take the form of an empirically tested set of design guidelines or heuristics that can be used to guide endeavours that have similar goals and aligned tenets. The professional development of practitioners involved in the research project is sometimes thought to be a third output of EDR.

In order to execute the EDR approach used in this study (Figure 1), a model was created (Cremers, Wals, Wesselink & Mulder, submitted) based on existing models by Wals and Alblas (1997), Andriessen (2007), and McKenney and Reeves (2012). This model contains four main stages, each of which has its own goals, questions to be answered, methods and results.

  (I)   Diagnosing and agenda setting. The researcher and practitioners analyse the problem in practice and formulate the *research question(s).*
 (II)   Analysis and exploration. The researcher develops the conceptual framework that underlies the design of the intervention by conducting a literature search and eliciting craft knowledge from experienced practitioners. This is translated into a set of *initial design guidelines.*
(III)   Design, implementation and evaluation. The actual design and implementation in practice is a creative act undertaken by the researcher and the practitioners in close collaboration. The researcher collects and analyses data during each iteration of the intervention. These analyses yield findings about participants' responses to the initial design guidelines as they are implemented in practice, and they assist in the evaluation of the effectiveness and usability of the intervention (Nieveen, 2009). Finally,

these *findings* are discussed with the practitioners and decisions are made about what adjustments to make in the next iteration.

(IV) Developing knowledge and consolidation. In the knowledge stream, the researcher draws conclusions and provides a set of *refined (or empirically tested) design guidelines* that addresses the target problem in practice. In the practice stream, the new educational practice is consolidated in the specific context for which it was designed as well as in similar contexts elsewhere.

The research project will be described according to these four stages.

Diagnosing and agenda setting

For this study an intervention for fostering self-directed lifelong learning was developed within an existing hybrid learning configuration at Hanze University of Applied Sciences in Groningen, the Netherlands. The relevant course was called the 'Da Vinci Course'. First we will describe the course and then we will present the practical problem and research questions.

Context for the intervention: the Da Vinci course

Da Vinci is a one semester elective course (which is called a 'minor') for third and fourth year students enrolled in different study programmes (e.g. technical studies, economics, sports or social studies). The course was conducted four times before this study started. The overall learning objective in the Da Vinci course is the acquisition of the professional task called 'effectuation' (Sarasvathy, 2008). Effectuation is the development and realization of a new concept or product which includes the involvement of relevant stakeholders and commissioners. The focus is on entrepreneurial thinking through which a set of evolving means is used to achieve new goals (Society for Effectual Action, 2010). An expert in the field of effectuation is referred to in the Da Vinci course as an '*innovation professional*'.

The students' central assignment is an ill-structured, authentic professional task. They are expected to conceptualize and develop their own project, and this allows them to develop the complex skill of effectuation. Two examples of student projects are a city bike rental system for the city of Amsterdam and a website like 'i-Tunes' for Hindu music, called 'Hindi Tunes'. Approximately 20 students participate in the Da Vinci course each semester. They are allowed to form their own project teams, or they can work on their own, though this alternative is discouraged. Students are expected to work full-time in their own office space. A course facilitator, a lecturer, an entrepreneur, and two student-coaches are available for coaching and instruction. The total number of hours for coaching, instruction, assessment and course coordination is approximately 275 hours for a group of 20 students. There is little guidance for the project work in terms of assignments or scheduled activities. Assessment of the overall learning goal of 'effectuation' consists of three parts: an essay on a subject relevant to effectuation, a report about the new concept or product developed by the students and an oral presentation.

Problem in practice and research questions

Up until the design research study commenced, the lecturers of the Da Vinci course observed that students seemed to learn a lot individually, but they were not able to make explicit either what they had learned or how they had gone about acquiring their learning results. This is problematic since students are expected to become lifelong learners who are capable of directing, monitoring and evaluating their learning throughout their working life. In response, the lecturers felt the need to design and implement an intervention within the Da Vinci Course that would foster these capacities. Along with this practical goal, our central research question was formulated as follows:

'Which design guidelines underpin an intervention that develops students' capacity for self-directed lifelong learning while working on ill-structured, authentic professional tasks?'

Analysis and exploration: initial design guidelines

In order to design an intervention that would foster self-directed lifelong learning, a set of initial guidelines was developed. Here we will describe how the guidelines were derived from theory and professional experience. First we characterize the capacity for self-directed lifelong learning in real-life situations. Second, we investigate the ways in which one might facilitate the development of this capacity. Third, we address possible obstacles to integrating self-directed lifelong learning in an existing learning configuration. Finally, we conclude by discussing initial design guidelines for the intervention as it was implemented in the Da Vinci course.

The capacity for self-directed lifelong learning

What is the nature of the capacity for self-directed lifelong learning in real-life situations? There is a body of literature that shows that self-directed lifelong learning can be described as a cyclical process (e.g. Bolhuis, 2003; Zimmerman, 2002). Different authors use different terms for the stages within the cycle, but the following five stages or sub skills are generally recognized: diagnosing, setting goals, planning, monitoring and evaluating.

