Portfolio use in vocational education

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Helping students to direct their learning

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Helping students to direct their learning

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Voorwoord

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Wendy

Contents

CHAPTER 1

General Introduction

Denise and Kelsey are two first-year hairdressing students. This month they will learn to cut the hair of a hairdressing dummy in a one-length haircut. "Use your comb to section the hair, put away the comb, open your scissors and cut the hair, put the scissors safely away and take the comb …", Denise stares at the monitor displaying the instruction DVD. "Hey Kelsey, do you get any of this? This is far too difficult for me. I cannot even manage to position the comb and scissors in one hand while sectioning the hair, let alone to change the position of the comb and scissors when I need to cut the hair … !". Kelsey looks up from her nicely cut hairdressing dummy. "What do you mean? It's a piece of cake!".

Introduction

In the example Denise and Kelsey have different levels of knowledge and skills, but they are working on the same learning task in a practical lesson. In many traditional educational programs the differences between individual students are hardly taken into account, and all students proceed through the same curriculum in the same pace. However, a suboptimal agreement between students' current knowledge and skills and the potential knowledge and skills to be acquired in a next learning task (cf. Vygotsky's 'zone of proximal development', 1978) will have negative effects on students' learning and performance, and likely will decrease their motivation (Milheim & Martin, 1991; van Merriënboer, Kirschner, & Kester, 2003).

It is thus important to adapt education and training to the learning needs of individual learners (van Merriënboer, Clark, & de Croock, 2002). In order to attain this, the traditional linear model of education and training in which all learners receive the same – sequence of – learning tasks should be replaced by a cyclical model (van Merriënboer & Kirschner, 2007). Such a cyclical model may consist of three processes: (a) the student performs the learning task, (b) the quality of task performance is assessed, and (c) the next learning task is selected on the basis of the assessment results. Because the selection of the next learning task is based on the outcomes of the performance assessment, the sequence of tasks becomes more adapted to students' needs, especially to the actual level of acquired knowledge and skills.

The control over the assessment and selection of learning tasks can either be given to a teacher or computer program (system-controlled approach) or to the learner (learner-controlled approach). In a learner-controlled approach the students themselves match the new learning tasks with their learning needs. The eventual result is that there is not one curriculum for all students, but each student is free to plan his or her own curriculum. One student may quickly proceed from learning task to learning task and mainly work on learning tasks with limited or no support, while another learner may need much more time to progress from learning task to learning task and mainly work on tasks with sizeable support.

For instance, hairdressing student Denise may prefer more support to develop the skill of cutting hair than her peer Kelsey. A learner-controlled approach enables Denise to select first a substantiate number of learning tasks that focus on simultaneously handling the comb and scissors, and only when she has fairly automatized this skill, to continue to select learning tasks with full support that focus on cutting the hair according to a certain pattern. Kelsey, on the other hand, will be able in a learner-controlled approach to select learning tasks with less support and to continue directly with learning tasks in which she cuts the hair of a hairdressing dummy, all by herself. A curriculum designed according to this approach is called on-demand education. In the Netherlands, this educational approach is becoming more and more popular in secondary vocational education.

From a theoretical perspective, on-demand education might be expected to have positive effects on students' learning process and performance and also on students' motivation (Boekaerts & Martens, 2006; Hooper & Hannafin, 1988; Merrill, 1994; Ryan & Deci, 2000). Nonetheless, its effectiveness has not been consistently established by empirical research (Levett-Jones, 2005; Niemiec, Sikorski, & Walberg, 1996). One plausible explanation for the discrepancy between theoretical assumptions and empirical results is that in order to make on-demand education effective students' ability to direct their learning should be taken into account. It is important to determine to what extent students are able to assess their own performance, to formulate their learning needs, and to select their tasks, or, in other words, possess the necessary self-directed learning (SDL) skills (Knowles, 1986).

Unfortunately, freshmen who enter on-demand secondary vocational education will typically have weak SDL skills because they never had the opportunity to develop them. They often come from a tradition of teacher-directed learning in which the teacher assessed the students' performance and selected appropriate tasks for them. A first-year hairdressing student like Denise, for instance, is not used to assess her performance, to unravel underlying causes of her weak performance, or to select an appropriate task to work on her learning needs, because her teachers at primary school and pre-vocational education would do this for her.

If students have no SDL skills to begin with, on-demand education should be designed in such a way that freshmen are compensated for their lack of SDL skills and supported to develop these skills throughout the educational program. If they are given too many choices (e.g., a very large set of learning tasks to choose from), and only little information, guidance or advice to base their choices on (e.g., information on the difficulty level of a task, prerequisite knowledge or skills for performing a task), they will probably select inadequate learning tasks with negative effects on learning outcomes and motivation (Katz & Assor, 2007; Williams, 1996). For instance, many hairdressing students want to start developing the skill of colouring hair, assuming that it is an easy skill, because it resembles the skill of giving their mother's hair a colour rinse. However, what they do not know, and what is often not explicitly mentioned, is that the skill of dying hair also involves preparing the hair-dye which requires mathematical knowledge, insight and a lot of practice. This makes this skill too difficult to develop during the first months of the hairdressing program.

The studies reported in this dissertation investigate how students in an on-demand hairdressing program in secondary vocational education can be supported to develop SDL skills by (a) a digital development portfolio, and (b) portfolio-based advice. First, a structured portfolio called STEPP (Structured Task Evaluation and Planning Portfolio) was developed. STEPP provides an overview of the hairdressing skills and sub-skills and related standards for acceptable performance to the students. Using STEPP, students can assess their performance for each practiced skill, formulate learning needs, and select future learning tasks including the desired level of support (e.g., observe an expert, practice on a hairdressing dummy, or practice on

a human model). Second, a protocol for giving portfolio-based advice on the development of SDL skills was developed. This protocol may be applied in both supervision meetings and practical lessons.

The main research question addressed in the studies in this dissertation is: *What are the effects of a development portfolio and portfolio-based advice on the development of students' SDL skills in on-demand secondary vocational education?* Table 1.1 provides an overview of the empirical studies conducted to address this question.

Table 1.1 Overview of the interventions per empirical study.

Case Study Chapter 3	**Experimental Study 1** Chapter 4	**Experimental Study 2** Chapter 5
STEPP	STEPP	Extended version of STEPP
	Portfolio-based advice during supervision meetings	Reflective dialogue to provide portfolio-based advice during supervision meetings
		Reflective dialogue during practical lessons

In the case study, the effectiveness of STEPP is examined. In the first experimental study, the effectiveness of STEPP in combination with portfolio-based advice given in supervision meetings is studied. In a second experimental study, the effectiveness of an extended version of STEPP (with added prompts to foster self-directed learning) in combination with reflective dialogue on students' progress in supervision meetings and on students' plans for practice in practical lessons is investigated. The three studies were conducted at two different schools for hairdressing in secondary vocational education.

Structure of the dissertation

Chapter 2 presents the theoretical framework for the empirical studies (Chapters 3 - 5). First, from a cognitive, affective, and metacognitive perspective, it provides an overview of the factors that influence the effectiveness of giving students control over the selection of learning tasks. Next, the Informed Self-Directed Learning (ISDL) model is introduced. This model starts from the cyclical model for task selection described above, and depicts three information resources supporting students' process of task selection and helping them to develop necessary SDL skills. The information resources are: (a) a structured development portfolio, (b) a protocol for giving advice to students, and (3) a description of task metadata. In three empirical studies the first two resources of the model were tested in a hairdressing program in secondary vocational education.

Chapter 3 presents the case study. In this study students worked with STEPP and could voluntarily subscribe for supervision meetings in which they received advice on the development of their SDL skills from their supervisor. The chapter gives a detailed description of the design and implementation of STEPP. Factors that influenced the actual use of STEPP are reported. Furthermore, the perceptions of students and their supervisor on the effectiveness of STEPP to help with the development of SDL skills (i.e., self-assessment of performance, formulating learning needs, and selecting learning tasks) are described and discussed. Both the students and their supervisor indicated that in order to reach positive effects of STEPP on SDL skills, it should best be combined with advice in supervision meetings.

The experimental study reported in Chapter 4 investigates the effects of STEPP on students' SDL skills (i.e., self-assessment of performance, formulating learning needs, and selecting learning tasks) and learning results (i.e., hairdressing skills), but in line with the findings of the case study STEPP is now combined with portfolio-based advice that is provided by the supervisor in compulsory supervision meetings. Two conditions with and without advice were compared. In the advice condition, the advice consisted of both feedback and feedforward on students' SDL skills to self-assess their learning, formulate learning needs, and select learning tasks. In the feedback-only condition, students only received feedback on their SDL skills. During interviews, students indicated that they preferred a dialogue with their teacher or supervisor about their learning needs and selections of learning tasks to only formulating and writing them in STEPP.

The experimental study reported in Chapter 5 investigates the effects of p/reflection prompts on students' SDL skills and learning results in the hairdressing domain. Three p/reflection prompts were implemented in the educational program: (a) extra questions in an extended version of STEPP to prompt students to formulate diagnostic learning needs and draw specific plans concerning the focus of future learning tasks, (b) reflective dialogue used during supervision meetings to help students diagnose their performance and plan future learning, and (c) reflective dialogue on students' plans for practice during the practical lessons. Students in the experimental condition received these prompts, while students in the control condition did not. They used the original version of STEPP and did not engage in any reflective dialogue during supervision meetings or practical lessons. Concerning the SDL skills in this study the focus was on formulating diagnostic learning needs and drawing specific plans for future learning.

Finally, Chapter 6 presents the main findings and conclusions of the described empirical studies. Practical implications of the findings for the design of on-demand education are provided and directions of future research are described.

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CHAPTER 2

Scaffolding advice on task selection: A safe path toward self-directed learning in on-demand education[1]

An intuitively appealing approach to increasing the flexibility of vocational education and training is to delegate choices on instruction, such as the selection of learning tasks, to students. However, empirical evidence shows that students often do not have sufficiently developed self-directed learning skills to select suitable tasks. This chapter describes the Informed Self-Directed Learning (ISDL) model, which depicts three information resources supporting students' process of task selection and helping them to develop important self-directed learning skills necessary for effective task selection: (a) a structured development portfolio to support and develop their self-assessment skills; (b) a description of task metadata to help them compare and select suitable tasks; and (c) a protocol for giving advice, which explicitly demonstrates how to use performance results to select suitable tasks. Furthermore, the ISDL model proposes that as students further develop their self-directed learning skills and improve their task selections, the frequency and/or level of detail of given advice gradually diminishes and the choice of available tasks increases.

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Introduction

Competence-based learning is the new paradigm for innovations in Vocational Education and Training (VET) programmes (Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004). In competence-based VET programmes, students develop complex skills or professional competencies by working on authentic learning tasks. Such tasks help students to integrate the knowledge, skills, and attitudes necessary for effective task performance, facilitating transfer of what is learned to future work settings and daily life (Merrill, 2002; van Merriënboer & Kirschner, 2001). However, competence-based education might easily overwhelm students because of the complexity of the learning tasks, which may negatively influence learning and motivation (van Merriënboer, Kirschner, & Kester, 2003). Therefore, it is critical to adjust the difficulty and support level of learning tasks to the nature and amount of the students' available prior knowledge and current levels of performance. Giving students control over the selection of learning tasks they want to perform is an intuitive and appealing instructional method to address their individual differences.

In the Netherlands, on-demand education is increasingly introduced to address the individual differences between students. On-demand education is largely based on the idea of learner-controlled task selection. It is an educational approach in which students are given control over one or more instructional aspects such as order, pace, available support, and so forth. Through such learner-controlled task selection, students can match their own individual characteristics and preferences with the instructional features of the available learning tasks in the curriculum, enabling them to plan their own learning (Katz & Assor, 2007; Williams, 1996). The amount of control given to learners over one or more instructional aspects can vary from full control, via shared control, to no control at all. This chapter addresses on-demand education in which learners are given a high level of control over task selection and are given the opportunity to choose their preferred learning task(s) in order to develop the complex skills or professional competencies that the educational programme aims to impart. They choose these tasks from a large collection of predefined learning tasks, which differ in level of difficulty, level of support, and other authentic features (van Merriënboer, 1997). For example, hairstylist students in an on-demand vocational training programme may develop the skill of colouring hair by selecting learning tasks in any order from a set of predefined tasks. Each learning task can be categorised according to the combination of its level of difficulty (e.g., apply only one colour of hair-dye, or several colours), the level of support given during task performance (e.g., expert observation, occasional help from an expert, or no help at all), and other authentic features (e.g., performance with or without a time limit; performance on a dummy hairdressing head or on a real model). Students are free to select any task, and to perform the tasks in any order they prefer.

Several cognitive, metacognitive, and affective learning theories provide sound arguments for the assumed positive effects of on-demand education on students'

performance, intrinsic motivation, and development of self-directed learning skills. However, its effectiveness has not been established consistently by empirical research (Hannafin, 1984; Levett-Jones, 2005; Niemiec, Sikorski, & Walberg, 1996; Steinberg, 1977, 1989). One explanation for this finding is that the learning environment does not always take learners' underdeveloped self-directed learning skills into account (i.e., their inability to plan, monitor, and evaluate own performance), whereas well-developed self-directed learning skills are prerequisite to function effectively in an on-demand educational setting (Biemans et al., 2004; Brockett & Hiemstra, 1991). In on-demand education, the learning environment is often too open, providing students with too many choices and too little guidance or advice to help them make adequate task selections, because it is assumed that all students are already able to choose adequate tasks to improve their performance. This can lead to negligible or even negative effects of on-demand education on cognitive (i.e., performance), metacognitive (i.e., self-directed learning skills), and affective (i.e., motivation) learning variables (Katz & Assor, 2007; Williams, 1996).

Because on-demand education is becoming increasingly popular in VET, the main aim of this study is to determine how the effectiveness of on-demand education can be improved by adjusting the learning environment in such a way that it helps students to compensate for their poor self-directed learning skills and to further develop these skills. First, factors positively or negatively influencing the effectiveness of on-demand education are deduced from cognitive, metacognitive and affective theories, and from empirical research findings on learner control and self-directed learning. Second, these factors are translated into mechanisms that must be supported by on-demand education and be available for students to guide them during their task selections, and help them to eventually develop their self-directed learning skills. Next, the Informed Self-Directed Learning (ISDL) model is proposed, which includes and combines these mechanisms. The model is based on the idea of providing students with sufficient and structured information in the form of a development portfolio, task metadata, and advice, to support the development of their (initially poorly developed) self-directed learning skills during a cyclical process of task selection. In addition, the model shows how scaffolding might be designed to help students develop their self-directed learning skills themselves. Finally, main conclusions and directions for future research are presented.

On-demand education: effectiveness and directions for improvement

Theories on cognitive, metacognitive, and affective learning activities provide a sound basis to understand the potential effectiveness of on-demand education. Using these theories to interpret previous research results, factors are deduced that either positively or negatively influence the effectiveness of this educational approach. In

the next sections, the three theoretical perspectives and empirical findings are discussed and integrated with each other. Subsequently, implications for the design of effective on-demand education are formulated.