(1) *Diagnosing.* Identifying what it is to be learned. This occurs by noticing a gap in one's knowledge or expertise (Sadler, 1989), often brought about by 'life events' (Bolhuis, 2003), which in the context of professional work could be called 'work events'.
(2) *Setting goals.* Translating perceived learning needs into concrete learning goals (Bolhuis, 2003; Knowles, 1975). Defining the gap in knowledge (Boud & Falchikov, 2006) and possible ways of closing it. Choosing a strategy underpinned by argumentation. Defining criteria for success.
(3) *Planning.* Investigating possible ways of achieving the goal (Bolhuis, 2003). Translating the strategy into subsequent concrete actions.

(4) *Monitoring.* Engaging in practice and monitoring one's performance. Seeking and responding to feedback from different sources (Boud & Falchikov, 2006; Hounsell, 2007; Sadler, 1989; Cremers & Hekman, 2010).

(5) *Evaluating.* Judging on the basis of evidence the extent to which the learning goal has been attained according to appropriate standards and criteria (Boud & Falchikov, 2006).

Bolhuis (2003) states that these stages are not always followed in a particular order and that students may jump back and forth between the stages. In addition, the evaluation stage often leads to renewed goal setting, which, in turn, leads to the initiation of a new cycle. For these reasons, it may be more accurate to describe a series of consecutive cycles as progressive or incremental, spiral development rather than as a cyclical process.

Developing the capacity for self-directed lifelong learning

How can the development of self-directed lifelong learning be facilitated? According to Combs (1974), while human beings are naturally inclined to self-fulfilment, this inclination has to be developed through practice. Responsibility and self-direction are learned when students have opportunities to experiment and are allowed to make mistakes. In line with this statement, several authors (e.g. Sadler, 1989) recommend providing direct authentic experience with self-directed lifelong learning. Others note that training, instructional support and feedback by the teacher are also needed (Jossberger, 2011).

Cremers & Hekman (2010) conclude that students should not start the cycle of self-directed learning at the very beginning of a course. For the most part, students' own learning goals emerge by working in practice on real issues. Only then will situations occur in which they experience a gap in their competence (Bolhuis, 2003; Sadler, 1989). In order to capture these critical incidents and provide the students with the opportunity for reflection (looking back) as well as 'preflection' (looking forward) (Van Merriënboer & Sluijsmans, 2009), students should be prompted to complete more than one cycle of self-directed lifelong learning during the course (Cremers & Hekman, 2010). Teachers should assist and empower students to observe their own effectiveness (Zimmerman, Bonner, & Kovach, 1996). This can be achieved by providing students with a clear description both of the professional task and of the competences that are central to the course. This helps students create a mental model of good professional practice. Such a 'professional profile' can guide the students while they define their own learning goals (Cremers & Hekman, 2010). Several authors also emphasize the importance of providing feedback on the students' work (Sadler, 1989; Nicol & Macfarlane-Dick, 2006; Hounsell, 2007; Jossberger 2011). Sadler (1989) also stresses the importance of peer feedback. Feedback from working experts is also highly valued by students (Cremers & Hekman, 2010). Well-crafted feedback can enhance learning in three significant ways according to Hounsell

(2007): by accelerating learning, by optimising the quality of what is learned and by raising individual and collective attainment.

The foregoing implies that one way to facilitate self-directed lifelong learning is to offer students the opportunity to engage in two or more cycles of self-directed, lifelong learning. Furthermore, educational support should consist of instruction, a professional profile and feedback from different sources.

Obstacles to self-directed learning

What are possible obstacles to introducing self-directed learning in an existing learning configuration? As mentioned in the introduction, many students and teachers consider self-directed learning to be a shift in mindset. It implies a change in learning strategy and may be conceived of as a case of conceptual change (Bolhuis, 2003). Assessment goals, requirements and criteria are usually set by the teacher or the programme. If students are subjected to the assessments of others, they construct themselves as passive subjects (Boud & Falchikov, 2007). However, 'when people face learning demands outside the context of formal study——that is, in the contexts for which higher education is intended to prepare them——they necessarily have to construct themselves as active subjects' (Boud & Falchikov 2007, p. 18). For these reasons, Bolhuis (2003) claims that it may take time for students and teachers to let go of the old strategy and fully embrace the new one, even when the new strategy has been learned cognitively.

In addition to this shift in mindset, students may have negative experiences with assessment or reflection on personal development. Kinkhorst (2010) notes that many students in higher education in the Netherlands have become 'allergic' to words such as 'reflection' and 'personal development plan' because in many cases students are asked to reflect on their own weak and strong points without also being offered the choice or the control to direct their learning activities, since these are already planned and structured for them. This is coincides with Boud and Falchikov's (2007) statement that students may not always see themselves as active learners. Moreover, Taylor (1986) points out that self-direction is often a struggle that involves periods of discomfort and anxiety as students move from one stage to the other in the cycle of self-directed learning. Thus, we conclude that special attention should be given to motivational and emotional aspects when facilitating the development of the capacity for self-directed lifelong learning.