Cognitive perspectives on learner control over task selection

Many cognitive theorists argue that providing learners with control over task selection positively affects the quality of their cognitive learning activities because it enhances the processing of new information (e.g., Gagné, 1985; Hartley, 1985; Merrill, 1994; Reigeluth & Stein, 1983; van Merriënboer, Clark, & de Croock, 2002). According to information processing theory, learners use several encoding strategies to organise and integrate new information in previously constructed cognitive schemata in memory (Gagné, 1985). Providing students with control over task selection, sequence and contents gives them the opportunity to choose and apply an encoding strategy that helps them to encode and store information in a personally meaningful way, which is best attuned to schemata already available in memory (Hartley, 1985; Milheim & Martin, 1991). This gives students the advantage to construct richer and more integrated schemata, which eventually enhance the retrieval process and thus the transfer of what is learned to new problems and situations (Hooper & Hannafin, 1988).

Besides these positive effects, cognitive theorists also point out and warn for the negative effects that learner-controlled instruction might have on learning outcomes and transfer. Gagné (1985) states that the sequence in which learners encode new pieces of information is critical, because this influences how they integrate the new information and gradually construct a representation of the domain. Because on-demand education gives students control over the sequencing of learning tasks, this might undermine the structure that is inherent to the learning domain, thus negating its effectiveness.

Research on learner-controlled instruction confirms the existence of negative effects associated with learner control over task selection, showing that learners are not always capable of making substantiated, appropriate, and effective selections of learning tasks (e.g., Clark, 1989; Steinberg, 1989; Williams, 1996), resulting in poor sequencing of information and, consequently, ineffective learning and low transfer of learning. Two cognitive factors responsible for ineffective task selection are absent or little prior knowledge, and incorrect prior knowledge of the domain. Students with absent or little prior knowledge are not sufficiently familiar with the domain, material, and task features to reason which tasks can best help them to construct or reconstruct their cognitive schemata in a meaningful way: without knowing much about a domain, it is very difficult or even impossible to select the most suitable learning tasks. Furthermore, if students have incorrect prior knowledge (e.g., misconceptions, naïve mental models), their misconceptions of a task's relative difficulty level, or the skills required to perform it, make them prone to choose tasks that are either too

difficult, too easy, or irrelevant to the schemata they need to construct (Anderson, 1990; Gray, 1987; Ross & Rakow, 1981; Ross, Rakow, & Bush, 1980).

Two decades ago, several researchers were already proposing that learner-controlled instruction, which regularly informs or advises learners, provides them with an aid to make effective decisions by counteracting the negative effects of little or incorrect prior knowledge (e.g., Hannafin 1984; Milheim & Martin, 1991; Steinberg, 1989; Tennyson & Buttery, 1980; Tennyson, Tennyson, & Wolfgang, 1980). Information on features of to-be-selected tasks (i.e., *task metadata*) is especially important for students who are novices in a domain. Students should be familiarised with relevant task characteris-tics, such as the topic or focus of the task, its level of difficulty, and support required. In addition, students should be informed on the optimal sequencing of tasks, and should be advised that in order to learn a complex skill or professional competency, one should start with tasks that are relatively easy and first learn the basic skills, smoothly progressing toward more difficult tasks and more complex skills (van Merriënboer, 1997).

Metacognitive perspectives on learner control over task selection

From a metacognitive perspective, learner control over task selection is assumed to have positive effects on the development of students' self-directed learning skills (e.g., Brockett & Hiemstra, 1991; Williams, 1996; Zimmerman, 1994). Moreover, exercising control over one's own learning is conditional for self-directed learning (Merrill, 1975, 1980), including the planning of new learning tasks, the monitoring of task performance, the assessment of results, and the formulation of learning goals (Knowles, 1975, 1986). Giving learners control over task selection, as in on-demand education, might induce more elaborate mental processing in students as a result of the deliberate choices they have to make (Salomon, 1983, 1985). Zimmerman (1994) even argues that if students are not allowed to take control over their own learning, they are not likely to develop effective strategies for self-regulation. Thus, from a theoretical perspective, a certain amount of responsibility for own learning seems to be a precondition of becoming a self-directed learner.

Paradoxically, empirical results show that self-directed learning skills are not only a positive result of giving control over task selection to learners, but also a minimum requirement to handle the control that is being delegated (Clark, 1989; Hill & Hannafin, 2001; Land, 2000). Thus, there is a chicken-and-egg relation between the two. To enable students to develop their self-directed learning skills, they should be given control over task selection; but at the same time, these skills should already be developed to some minimum level, to protect students from the negative effects of being for the first time in control of their own learning.

Students are better able to make effective task selections if they know their own strengths and weaknesses (Sadler, 1983). However, inexperienced self-directed learners and students with a low level of expertise or little prior knowledge have poorly developed self-assessment skills, insufficient knowledge of performance

standards (i.e. criteria, values, attitudes), and *do not know what they do not know* (Williams, 1996; Wydra, 1980). This makes these students prone to base their decisions on a subjective, distorted perception of their learning (Bjork, 1999; Tillema, 2003; Tousignant & DesMarchais, 2002), resulting in inappropriate task selections or ending practice too early because they believe that they have already reached the desired goals.

Furthermore, students are often unable to formulate learning goals effectively; that is, they do not formulate goals in terms of target behaviour, conditions, and criteria (Mager, 1962), or as SMART goals (i.e., Specific, Measurable, Attainable, Realistic, Timely). The poor specification of goals inhibits students from systematically selecting their tasks and working deliberately on improving their performance. To help students make appropriate task selections, they need to be regularly informed on the quality of their task performance and/or the performance standards and the degree in which they have reached those standards (Tennyson & Buttery, 1980). This information helps them to determine which aspects of their performance need improvement (i.e., do not yet reach the performance standards). This, in turn, provides useful information for determining the level of difficulty, available support, and other authentic features of the next learning task(s) they have to select. However, informing students on the quality of their performance by an external source only (e.g., teacher, computer program) does not automatically contribute to the development of their self-directed learning skills: students should also learn to inform *themselves* on the quality of their performance and their learning goals.

To help students make increasingly accurate self-assessments and induce effective learning goals from these assessments, they should be provided with instructional guidance and need to be better informed (Bell & Kozlowski, 2002; Birenbaum & Dochy, 1996; Tillema, 2003). This information might refer to performance standards that must be reached; videotapes or other recordings that may be studied in order to compare and contrast current performances with previous performances; assessments conducted by peers or experts (e.g., teachers, employers) that allow for comparisons with self-assessments; and so forth. In addition, students' self-assessment skills might be supported and developed by providing them with structured tools that help them to systematically plan, monitor, and assess their performance. In this way, students are supported in creating a more realistic view of their strengths and weaknesses. In addition, after gathering the information on their performance, students need to be advised on how to formulate effective learning goals (e.g., using the SMART acronym). Together, these information elements provide students with a sound basis for task selection.

Affective perspectives on learner control over task selection

A third theoretical perspective helping to explain the effectiveness of learner-controlled task selection is provided by theories on the role of affect in learning. Perhaps the most obvious (or at least most cited) framework to understand the

potential effectiveness of learner control is provided by Milheim and Martin (1991): motivation. Motivation can be defined as the degree to which students are willing to invest time and effort in their learning processes (Keller, 1987). Several principles can be identified that develop, sustain or forestall motivation. Motivation to learn almost naturally occurs in situations where learners perceive the learning process to be interesting, personally meaningful and relevant, and where the instruction allows for autonomy of learning (Boekaerts & Martens, 2006; Deci & Ryan 1985; McCombs & Whisler, 1989; Ryan & Deci, 2000). Giving learners control over task selection clearly addresses the principles of autonomy and relevance. Students experience autonomy by the freedom to choose whatever task(s) they prefer. This freedom enables them to match instruction with their personal goals, which makes instruction more relevant and personally meaningful. This feeling of autonomy and relevance is expected to increase their motivation to learn, with positive effects on performance.

Paradoxically, students who are given control over task selection may also perceive this as a burden of choice, yielding negative effects on their motivation. When making complex decisions, people might become overwhelmed by the freedom of choice and experience the given control as more of a burden than a privilege (Schwartz, 2004). Students in on-demand education are also provided with a wide range of choices and have to continually assess whether they are able to make a worthwhile selection, which might result in a feeling of cognitive overload (Roselli, 1991).

In order to counteract this feeling of cognitive overload or burden of choice, students should be provided with detailed and structured information on the characteristics of the learning tasks they can choose from (Schwartz, 2004). Detailed information on tasks' level of difficulty, support requirements, and/or topic (i.e., what will you learn from it?) can help to reduce the complexity of the task selection process. These information elements help students systematically cancel out tasks that are not worth selecting because they do not match with their current performance level or learning goals. Besides providing students with detailed task metadata, the number of tasks students can choose from may also be varied, according to the level of their self-directed learning skills and their prior knowledge of the domain.

Another factor that may negatively influence students' motivation and performance is a feeling of incompetence. The need for competence is an important factor that enhances motivation (Ryan & Deci, 2000), and a feeling of competence has positive effects on performance (Bandura, 1986). Giving students control over task selection can threaten their feeling of competence with respect to task performance and/or task selection. A feeling of incompetence may, for instance, result from the fact that students with a limited ability to judge their own performance base their task selections on biased information. This increases the risk of them selecting tasks that are too difficult for their actual skill and/or knowledge level, which, in turn, negatively influences task performance and hence their feeling of competence. A feeling of incompetence might also result from the fact that students have not

experienced responsibility for their own learning before. This may result in the development of a negative attitude toward on-demand education, which in turn negatively influences their motivation and performance (Clark, 1989). When giving learners control over task selection, it is thus of utmost importance to create positive feelings of competence and attitudes toward this educational approach, because the affective variables are important drives for continuing participation in the training programme.

Students' feeling of competence for task selection could be enhanced by informing them on performance standards, on their progress, and by providing them with information on the relative difficulty level and the amount of support provided by the learning tasks they can choose from (i.e., the task metadata). In this way, students' confidence and feeling of competence is enhanced because they each (a) know what is expected of them; (b) may acquire a realistic view of their performance level; and (c) are less prone to choose tasks that are too difficult, which increases the likelihood of experiencing success (Keller, 1987). In addition, students' feeling of competence for task selection may be maintained if they are guided in their task selection process by an expert (e.g., teacher, supervisor) who provides advice on the choices they make. The advice not only prevents them from making wrong choices, but also functions as an example from which students can learn and develop task selection skills, which will eventually make them feel more competent to effectively select learning tasks.

Combining the three perspectives

Integrating the three frameworks, it can be concluded that, in general, the different perspectives support on-demand education because it might enhance the learning process and learning outcomes, either directly or indirectly via cognitive, metacognitive, and affective mechanisms. At the same time, these theories point out the necessary conditions that have to be met by the learning environment for on-demand education to be effective. Many empirical studies on learner control, examining a variety of cognitive, metacognitive, and affective variables (e.g., attitude, prior knowledge, anxiety, self-directed learning skills) in combination with different levels of control, confirm these theoretical precautions (Hannafin, 1984; Ross & Rakow, 1981; Snow, 1980). Effective on-demand education yielding positive effects on these learning variables needs to support students in the development of their self-directed learning skills: their ability to monitor task performance, assess learning outcomes, diagnose learning needs, formulate learning goals, and select and plan learning tasks (Knowles, 1975). To realise this, the learning environment must be structured, transparent, and informative to students, by providing them wispecific information enabling a continuous process of assessment, task selection, and performance improvement (Tennyson & Buttery, 1980).

From a cognitive perspective, this information relates to the quality of students' performance (Reigeluth & Stein, 1983) and the metadata of the learning tasks they

can choose from (Steinberg, 1989; Williams, 1996). From a metacognitive perspective, it is important to inform students on the assessment of others (e.g., peer, trainer), the performance standards, and how to formulate learning goals. Taking an affective perspective, the information provided to the students should concern information on their progress and detailed metadata of available tasks. However, the information provided on performance, performance standards, and task metadata available in the learning environment might not be sufficient for all students to make adequate task selections. Therefore extra information should be provided, in the form of advice on task selection, to help students make their choices.

A distinction can be made between procedural and strategic advisory models. Procedural models provide straightforward advice on which task(s) to select and why, whereas strategic models explicitly help students to apply cognitive regulation strategies for assessing their performance and matching assessment results with the characteristics of available learning tasks. Advice on task selection provides students with some form of support, which can actually hamper the full development of their self-directed learning skills. Therefore, on-demand education should apply a process of 'scaffolding' (Rosenshine & Meister, 1992); that is, a high level of support and guidance is given in the beginning of the educational programme (e.g., a teacher assesses performance, a small set of tasks and their metadata is provided to choose from, detailed advice on task selection is given), but support and guidance gradually diminish as students further develop their self-directed learning skills (e.g., learners self-assess performance, a large set of tasks and their metadata is provided, and no advice on task selection is given). Ideally, students need no further advice before the end of the educational programme, because they have eventually become self-directed learners. In addition, these scaffolds can be adapted to the individual needs of each students, because students differ in their ability to self-direct their learning (Snow, 1980; Williams, 1996).

Combining the three perspectives, it becomes clear that in order to help students to effectively use the control they are given in on-demand education, the learning environment needs to become more informative (i.e., provide students with specific information). The findings resulting from the combination of the three perspectives can be converted into mechanisms that should be available in the learning environment in order to enhance the effectiveness of on-demand education. These mechanisms are described in the ISDL model, which is explained in detail in the next section.

The informed self-directed learning (ISDL) model

Based on the three theoretical perspectives described above, the ISDL model depicts how the cyclical process of self-directed task selection in on-demand education is made more effective by including three information resources to inform students. In

Figure 2.1, the resources are positioned within the large arrow: a development portfolio, an advisory model, and task metadata. The information resources aim to increase the effectiveness of on-demand education, which, according to our theoretical framework, is jeopardised by students' lack of information that is essential for a successful process of task selection. The inclusion of the advisory model is based on the empirical finding that students often have not yet sufficiently developed their self-directed learning skills, and need to be explicitly supported in the development of these skills. The information provided to the students by the development portfolio and task metadata is directly related to the activities and the corresponding self-directed learning skills that play a key role in the process of task selection: self-assessment of performance, formulation of learning goals, and choosing learning tasks (Knowles, 1975). The next sections discuss how the three information resources should be designed in order to increase the effectiveness of self-directed task selection, both in terms of selecting more appropriate learning tasks and in terms of facilitating the development of self-directed learning skills.

Development portfolio

The metacognitive perspective on learner-controlled instruction stresses that students must be able to identify their strengths and weaknesses in order to choose one or more suitable tasks to work on, that is, to plan their future learning (Knowles, 1975, 1986). A development portfolio is a useful tool for this purpose (see the document box in the left part of Figure 2.1) (Zeichner & Wray, 2001). A development portfolio such as a learning portfolio (Zeichner & Wray, 2001) or a process-folio (Seidel et al., 1997) contains a students' collection of artefacts indicating the development, or lack of development, of students' abilities. It is used for formative assessment purposes, prompting students to critically reflect on their performance and identify the cause of their weak performance. To help students assess their performance and identify their learning needs, a development portfolio has the following functionalities: (a) it provides an overview of conducted assessments, the student's current level of performance, and performance standards; (b) it supports systematic self-assessment, as well as the development of self-assessment skills; and (c) it supports systematic task selection.

First, a development portfolio in on-demand education should provide students with an overview of their performance level, containing detailed information on assessments of previously performed tasks conducted by different assessors, such as teachers, peers, employers, computer systems, and students themselves (i.e., self-assessments). By combining assessments of these different assessors, students receive 360-degree feedback on their performances, which is expected to help identify gaps between current and desired performances.