Initial design guidelines

It follows from our theoretical exploration that self-directed lifelong learning is comprised of a cyclic process that consists of five stages: diagnosing, goal setting, planning, monitoring and evaluating. We also found that developing the capacity for self-directed lifelong learning should be embedded in authentic experience, that it should occur over two or more cycles and should be complemented by instructional support, a professional profile and feedback from different

sources. Finally we found that motivation and emotional aspects should be considered when designing the relevant learning interventions. These features can be captured by the following three initial design guidelines:

Table 1.   Design guidelines and features of the intervention

	Design guideline	Features of the intervention
1	**Provide opportunities to engage in two or more cycles of self-directed lifelong learning**	**Iterations 1 and 2 (additions in iteration 2 in *italics*)** Students determine their learning progress twice during the course. Assignments for each stage (1.1—1.5) of the process are described below.
1.1	Diagnosing	Create a mind map of the innovation professional (characteristics, knowledge, skills) using the professional profile and presentations from experts. Analyse critical situations, problems, and events described in your blogs.
1.2	Setting goals	Describe your learning goals, a strategy to achieve them, an argumentation informed by existing theory or expert knowledge, and criteria for success.
1.3	Planning	Plan activities for each learning goal, specifying what, where, when, and with whom.
1.4	Monitoring	Alongside your project work, keep regular (e.g. daily or weekly) logs of events and describe critical situations and problems in detail. Give and receive (peer) feedback.
1.5	Evaluating	Evaluate your learning and translate successful work on learning goals into learning results.
2	**Provide educational support**	Two instructional workshops are provided. *A third workshop is added at the beginning of the course: the 'kick-off workshop'.* *Examples of learning goals and learning results are provided.* *The procedure for personal professional development is integrated in the handbook (study guide) of the course.* A professional profile (a profile of the 'innovation professional' including the task, characteristics of professional practice, required competencies) is provided. Expert innovation professionals are invited as guest speakers.

(*Continued*)

Table 1. (*Continued*)

	Design guideline	Features of the intervention
3	**Pay attention to emotional and motivational aspects**	'Personal professional development' is presented as a competence of the innovation professional and as a valuable complex skill that students need in working life. The importance of lifelong learning is stressed.
		Possible aversion against 'personal professional development' is acknowledged, but it is pointed out that learning goals in this course can actually be put into practice.
		Lecturers (coaches) are open to suggestions for improving the facilitation process, and they evaluate the process during and at the end of each course along with the students.
		At the end of the course study credits are awarded for the 'final report on personal professional development'.
		Study credits are awarded twice: for the progress report and for the final report.

(1) *Provide opportunities to engage in two or more cycles of self-directed lifelong learning,* which consist of five stages: diagnosing, setting goals, planning, monitoring, evaluating.

(2) *Provide educational support* consisting of instruction, a professional profile and feedback from different sources.

(3) *Pay attention to the emotional and motivational aspects* that are evoked either by a shift in mindset or by resistance to and struggle with the process of self-direction.

Design and implementation

The first steps of phase III (Figure 1) consisted of design and implementation. The researcher and the course facilitator translated the design guidelines into a set of intervention features that would be implemented in practice (Table 1). The specific teaching and learning activities for self-directed lifelong learning in the Da Vinci course were called 'procedure for personal professional development'.

These guidelines and their features were implemented and evaluated in two consecutive iterations of the Da Vinci course. 23 third- and fourth-year students from 10 different study programmes (7 female and 16 male) participated in the first iteration of the course. In the second iteration 18 students (3 female and 15 male) representing eleven different study programmes participated. The

researcher played an intervening role as an instructor of 'personal professional development' in cooperation with the course facilitator.

Evaluation

After the initial design and implementation, two consecutive iterations of the intervention within the Da Vinci course were evaluated. First, the features of the initial design guidelines in practice were investigated, and then the overall effectiveness and usability of the intervention was assessed.

Questions to be answered with respect to the design guidelines were:

- How did the participants (students and course facilitator) respond to and experience the manifestations of the guidelines in practice?
- What suggestions for improvement were made?
- Did possible new design guidelines emerge from the data?

Relevant questions regarding the effectiveness of the intervention were:

- To what extent did students develop the capacity for self-directed lifelong learning?
- To what extent was the students' learning during the project work actually made explicit?
- To what extent was the students' learning aligned with the intended outcomes of the course (i.e., the competencies of the innovation professional)?
- Were the students satisfied with their learning results?

For assessing the usability of the intervention we asked:

- How did participants experience the intervention (the 'procedure for personal professional development') as a whole?

Different types of data were collected in order to ensure that at least two data sources provided information on each of the design guidelines, the effectiveness and the usability of the intervention (triangulation) (Miles & Huberman, 1994). Table 2 shows which data sources provided information about design guidelines, usability or effectiveness. If the data source provided information, this is indicated with a '+'. If not, this is indicated with a '-'.

We will first describe the data sources and methods for analysis, followed by the findings.

Data sources and methods

The following data sources were used in iterations 1 and 2: Interviews with students and the course facilitator, student questionnaires, students' progress reports on their personal professional development and student blogs. As formal learning activities were carried out, a researcher observed, took notes and kept a course log. The data analysis process was checked by a second researcher who

Table 2.   Data sources in relation to design guidelines, effectiveness and usability

Data Sources	Design Guidelines							Usability	Effect-Iveness
	1. Provide opportunities to engage in two or more cycles of self-directed lifelong learning					**2. Provide educational support**	**3.Pay attention to emotional and motivational aspects**		
	1.1 Diagnosing	1.2 Setting goals	1.3 Planning	1.4 Monitoring	1.5 Evaluating				
Retrospective interview	+	+	-	+	+	+	+	+	+
Questionnaire	-	+	-	+	+	+	+	+	-
Progress reports	-	+	+	-	+	-	-	-	+
Student blogs	+	-	-	+	-	-	-	-	+
Course log and notes	-	+	+	+	+	+	+	+	-

was not involved in the Da Vinci course. Methods for data collection and analysis for each data source are as follows.