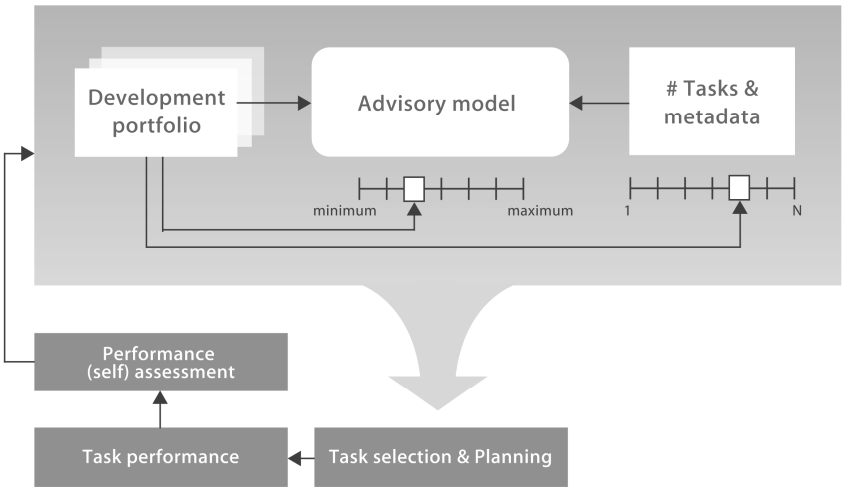

Figure 2.1. The Informed Self-Directed Learning (ISDL) model.

In addition, it is recommended that the development portfolio should not only provide students with an overall score (e.g., excellent, average, failed) on their task performance, but also inform them on constituent skills involved and their corresponding performance standards, in particular which aspects or constituent skills of their performance already do and which do not yet reach the required standards. For example, if hairstylist students create a coloured hair style, they should not only receive an overall assessment, but should also be informed whether standards (e.g., pace, precision, distribution) are met for different constituent skills such as advising, application of colour, washing, and shampooing, and if not, explain necessary points for improvement (e.g., colour is not washed out properly, hair-dye applied too slowly and imprecisely). Furthermore, information on performance may be supplemented with information on invested mental effort, time spent on the learning task, and degree of independency while accomplishing the task (Salden, Paas, Broers, & van Merriënboer, 2004). All this information helps students to compile a detailed overview of their performance level and insight into their strengths and weaknesses (Kluger & DeNisi, 1996), which is important in formulating relevant learning goals and selecting the most appropriate learning task(s) to fulfil their learning needs.

Second, the development portfolio should help students systematically assess performance and develop their self-assessment skills by providing, for each learning task recorded in the portfolio, an overview of (constituent) skills relevant for this particular learning task, as well as the performance standards relevant for the assessment of each (constituent) skill. This helps students to self-assess all relevant

aspects of performance, taking the standards for acceptable performance into account. Besides using this pre-structured format, students should be given the opportunity to formulate the most important points for improvement in their own words. Because the development portfolio also contains assessments by others, students are in a position to critically compare these with their own self-assessments, and also to learn from the assessment by others because they serve as 'worked-out examples' (van Gog, Paas, & van Merriënboer, 2004).

Third, a development portfolio should help students systematically select learning tasks and plan their learning trajectory. After having identified their learning needs, students often do not relate this information to selection of an appropriate task to fulfil these needs (Bell & Kozlowski, 2002). By letting students use the same tool to support both reflection (looking back on performed tasks) and planning (looking forward to future tasks), performance assessment is explicitly related to task selection, which might make students more conscious of the relevance of (self-) assessments to improve their performance (Boud, 1995).

Notably, the effectiveness of students' selection of learning tasks, in the performance–assessment–selection cycle, is especially affected by the *repetitive* estimation of their level of performance (Flavell, 1979). The use of a development portfolio will therefore have more positive effects on students' task selections when it is used on a regular basis (i.e., if they are regularly informed on their progress). For instance, assessments are best gathered on a daily basis for *all* performed learning tasks, providing the best basis to plan the selection of future tasks. Furthermore, the daily assessments could be carefully analysed once a week to plan tasks to be performed in the upcoming week. Digital development portfolios are particularly useful for this frequent evaluation of performance levels, because they release students from many administrative and arithmetic duties. Calculations of mean scores and overviews of all tasks ordered by difficulty level, topic, date and assessment criteria can be composed in only a few seconds. In order to reach a good match between the learning tasks they want to work on and their learning needs, students need not only information on their performance level, but also information on the available tasks. This information is provided by task metadata.

Task metadata

In on-demand education, a – typically large – set of learning tasks is available for students to help them further develop their competencies. To select tasks that best match their learning needs, students should be informed on the metadata of these tasks (see the database on the right-hand side of Figure 2.1) (Bell & Kozlowski, 2002). These metadata should at least include the task's level of difficulty and support, the applicable performance standards, and prerequisite skills, knowledge, and attitudes to perform it. Having these task metadata available, together with the information on their performance from their development portfolio, students are better able to match their needs with suitable tasks. Information on relative levels of

difficulty and support also informs students on which learning tasks should be chosen to master basic competencies before working on more complex tasks that aim at higher-level competencies.

Unfortunately, even when a development portfolio is used to inform students on their level of performance, and all critical task metadata are presented, not all students will be able to select suitable learning tasks. This is due to the fact that selecting appropriate learning tasks is a difficult aspect of self-directed learning, which must be learned by practicing it and receiving feedback on the quality of the selection process and the appropriateness of final selections. Providing students with advice has shown to be an effective method to help students make better choices and develop their task selection skills (Bell & Koslowski, 2002; Tennyson & Buttery, 1980).

Advice protocol

An advisory model (see the box between the development portfolio and the task metadata in Figure 2.1) combines the information from the development portfolio and the metadata of the available tasks into directions for task selection. The advice is composed of feedback and feedforward information. Feedback is provided on self-assessments and the formulation of learning goals, using the information from the students' development portfolio. Feedforward is provided in terms of directions for suitable learning tasks to select, combining the information form the development portfolio with the available task metadata. The advice may be either procedural or strategic in nature.

A procedural advisory model provides the students with feedback on their self-assessment skills and formulated learning goals, by informing them whether the self-assessments are in line with expert assessments and the SMART rules. Feedforward is provided merely by informing students which task(s) they could select in order to improve their performance. The directions for task selection are algorithmic in nature and do not provide any explanation of *why* a particular task should be selected. For example, in the domain of hairdressing, a student who performed poorly on colouring a person's hair and who wants to select an even more difficult task, might receive the following procedural advice: (a) 'your own assessments are often more positive than the assessments of your teacher'; (b) 'you formulate your learning goals too broadly'; and (c) 'you are now advised to select task *x,* for which you have to apply hair conditioner as fast as possible on a dummy, without any help'. She is not told that task *x* is advised because her poor performance was due to slow application of the hair-dye, and because this relatively easy task *x* gives her the opportunity to automatise the routine constituent skill of applying hair-dye.

A strategic advisory model provides the students with feedback on their self-assessments and self-formulated learning goals in terms of their accuracy and effectiveness, and provides directions for improvement of self-assessment skills (e.g., they might observe an expert who assesses the quality of task performance) and

formulating learning goals (e.g., 'try to work faster' should be reformulated as 'complete the task within 15 minutes', because the second goal is measurable). With respect to feedforward information, the directions for task selection are heuristic in nature and extend the basic information on suitable tasks with in-depth explanations and arguments for their suitability. A strategic model makes explicit how assessments of prior performance are interpreted and converted into directions for the selection of new learning tasks. The advice can, for instance, take the form of a modelling example (van Gog, Paas, & van Merriënboer, 2004), showing an expert (e.g., teacher, supervisor) who is thinking aloud during the interpretation of a development portfolio in order to formulate directions for the selection of new learning tasks. To illustrate, the teacher may explain to the hairstylist student that, from an examination of her performance, it becomes apparent that her weaknesses in the skill of colouring hair are the pace of the application technique and the carefulness of the washing technique. Next, the teacher may explain that, based on this information on points for improvement, she should undertake tasks that help enhance speed of application and/or washing technique. The teacher then explains how using the task metadata helps to locate a relatively easy task (i.e., low difficulty level), without any support, in which the two indicated points for improvement can be practiced and assessed. Finally, the teacher explains that task *x*, in which the student has to apply hair conditioner on a dummy within 15 minutes, wash it carefully, and evaluate task performance specifically on duration and residual hair-dye, meets these demands, and advises the student to select this task.