Retrospective interviews.   Eight students and the course facilitator were interviewed at the end of iteration 1. The students were selected in such a way that they differed in the degree to which they had been engaged in the procedure for professional development. They also differed in the degree to which they were enthusiastic about it. The interview consisted of two parts. Part one concerned general questions about the entire procedure. The students' answers provided information about guidelines 1.1, 1.2, 1.4 and 1.5 (diagnosing, setting goals, monitoring and evaluating) and the usability and the effectiveness of the intervention. In addition, students were asked to comment on their satisfaction with their learning results and the degree to which all their learning had been made explicit.

The second part consisted of questions concerning each formal learning activity or related product. The goal of each activity was explained, and students were asked if this goal had been accomplished. These questions also concerned the usability of the activity. This shed further light on guidelines 1.2, 1.4, 1.5 (monitoring, evaluating), 2 (educational support) and usability. The course facilitator was asked to answer the same questions both from his own point of view and from what he imagined the students' point of view to be.

The interviews were recorded, transcribed and coded according to design guidelines, usability and effectiveness. Suggestions for improvement were coded as well. For each code, a list of corresponding quotes was generated, and this list was summarized by the researcher. The coding process was documented by writing memos for any decisions and dilemmas encountered during coding and by maintaining a research log.

Questionnaire.   At the end of iteration 2 a questionnaire was filled out by twelve students. The content of the questionnaire corresponded to the second part of student interviews in iteration 1. Students were asked to comment on the accomplishment of the goal and on the usability of each activity. Students were also asked two open questions. The first was about how and from whom the student received feedback during the course, and the second asked for remarks about or suggestions for the 'procedure for personal professional development'. Questionnaire answers were coded using the same coding scheme utilized for the interviews.

Progress reports and student blogs.   The progress reports from iterations 1 and 2, which included a report of learning results, learning goals and an action plan, were used to analyse the extent to which students actually engaged in goal-setting, planning and evaluation (guidelines 1.2, 1.3 and 1.5). The blogs were studied to find out more about guideline 1.4 (monitoring), especially where it concerned students' capacity to keep a record of their work and recognize critical events.

Three aspects of the effectiveness of the intervention were also derived from the reports and blogs. First, the extent to which students developed the

Table 3. Examples of criteria for assessing the mastery of self-directed lifelong learning

Stage in the cycle of self-directed lifelong learning	Weak	Moderate	Satisfactory
Monitoring	Less than 4 blog entries.	4–7 blog entries.	8–12 blog entries.
	Blog entries not specific (according to STAR-method criteria: situation, task, actions and results).	Blog entries not very specific (STAR method partly used).	Blog entries are specific using STAR method.
	Blog entries not reflective.	Blog entries partly reflective: jumping to conclusions without analysing the situation.	Blog entries reflective: situations are analysed before drawing conclusions.
Evaluating	Learning results are not documented with literature or references to experts.	Learning results are poorly documented (sources not specific enough).	Learning results are well documented (sources specifically referenced).
	No evaluation criteria.	Evaluation criteria not measurable or to-the-point.	Evaluation criteria measurable and to-the-point.

capacity for self-directed lifelong learning was assessed via scoring rubrics. The rubrics addressed stages 1.1 – 1.5 of the cycle of self-directed lifelong learning. In this study we focused on the development of skills associated with the stages of self-directed lifelong learning in order to limit complexity. Therefore, other competencies for self-directed learning, such as those concerning personal characteristics or self-conceptions (e.g. Knowles, 1975; Candy, 1991) were not taken into consideration. For each stage in the cycle, several criteria were formulated and rated on three levels: weak, moderate and satisfactory. The intervention aimed at 'satisfactory'. An example of criteria and levels is given in Table 3.

Second, an indication of the extent to which students' learning was made explicit was derived from students' comments in the interviews on this issue combined with the content and amounts of learning results found in their progress reports.

Third, for each student learning results were categorized according to the competencies of the innovation professional. This was done in order to find out the extent to which student learning was aligned with the intended outcomes of the course.

Course log and notes. During both iterations the researcher recorded student questions, discussions that occurred during workshops and other observations. This information was used to support and supplement findings from the other sources. The course log and notes provided extra information on motivation (guideline 3) and usability.

Findings

For each guideline (Table 1) we will describe how the participants responded in both iterations. Suggestions for improvement that emerged from these findings are translated into refinements for each guideline, which will be summarized in Table 4 in the conclusions section. We conclude this section by detailing our results regarding effectiveness and usability of the intervention.

> *Design guideline 1: Provide opportunities to engage in two or more cycles of self-directed lifelong learning, which consist of five stages: diagnosing, setting goals, planning, monitoring, evaluating*

For this guideline each stage of the cycle was evaluated.

Diagnosing (guideline 1.1).   The tools that best helped students to get a mental image of the 'innovation professional' were different for each student. Some mentioned the professional profile and others stated that the the mind maps and expert's presentations were most helpful. Some students indicated that they made decisions about their learning needs based on the requirements in the professional profile. A refinement to design guideline 1.1 would therefore be: 'Provide different representations of the professional and competencies central to the course (e.g. professional profile, mind maps and presentations by experts).'

Most students, however, based their decisions about learning needs on what happened in practice. For example, one student said: 'Many things just happen to you while working on the project and that is what you learn'. Those critical situations were sometimes derived from checking their own blogs, but most often they were directly derived from an event that 'didn't feel right' or from feedback they received. Thus, a second refinement emerged: 'Be aware that learning needs tend to emerge mostly from working in practice.' Nevertheless, some students mentioned that they had formulated learning needs before they started the course.

Setting goals (guideline 1.2).   Several students admitted that they did not elaborate on their learning goals until the first progress report was due. Their learning goals often were not very specific and therefore not feasible. The refinement derived here is: 'Assist students in making their goals specific and feasible.'

The concepts 'strategy', 'argumentation' and 'criteria for success' for a learning goal appeared to be new for most students. The course facilitator often provided directions for locating existing theory or expertise that could help students attain a learning goal by setting a strategy and formulating measurable or observable criteria for success. This observation led to the following refinements: 'Assist students in underpinning their strategy with an argumentation based on theory or expertise', 'Make students aware of the existence of relevant theory or expertise' and 'Ensure that criteria are measurable or observable.'

Students indicated that the instructional workshops and coaching were important for helping them understand the concepts related to goal setting. Students appreciated being exposed to examples of good and poor goal setting, which

was done more in the second iteration. This led to the refinement: 'Provide examples of goals, strategies, argumentation, and criteria for success.'

Planning (guideline 1.3).   Students tended to plan only the first action needed to engage in activities for the learning goal. Most of them did not update their plan of action nor did they check their progress on their own (they only did this when urged during a workshop or another structured activity). Students needed help in making their plan concrete and explicit. They also needed suggestions for involving others to help them achieve their goals. This resulted in two refinements: 'Assist students in making their plan of actions concrete and specific' and 'Make suggestions about how students can involve others for support.'

Monitoring (guideline 1.4).   Students differed very much in the degree to which they engaged in regular blogging for monitoring their work. A few did it every week, some almost never, and others had periods of active blogging followed by inactive stretches. Most students mentioned that they found working on the blogs useful. In some cases blogs were useful for deriving learning needs, and in others the blogs aided in reflection. As one student put it: 'It makes you think about what you are doing, why you are doing it and if it is the right thing to do'. Students had to learn when an event apparently was 'critical' to them, how to describe this event as concretely as possible, and how to reflect on it. Several students indicated that interrogating each other about details of the event worked well because it helped them get to the core of the matter. Two refinements relating to blogging were derived here: 'Encourage students to be specific and reflective in blogging' and 'For their blogs, have students interrogate each other about critical incidents.'

All students were very positive about the feedback they received from coaches during project work, especially when setbacks occurred. Almost every student project team engaged in peer feedback. This feedback was sometimes very structured and other times more ad hoc. 'We gave each other feedback when it was needed, we were very open to each other' was a comment often heard. One of the students who engaged in structured peer feedback activities recommended making this a compulsory part of the course for every project team. Two refinements regarding feedback resulted: 'Provide feedback at critical times during project work' and 'Have students offer each other feedback.'

Evaluating (guideline 1.5).   On average, students had described approximately four learning results by the end of the course. By analogy with 'setting goals', they needed help in specifying what they had learned and what they took to be the strategy, argumentation and criteria for success. The corresponding refinement would be: 'Assist students in defining what exactly was learned and give feedback on strategy, argumentation and criteria.'

Design guideline 2: Provide educational support

In general students were satisfied with the instruction and feedback provided to them. Most students indicated that they eventually realized what was expected from them, if they did not do so right away. Students appeared to have different

conceptions of 'learning' and 'knowledge'. They seemed to think that theory is 'what we learn from books', and did not easily relate that to their learning during their project work. A refinement to this guideline would therefore be: 'Pay attention to the students' conceptions of 'learning', 'knowledge' and 'theory'.'

The students also remarked that the workshops and written guidelines complemented each other. All students very much appreciated the individual coaching session they received after the first few weeks of the course. Their reasons were not only because it made much clearer what the 'procedure for personal professional development' entailed, but also because their learning goals became more explicit and because they were given personal attention. Indeed, one student indicated that he would have liked to have more than one individual coaching session. Two refinements regarding teaching activities resulted from this: 'Provide workshops as well as written guidelines' and 'Provide individual coaching that helps students specify individual learning goals.'

Almost all respondents in the interviews and questionnaire indicated that they very much appreciated the final presentation of their learning results in small groups: 'you hear about each other's learning results in a pleasant atmosphere'. The feedback from peers and from the course facilitator during this meeting was thought to be very informative and also reassuring: 'I always thought that being a very ambitious student was mostly regarded as negative or annoying by peers, but it appeared to have good sides as well'. This resulted in the following refinement: 'Have students present their learning results to each other.'

One student suggested making the procedure 'more social': 'We always talk about our projects with each other, but never about our learning goals'. This suggestion could become a **new design guideline**: 'Treat self-directed lifelong learning as a social learning process' (Wals & Schwarzin, 2012). A suggestion made by another student was to make sure that students were aware of each other's learning goals and results from earlier on in the course. This would be a refinement to this new guideline: 'Have students share each other's learning goals and results from early on in the course.'