Alternatively, the strategic advisory model may take the form of a *process worksheet*, using a method of self-questioning and to guide the student through the conversion process from assessment results to directions for task selection. For example, students might have to answer questions like 'Examine your performance – which aspects of your performance are not sufficiently developed?'; 'Which of these aspects should be improved first?'; 'How can you improve the selected aspect?'; 'What tasks could help you to improve these aspects?'; 'What information do you need to choose these tasks?'; and 'Choose one task to improve your performance. Why did you choose this specific task?'. When a strategic advisory model is used, both the modelling example and the process worksheet approach explicitly help students to learn and apply cognitive strategies for matching their assessment results with the metadata of the available learning tasks, making an informed selection from those tasks (Tennyson, 1980). In addition, the information should be formulated and perceived as non-binding advice that can either be followed or neglected by the student. In this way, it will interfere less with students' own decision making strategies, which diminishes the risk of advice having negative effects on students with more relevant prior knowledge or who already have well-developed self-directed learning skills (i.e., it prevents 'mathemathentic effects'; Clark, 1989). In addition, the advice can be formulated less detailed or not formulated at all, if students have already sufficiently developed their self-directed learning skills.

Scaffolding in the ISDL model

If the learning environment adequately supports the development of students' self-directed learning skills, students eventually become self-directed learners who no longer need elaborate advice in order to make effective choices in various complex contexts and situations. As mentioned before, a promising approach to improving students' self-directed learning skills is 'scaffolding' (Rosenshine & Meister 1992). In the ISDL model, two approaches to realise scaffolding are distinguished: (a) a gradual increase in the number of learning tasks to choose from (indicated by the sliding calliper below the task box in Figure 2.1), and (b) a decrease in frequency and level of detail of the given advice on the process of task selection (indicated by the sliding calliper below the advice box). The next sections discuss these two approaches to scaffolding.

Increasing the number of tasks to choose from

In on-demand education, allowing students to select one or more learning tasks from a large database of tasks (e.g., dozens or hundreds) may lead to stress, high mental effort, and demotivation (Iyengar & Lepper, 2000; Schwartz, 2004). This may be explained by the fact that students have often not yet developed the necessary skills to effectively reduce the total set of tasks to a smaller selection of potentially appropriate tasks, from which one or more suitable learning tasks may then be selected. To scaffold students' task selection process, a teacher, expert or other intelligent agent could make a pre-selection of suitable tasks from which students can subsequently make a final selection (Corbalan, Kester, & van Merriënboer, 2006). This allows students to develop their task selection skills in relatively simple and 'safe' situations. The optimum number of pre-selected tasks should gradually increase as students further develop and improve their task selection skills, as registered in their development portfolio. Students with better-developed self-directed learning skills should be given a larger choice of learning tasks than novice students. In Figure 2.1, this relationship is indicated by the arrow that runs from the development portfolio to the sliding calliper below the task database (ranging from 1 to *N* tasks to choose from).

Diminishing the frequency and detail of advice

Even when the number of learning tasks students can choose from is limited, they may encounter difficulties in the process of task selection. As discussed, advice on task selection may provide students with directions. However, eventually students have to make the task selections themselves, without any advice. The frequency and the level of detail of the advice should therefore gradually diminish, which allows students to improve and develop their task selection skills in a smooth manner. The scaffolding of advice can be realised in two ways: by diminishing the level of detail of

the advice, and by decreasing the frequency of providing advice. The level of detail of the advice may, for example, be decreased by first giving advice for performing the assessments, formulating the learning goals, and selecting new tasks; then for formulating the learning goals and selecting new tasks; then only for selecting new tasks, and finally not giving advice at all. The frequency of giving advice can be varied in two ways. First, the frequency may diminish according to a fixed rate. For example, during the first three weeks of the training programme, students receive daily advice; during the next six months, students receive weekly advice, and during the remaining period, students receive monthly advice. Second, frequency may decrease in accordance with an increase in the quality of students' self-directed learning skills, as recorded in the development portfolio (i.e., adaptive frequency).

In the ISDL model, the process of scaffolding is depicted by a sliding calliper that works in two directions. Thus, the number of tasks to choose from can increase, but it can also decrease again if a student's task selection process becomes problematic again. Similarly, the level of detail and frequency of advice may increase again, if students appear not to be able to select appropriate tasks when given less advice. In addition, the amount of tasks and the frequency/detail of advice can decrease and increase independently of each other. For example, allowing students to choose from a larger amount of tasks and at the same time give them less detailed and frequent advice, may overwhelm them. Therefore a larger amount of tasks to choose from is better coupled with an increased or unchanged level of detail and frequency of advice, to help students first adjust to the more complex situation. After some time the advice could be given less frequently and be formulated in a less detailed way. When students are able to select from a set of tasks with a given size without receiving advice, they might be given a larger set to choose from, but are also given advice again. This cycle continues until students are able to select from a theoretically unlimited amount of tasks without receiving any advice.

Discussion

This article described the ISDL model, which specifies how on-demand education can be designed in such a way that students are provided all necessary information and are adequately supported to exert control over the selection of learning tasks in an effective way. The mechanism presented in the ISDL model is based on cognitive, metacognitive, and affective explanations for the positive as well as the negative outcomes of self-directed learning and learner control, as reported in the literature. According to the model, the cyclical process of self-directed task selection will be more effective if students are enabled to make informed task selections, because they have at their disposal a development portfolio, metadata of available tasks, and advice on which tasks would best match their learning needs and why. After one or

more tasks have been selected, students perform them and update their development portfolio with self-assessments and/or assessments from others. Because students eventually need to become self-directed learners, who make effective task selections without support or guidance, the amount of learning tasks they choose from should gradually increase, and the frequency and level of detail of the given advice should gradually decrease.

Future research needs to provide more insight into the specific effects of the information resources and their combined effects on cognitive, metacognitive, and affective learning outcomes. This research can be both experimental and quasi-experimental in nature. Highly controlled, experimental research in artificial settings is needed to examine the effects of variations in content and design of the information resources on students' self-directed learning skills, aimed at further theory building and to allow for generalisation and standardisation of findings. Quasi-experimental and evidence-based research, in realistic environments that are complex and multi-factorial, can provide more insight into other factors and interacting forces that influence the effectiveness of the ISDL model. The outcomes of both types of research contribute to the theoretical base and effective implementation of the ISDL model (Norman & Schmidt, 2000).

With respect to information on performance levels gathered by self-assessments and assessments by others, relevant research questions concern the optimal way of presenting performance levels and performance standards to students, approaches to modelling and peer assessment, and characteristics of assessment methods that help students reliably judge their own performance (e.g., ranking, videotaping). Regarding the task metadata provided to students, it needs to be examined which metadata are sufficient and necessary for students to make appropriate decisions and how those metadata should best be presented (e.g., time, frequency, mode of presentation).

Finally, with respect to advice, research should provide more information on how advice is best formulated and presented to students in order to help them perform the process of task selection independently and adequately (Higgins, Hartley, & Skelton, 2001). Different students need different types of advice. Some students need detailed and structured advice, whereas others profit more from global advice and self-questioning techniques. Future research might focus on the effects of different forms of advice on students' task selection skills, taking into account both short-term and long-term effects as well as different student characteristics. Research on students' and experts' reasoning during the interpretation of development portfolios on behalf of task selection (i.e., converting assessment results into directions for task selection) may also be an effective approach to find out which information resources, what kind of information, and which cognitive processes are (in)correctly used by students when they select one or more new learning tasks. The scaffolding of the procedural and strategic advice also needs to be examined in future research, exploring the different effects of providing students with a modelling

example or with process worksheets. This research might especially focus on measurements that indicate when guidance can diminish and what kind of advice should be provided during the phases of scaffolding. The outcomes of such studies can yield more specific guidelines for the improvement of students' task selection process.