Design guideline 3: Pay attention to emotional and motivational aspects

When asked to estimate how many students seriously engaged in the procedure for personal professional development at the end of iteration 1, estimates offered by students were as follows: approximately five students were very seriously engaged and enthusiastic; six were 'followers', doing it because it was asked from them; and about six were not really serious, but they engaged in it to some extent for the study credits.

Most students found it difficult to actually carry through on their blogs and progress reports. Many students reported that initially the most important reason for this was the allergy they had to 'personal development', 'reflection' and related terms: 'Here we go again; we have to state our strong and weak points again'. It was a chicken-and-egg situation, which one student expressed well in the interview: 'If a student sees the benefit, he will do it'. And, further on he mentioned: 'You have to experience it, then you see the use of it'. So in hindsight, most students thought that working on their personal professional development was useful because (summarizing the students' comments in the

interviews): 'If you stop to think about what you do, you get more conscious of what you are good at (or not), what you learn, how you are developing and what you actually want to do or learn'.

Another aspect was the different dynamics between project and personal development: one is doing, the other is pausing and reflecting. The project is often regarded as more important and certainly more urgent than pausing and reflecting. Students offered several suggestions about how to motivate them to do the necessary work. This included: making students work on it as a group every week at the same time, and having students from earlier iterations visit and share their experiences. The corresponding refinements for this design guideline were: 'Organize regular working sessions on self-directed lifelong learning' and 'Have alumni of the course give presentations about their experiences with self-directed lifelong learning.'

Some remarks were made about the learning environment itself as a motivating factor. One student commented: 'Here you can put your own learning goals into practice. Because of this freedom you start to think more about: what am I doing and what do I want?' Another refinement related to motivation would therefore be: 'Point out that the students can put their own learning goals into practice.'

The same student also said: 'Because you work with people from other fields of study you learn automatically because you are taken out of your usual way of thinking. You start to look at things differently; you see that there is another way as well'. Thus a refinement on diversity was added: 'Ensure diversity: enrol students from many different study programmes.'

Another suggestion was to make the personal professional development tasks a more natural and integrated part of the course, involving all coaches and assistant-coaches in the procedure. This suggestion could become a **new design guideline**. A **r**efinement for this guideline would be: 'Involve all lecturers and assistant-coaches in the process of self-directed lifelong learning.'

When asked whether the fact that their reports were also data for research provided any extra motivation, most students answered that that it did not. Two students said that initially they just wanted to help the researcher, but soon saw that it was useful for them as well.

Effectiveness of the intervention

Relevant questions regarding the effectiveness of the intervention were:

- To what extent did students develop the capacity for self-directed lifelong learning?
- To what extent was learning during the project work actually made explicit?
- To what extent was learning aligned with the intended outcomes of the course (i.e. developing the competencies of the innovation professional)?
- Were the students satisfied with their learning results?

In general, the students did develop their capacity for self-directed lifelong learning but only at a weak to moderate level. The progress reports showed that

they could describe learning goals and strategies for pursuing them, although this was not always expressed in concrete actions. They attempted to link their learning goals and results to theory or expert knowledge but were often not very specific (e.g. by referencing a study course instead of a specific source). The evaluation criteria for their learning results were often not directly measurable or observable. Most blog entries did describe critical situations, although they were not always very specific; students tended to jump to conclusions before really reflecting on the event. For instance, one student stated that another student 'got upset' with him but did not describe the incident in any detail.

From students' blogs and also from comments in the interviews, it appeared that they learned more than what was captured in learning results. This suggests that part of their learning remained implicit. One student captured this nicely: 'Some things are in your head but you cannot get them on paper; something has changed, but you don't know what'. Several students said that when they became better at a competence they already possessed, they did not include it as a learning result. This suggests that their conceptualization of what learning is or is not also determined what they included in their learning results.

Most of the learning results were aligned with the intended outcomes of the course. When the learning results (89 in total) from students' reports that received a 'satisfactory' in iteration 1 and 2 were clustered according to the competencies of the innovation professional, it appeared that most of the learning results related to the field of personal development (43%). A considerable amount of these learning results had to do with self-discipline, possibly because this learning environment offered little structure for the students' project work. Other learning results concerned collaboration (21%), networking (15%), innovation (10%) and communication (8%). 3% of the learning results were not directly related to the competencies of the course such as 'setting up a business plan'. Some students commented that they had not enrolled in the course to become an innovation professional but to pursue their own goals such as 'discovering if I am an entrepreneur', 'to develop my creativity' or 'to find out if I can function in an unstructured environment'.

Most students were very satisfied with what they learned. Several students made comments such as 'I learned more about myself in this course than in the other three years of my study'. The course facilitator toned this result down a bit. He stated that most students were very proud of their projects and of what they learned, but for some of the students he doubted if they really had stretched their limits: 'Some students come into the course already very capable and competent. For a few of them I wonder how much they actually have grown in this course'. Most students said that what they learned differed from their expectations going into the course and that they were satisfied with this because they valued these learning results. Students mentioned for instance learning to cope with freedom and getting to know their own strengths and weaknesses.