A particularly important issue in on-demand education, which may warrant further investigation, is to acknowledge students' perceptions. Because students mostly come from a 'supply-driven' educational tradition, they may perceive the self-directed learning activities that are central in on-demand education, such as systematic self-assessment and independent task selection, as a burden or a superfluous external goal imposed by the educational system. This might negatively influence their motivation and, in turn, the effectiveness of the instructional approach, because negative perceptions result in poor and externally motivated learning activities (Könings, Brand-Gruwel, & van Merriënboer, 2005). Internalisation of the goals to direct one's own learning may counteract these negative effects. Promising ways to enhance this internalisation process should be investigated in future research.

Finally, for the experimental design of research on self-directed learning, it is particularly important to control for factors that may invalidate the results and cause negative effects (Bell & Kozlowski, 2002; Reeves, 1993). In addition to student perceptions, these concern time and setting. With regard to time, the duration of the treatment should be sufficiently long: students do not develop self-directed learning skills on one single trial, but need ample time to tune to the new educational approach and need sufficient and regular practice to be able to develop and improve their self-directed learning skills. With regard to the setting, it is important to implement on-demand education in a whole curriculum or educational programme, rather than in only one or a few courses.

To conclude, we think that a common mistake in on-demand education is to assume that students who enter it already have well-developed self-directed learning skills. Instead, it is better to assume that most of the students have not yet sufficiently developed these skills. Therefore, the learning environment should provide all relevant information and scaffold experiences to help students select their learning tasks and develop their self-directed learning skills. This is clearly reflected in our ISDL model: the mechanisms presented in the model aim to create a safe path toward on-demand education for all learners.

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CHAPTER 3

Design and evaluation of a development portfolio: How to improve students' self-directed learning skills[1]

In on-demand education, students often experience problems with directing their learning processes. A Structured Task Evaluation and Planning Portfolio (STEPP) was designed to help students develop 3 basic self-directed learning skills: Assessing the quality of own performance, formulating learning needs, and selecting future learning tasks. A case study with 10 first-year students in the domain of hairdressing was conducted to evaluate STEPP's use, usability, and perceived effectiveness. Results from student interviews show that usability and use are influenced by several factors. Students with low prior hairdressing skills, a weakly developed personal approach to direct their learning, and an inclination to update STEPP as part of their weekly routine, use STEPP more frequently than students without these characteristics. Both the supervisor and students who frequently used STEPP perceived its use as a positive contribution to the development of self-directed learning skills. Furthermore, this study provides guidelines for the design of development portfolios in on-demand education.

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Introduction

In the Netherlands, on-demand education is becoming increasingly popular in secondary vocational education because it is expected to address the uniqueness of students' learning needs and to better prepare students for lifelong learning in their future profession. It offers students the opportunity to plan their own learning trajectory by providing them a certain amount of freedom to choose what they want to learn (i.e., selecting a topic) and how they want to learn this (i.e., selecting particular learning tasks). For instance, an on-demand educational program at a school for hairdressing offers students the opportunity to decide for themselves which skills, from a predefined set of skills, they prefer to develop first: washing hair, permanent waving, applying hair-dye, and so forth. After choosing which skill(s) they want to develop, students select from a predefined set of tasks the tasks they want to perform to develop these skill(s), creating their personal learning trajectory. Students can choose from tasks in which they practice on a dummy or a model, in which they learn from studying a book, watching a video, or observing an expert at work, in which they work in groups or individually, in which they practice only one skill (i.e., part-task practice) or more than one skill (i.e., whole-task practice), and so forth.

Self-directed learning (SDL) plays an important role in on-demand education. Although the concept of SDL originally emerged from the field of adult education, with particular relevance to workplace learning, students in secondary vocational education are also more and more required to direct their learning processes, including assessing their own performance, deducing their learning needs from these assessments, and selecting suitable learning resources (e.g., learning tasks, study materials) to meet those needs (Knowles, 1975).

While several theorists in adult education promote the advantages of SDL (Brookfield, 1986; Tough, 1979), students in secondary vocational education often experience problems with it, leading to adaptation difficulties or even open rejection (Nolan & Nolan, 1997a, b; Slevin & Lavery, 1991; Williams, 1996). Most students who enter vocational education are used to a learning environment with a strong tradition of teacher-directed learning and are not well prepared for SDL. In addition, teachers often incorrectly assume that students already possess SDL skills, or that they will simply develop those skills by working in an on-demand learning environment which requires them to direct their own learning (Levett-Jones, 2005). Therefore, the potential benefits of on-demand education are easily undermined by both the lack of SDL skills of students who enter vocational education and the lack of support for learning SDL skills.

Knowles (1998) recognizes these problems and asserts that on-demand education can only be successful if learners are familiar with the concept of SDL and possess the skills required to implement it. At least in the early stages of an educational program, it is thus critical that students are informed on what is expected of

them and are supported in the development and use of SDL skills. To support the development of these SDL skills, tools such as reflection reports and (digital) portfolios are indispensable. They help students and teachers to pay not only attention to the transmission of domain knowledge, but also to the learning processes responsible for the purposeful and, ultimately, independent acquisition of such knowledge (Langenbach, 1993). Compared to portfolios with a focus on learning products (e.g., showcase portfolios), especially portfolios with a focus on the learning process, such as development portfolios, learning portfolios, and process-folios have been advocated by many theorists as promising tools to help students become reflective and self-directed learners (e.g., Driessen, van Tartwijk, Overeem, Vermunt, & van der Vleuten, 2005; Järvinen & Kohonen, 1995; Klenowski, 2002; Seidel et al., 1997). In this chapter we will use the term 'development portfolio' to refer to portfolios that (a) contain students' progress reports and reflections and (b) are used for formative assessment purposes. A development portfolio, either digital or paper-based, is thus a tool that helps students to document information about their development of a skill. It documents a student's skill development and its information can be used for promoting further development of the skill, hence the term 'development portfolio'. A development portfolio may contain formative self-assessments of performance, reflections on task performance, artefacts like pictures, documents, photographs and video fragments, which indicate the failures and successes the student experienced during his or her skill development, and may also contain a plan to work on skill improvement based on performance assessments and reflections. Unfortunately, research on the design of development portfolios for secondary vocational education and, especially, evidence documenting positive effects of such portfolios on the development of students' SDL skills is sparse (Herman & Winters, 1994).

This chapter describes the design and evaluation of a digital development portfolio as a tool to support and enhance the development of SDL skills of students in on-demand education. The following sections first elaborate on the importance of 3 basic SDL skills and the problems students encounter in on-demand education if they have not yet sufficiently developed these skills. In addition, possible solutions to these problems are discussed and implications for the design of a development portfolio are presented. Given the theoretical foundation, the design of the development portfolio is described. Next a case study is presented which investigates how the portfolio is used in practice, which factors influence its use, how its usability is valued by students and their supervisor, and how they perceive its effectiveness with regard to the development of SDL skills (i.e., the ability to self-assess learning, formulate own learning needs, and select future learning tasks). Finally, the results of the case study are discussed, guidelines for the design of development portfolios are given, and suggestions for future research are presented.