Usability of the intervention

In order to assess the usability of the intervention we investigated how the participants experienced the intervention as a whole. As mentioned above, most students found working on their personal professional development useful but

only after they made a serious effort. According to the students, the usability of the procedure could be improved if the 'rules of the game' were stricter. Students mentioned that there should have been consequences if they did not blog regularly or did not hand in their progress report in time to receive feedback. As one student said, 'without consequences you don't put in a lot of effort, even if you intended to do it'. As to what consequences would be appropriate, the students' comments were a bit vague. Most suggestions were in the direction of awarding study credits for blogs and progress reports and withholding feedback if work is turned in after the deadline. This could be translated into another refinement for guideline 2: Have strict rules and adhere to them (with consequences, such as no feedback or no study credits, if students fall short of the rules).

Conclusions

The findings seem to confirm that based on the initial design guidelines, the intervention actually supported the development of students' capacity for self-directed lifelong learning while working on ill-structured, authentic professional tasks. The findings resulted in refinements to each initial guideline and the possible addition of two new guidelines. These are summarized in Table 4. Here, we discuss the suggested new guidelines and draw some additional conclusions from these findings.

The first new design guideline is: 'Position self-directed lifelong learning as a self-evident, integrated part of the course'. In hindsight, most students found working on their personal professional development useful as they felt it made them more aware of their actions and their own development. Being able to work on their own learning goals motivated them. Nevertheless, they found it hard to actually do the work during the course, probably because project work and self-directed learning are different in nature. The dynamic rush of the project work makes it difficult to slow down, pause and engage in the reflective activities involved in self-directed learning. Additional measures should be taken to urge or motivate the students to regularly work on self-directed lifelong learning. At first sight, this seems paradoxical: urging students to self-direct. However, the notion of self-directed lifelong learning is new for most students. Moreover, it involves a change in mind-set. The student rather than the lecturer decides what is to be learned. Evidence from controlled studies suggests that strong instructional guidance is needed for novice to intermediate learners (Kirschner, Sweller, & Clark, 2006).

The second new design guideline is that self-directed lifelong learning should be treated as a social learning process. This coincides with Bolhuis' (2003, p. 341) recommendation: 'Treat learning process and results as social phenomena'. It should be noted, however, that working on one's personal development can be perceived as 'private', and it can sometimes be experienced as threatening. One student stated: 'I don't need everyone to know what I am learning' and 'I will not accept feedback easily from students who don't take this as seriously as I do'. Giving and receiving peer feedback requires an atmosphere of safety and trust among students, and for this reason, a social learning approach must be implemented carefully (Sol, Beers, & Wals, 2012).

Table 4. Refined design guidelines for self-directed lifelong learning

	Design guideline	Refinements
1	**Provide opportunities to engage in two or more cycles of self-directed lifelong learning**	Implement two cycles of self-directed lifelong learning into the course.
1.1	Diagnosing	Provide different representations of the professional and competencies central to the course (e.g. professional profile, mind maps, presentations by experts).
		Be aware that learning needs tend to emerge mostly from working in practice.
1.2	Setting goals	Assist students in making their goals specific and feasible.
		Assist students in underpinning their strategy with an argumentation based on theory or expertise; make students aware of the existence of relevant theory or expertise.
		Ensure that criteria are measurable or observable.
		Provide examples of goals, strategies, argumentation and criteria for success.
1.3	Planning	Assist students in making their plans of action concrete and specific.
		Make suggestions about how the students can involve others for support.
1.4	Monitoring	Encourage students to be specific and reflective in blogging.
		For their blogs, have students interrogate each other about critical incidents.
		Provide feedback at critical times during project work.
		Have students offer each other feedback.
1.5	Evaluating	Assist students in defining what exactly was learned and give feedback on strategy, argumentation and criteria.
2	**Provide educational support**	Pay attention to the students' conceptions of 'learning', 'knowledge' and 'theory'.
		Provide workshops as well as written guidelines.
		Provide individual coaching that helps students specify individual learning goals.
		Have students present their learning results to each other.

(*Continued*)

Table 4. (*Continued*)

	Design guideline	Refinements
3	**Pay attention to emotional and motivational aspects**	Organize regular working sessions on self-directed lifelong learning.
		Have alumni of the course give presentations about their experiences with self-directed lifelong learning.
		Point out that the students can put their own learning goals into practice.
		Ensure diversity: enrol students from many different study programmes.
		Have strict rules and adhere to them (with consequences such as no feedback or no study credits if students fall short of the rules).
4	**Treat self-directed lifelong learning as a social learning process.**	Have students share each others' learning goals and results from early on in the course.
		Provide an atmosphere of safety and trust among students.
5	**Position self-directed lifelong learning as a self-evident, integrated part of the course.**	Involve all lecturers and assistant-coaches in the process of self-directed lifelong learning.

As expected, individual students achieved different learning results, most of which appeared to be in line with course's target competencies. Since most of the learning goals and results emerged from project working, the learning results often differed markedly from the learning goals that students focused on going into the course. Part of their learning remained implicit, however. Students were aware that 'something had changed' but were not able to express what exactly.

The quality of the blogs and progress reports was below expectation (see also Table 3). More training, instruction and coaching is probably needed, especially with respect to the task of educating students about the concepts of strategy, argumentation and the criteria for success for a given learning goal or result. The finding that students often needed help in locating existing knowledge or expertise seems to confirm the notion that the capacity for self-directed learning is domain-specific. Learners tend to be more self-directing in familiar domains of activity than in domains less familiar to them (Candy, 1991). For most students the domain of effectuation was new. For instance, many of the students had never before been required to involve external stakeholders for their projects. However, in domains in which students could be expected to have some prior knowledge, such as communication, they also needed help finding appropriate resources. This may be a problem of transfer of knowledge: students tend to have difficulty with linking the theory learned in class to their practical work (see e.g. Eraut, 2004).

Students reported that individual coaching and feedback was very effective. The time available for this course is restricted, however, by established institutional regulations that cannot easily be changed. Therefore, we also conclude,

in accordance with several studies conducted elsewhere, that the capacity for self-directed lifelong learning should probably be developed during the whole study programme, and not only as part of one individual course (Boud & Falchikov, 2006; Bolhuis, 2003; Jossberger 2011). It is plausible to assume that if students were offered more opportunities to work on self-directed lifelong learning in different courses throughout their curriculum, they would reach a higher level of proficiency. Indeed, this conclusion seems to be supported by other research. Posner (1991) shows that students' competence in self-directed learning increased significantly after they had completed two or more different self-directed learning projects.

In summary, five refined guidelines were found to underpin the design of the intervention for facilitating students to develop their capacity for self-directed lifelong learning while working on ill-structured, authentic professional tasks. Table 4 shows the guidelines and the suggested refinements for this particular context. These guidelines are not intended as recipes for success, but can help others select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in their own settings (McKenney, Nieveen, & Van den Akker, 2006).

Discussion

Self-directed learning while working on ill-structured professional tasks implies a shift in world-view both for students, but also for course facilitators. The professional development of course facilitators is often a third aim of EDR, in addition to the aims of developing curricular products and formulating design guidelines. In this research project gradual involvement appeared to be a good strategy for the professional development of course facilitator and coaches. The design and development of educational activities such as workshops and a study guide was a collaborative effort by the researcher and the course facilitator. During the first iteration the researcher carried out most of the instructional activities, and then the course facilitator and the other coaches were gradually involved for successive iterations. The course facilitator appreciated the fact that the researcher actually worked in practice and therefore could ascertain whether the new design was feasible. He also stated that he felt confident 'we are doing the right thing' because of the theoretical underpinning of the design.

For the coaches of the Da Vinci course one of the reasons for facilitating the students to self-direct and make explicit their learning was their wish to assess (and communicate to others) what the individual students had actually learned. In this study only the 'how to' or the technical execution of self-directed lifelong learning was facilitated and assessed. Its main goal was to enhance the students' capacity for self-directed lifelong learning, rather than evaluating the content and level of their individual learning outcomes (which were, in part, assessed by the project report, presentation and the essay). From an assessment point of view, it can be helpful to discern the different goals that assessment can serve. Boud and Falchikov (2006) use the term 'assessment for future learning' in relation to preparing students for lifelong learning. Tan (2007, p. 125) emphasizes that 'future-driven self-assessment' is different from 'teacher driven' or 'programme-driven' assessment in that 'there is no emphasis on students being

able to match the teacher's or the programme's requirements exactly. […]
When self-assessment is future-driven, it focuses on utilizing the programme of
study to prepare students to develop sustainable self-assessment ability'. This
development will extend beyond formal education and improve with practice
and everyday (working) life experience.

If the students' self-reported learning results in the Da Vinci course were to
be used for certification, a higher level of mastery of their capacity for self-direc-
ted lifelong learning would be required. In this experiment we were unable to
judge exactly what was learned and to which extent because there were too
many flaws in the strategy, the argumentation and the use of relevant criteria.
As mentioned before, more instruction and practice would be needed through-
out the curriculum. Further research is needed to investigate conditions for real-
izing higher levels of proficiency in self-directed lifelong learning throughout
the curriculum and beyond.

Moreover, the system for higher education would have to find ways to accredit
learning achievements claimed by the students that do not exactly match the
(often nationally) defined standards and criteria for a specific study programme.
This would imply a shift away from the current educational trends towards more
detailed specification and assessment of learning outcomes in higher education.

In theory, design research is never finished. The 'procedure for personal pro-
fessional development' was continued in further iterations of the course, and new
guidelines and suggestions for improvement were implemented. Even though this
study showed that some student learning was not captured and that the capacity
for self-directed lifelong learning could not be developed at a very high level dur-
ing a one semester course, the coaches felt that the 'procedure for personal pro-
fessional development' added value to their educational practice. Students
appreciated the fact that they were able to articulate their learning results and the
coaches felt that they had a better grasp of what was actually learned.

Two issues should be considered regarding the transferability of the design
guidelines to other contexts. First, the guidelines are interdependent and coher-
ent. This means that conclusions drawn about an individual design guideline
always need to be considered in relation to the others. Second, in order to study
the effects of the guidelines in practice, one must observe their specific features
in a particular context. For this reason, the context of this particular case should
be known to those who wish to apply the guidelines to their own context. The
description of the context and the features of the intervention in practice can
be considered a 'thick description' of the learning configuration that was stud-
ied here. Field testing in other contexts (Andriessen, 2007) would increase the
transferability of the results, provided that the similarities and differences
between these contexts are well documented. It is recommended that, as more
and more educational design research is done, case-to-case comparisons should
yield more insight into the working of design guidelines that might facilitate
self-directed lifelong learning in hybrid learning configurations.

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