SDL in on-demand education

In its broadest meaning, SDL is a process in which individuals take the initiative in evaluating their learning outcomes, diagnosing learning needs, formulating learning goals, and selecting appropriate learning tasks (Knowles, 1975). This makes SDL conditional to students' effective functioning in a system of on-demand education. Thus, students need to develop several SDL skills, such as the ability to diagnose their learning needs in the light of given performance standards, formulate meaningful goals for own learning, diagnose and monitor performance, identify resources for accomplishing various kinds of learning objectives, develop and use a wide range of learning strategies appropriate to different learning tasks, and carry out a learning plan systematically and sequentially (Biggs & Moore, 1993; Knowles, 1975; Long, 1990; Pressley, 1995; Schunk & Zimmerman, 1994). Besides SDL skills, which are mainly related to planning a learning trajectory, self-regulation skills also play an important role in on-demand education. The latter skills are more related to the process of task performance, including the monitoring of performance and regulation of motivation (Jossberger, Brand-Gruwel, Boshuizen, & van de Wiel, 2008). This chapter will focus on the process of task selection and the three SDL skills directly related to this process, namely, self-assessment of performance, formulation of learning needs, and selection of learning tasks. When sufficiently developed, these three skills help students to direct their learning in the first stages of an on-demand educational program.

The first basic SDL skill is self-assessment. Students collect information on their own performance, reflect on and evaluate the quality of their work and their learning, and see how it matches the goals and/or the standards for their work (Andrade & Boulay, 2003; Paris & Paris, 2001). Self-assessments help students critically analyse their own products and processes, and as a consequence to become more aware of their own weaknesses and strengths (Sluijsmans, Dochy, & Moerkerke, 1999). However, research has shown that students are not always the best judges of their own performance (Bjork, 1999; Falchikov & Boud, 1989). Inaccurate judgment of own performance may be caused by ignorance of desired performances and associated standards, that is, students do not know what they do not know (Williams, 1996) and are unaware of what differentiates unacceptable from acceptable performance. In addition, when students have no or little experience with self-assessment, they have an incomplete frame of reference to base their decisions on, which may make their assessments less accurate.

A first approach to counteract inaccurate assessment of performance is to better inform students on relevant performance standards, including criteria (requirements in terms of speed, accuracy etc.), values (application of particular rules, conventions etc.), and attitudes (Black & Wiliam, 1998; Stiggins, 2001; Wiggins, 1998). Students should be stimulated to base their self-assessments on the presented standards. Hanrahan and Isaacs (2001), for instance, report that students who were given the

same marking sheets as their teacher to assess their own work, indicated that they "… gained better understanding of marking" (p. 58). Their results extended previous research (e.g., Stefani, 1992, 1994) and were also replicated in a study by Andrade and Du (2007), in which students reported they felt able to self-assess effectively only when they knew beforehand what the teacher expected. In this study, students also reported that they endorsed self-assessment only after extended practice.

A second promising approach to improve self-assessments is providing students with information on their performance as assessed by 'experts' (i.e., teachers or instructors) in the form of worked-out examples (Gordon, 1992; van Merriënboer, 1997). This allows students to compare and contrast their own assessments with the assessments of more experienced assessors and learn from the similarities and dissimilarities. Comparing and contrasting own assessments with expert assessments may also inform students on weaknesses they were not aware of. If students receive more information on relevant performance standards and acquire more experience in self-assessments and see more expert assessments, they learn to assess their performance on a greater variety of dimensions, to assess each dimension with a higher accuracy, and to gain more insight into their progress and possible causes for lack of progress (Birenbaum & Dochy, 1996; Falchikov & Boud, 1989; Paris & Cunningham, 1996; Rosenholtz & Simpson, 1984).

The two approaches to counteract poor self-assessments provide clear guidelines for the design of a development portfolio. First, such a portfolio should provide students with all the standards relevant for the skills they need to develop during the educational program. Each time the portfolio is updated with a new self-assessment, students should be confronted with the relevant standards for the skill(s) they want to assess, so that they become more and more familiar with the standards used by expert assessors (e.g., their teacher). In addition, the portfolio should offer opportunities to study assessments from other assessors (e.g., teachers, instructors, peer students) and to compare and contrast them with own assessments. The portfolio should also be easy to use, encouraging students to use it frequently. Frequent use creates the best opportunities to assess performance on many different standards and to learn from repeatedly comparing own assessments with assessments made by others (Mansvelder-Longayroux, Beijaard, & Verloop, 2007).

The second basic SDL skill, formulating learning needs, refers to the process of using assessment information (gathered through self-assessments or from other sources), and performance standards to deduce which aspects of performance need to be improved (Boud, 1995; Knowles, 1975). Learning needs are best formulated in terms of specific and observable behaviors (cf. learning objectives) along with the conditions under which these behaviors must be shown (e.g., "in order to reach standard X, I must yet learn/practice/revise/improve behavior Y under conditions Z") (Mager, 1962). Students are typically not used to explicitly formulate or think about their learning needs (Holme & Chalauisaeng, 2006). It is therefore of utmost importance that students not only perceive assessments as an overall indication of their

performance (i.e., summative assessment), but especially as a set of indicators from which specific learning needs can be deduced (i.e., formative assessment; Boud, 1995).

With regard to the design of the development portfolio, it is important to give students the opportunity to document both their strengths and weaknesses (i.e., learning needs) concerning a particular skill, without any consequences for their final grading. After self-assessing their task performance on the given standards students should thus be prompted to think about their learning needs. They should be stimulated to make the learning needs that become apparent from the self-assessments explicit, for instance, by writing them down in their own words. In addition, teachers should clearly communicate the goals of using a development portfolio and its relation with formative, learning-oriented assessments and self-assessments (Knowles, 1998). Teachers must also explain and show how to formulate learning needs in terms of standards, required improvements or changes to behaviors, and conditions. For instance, the learning need "I need to talk more to my client", does not provide students with sufficiently concrete directions for improvement, whereas "I need to initiate a conversation about common topics, like the weather or the news, to break the ice" is formulated more specifically in terms of required improvements and behaviour.

The third basic SDL skill in on-demand education pertains to the selection of human and material resources (e.g., learning tasks, instructional materials, teacher advice) to accomplish various kinds of learning needs (Knowles, 1975). Students who enter vocational education are often conditioned by teacher-directed learning experiences in the past and are thus not equipped to select their own learning tasks (Levett-Jones, 2005). Research on learner-controlled instruction showed that students who were given control over task selection often selected tasks that were either too easy or too difficult, or even totally irrelevant, to meet their learning needs (Williams, 1996). Especially students with low prior knowledge and skills in the learning domain either overestimated or underestimated the difficulty of the selected learning tasks (Steinberg, 1989; Williams, 1996).

A development portfolio should give students detailed information on relevant features of learning tasks (i.e., task metadata), like the level of difficulty and required prior knowledge, because this provides them with a sound basis to decide which tasks best match their learning needs (Bell & Kozlowski, 2002). In addition, the portfolio may provide students with overviews of previously selected learning tasks and associated learning needs. This information reminds them of those aspects of performance they previously thought to be poorly developed and needing extra practice.

Concluding, on-demand education can only be effective if students are—at least in the early stages of the educational program—guided in the development of their SDL skills. A well-designed development portfolio supports this process. It should (a) provide students with information on performance standards and example assess-

ments by others, (b) help students to think about their learning needs and formulate those needs in their own words, and (c) provide students with task metadata and a list of previously selected tasks and associated needs, so that they are enabled to select learning tasks that best meet their current needs. Using one-and-the-same development portfolio for both assessment of prior performance (reflection) and thinking about future performance (planning) makes students aware of the close connection between reflection and planning in SDL.

To be successful, the design of the development portfolio is only one side of the coin. The other side of the coin is how the portfolio is embedded in the learning environment. Van Tartwijk et al. (2007) pointed out four factors to make the practical use of a portfolio successful. First, the goal the portfolio is supposed to realize must match its content and structure. Above, we already explained which design guidelines are expected the help reaching the goal of developing SDL skills. Second, the portfolio must be designed in such a way that it fits the learning environment in which it will be introduced. In our case, this pertains to its application in on-demand secondary vocational education. Third, teachers, students, and educational leaders must accept the portfolio as an important learning tool. Fourth, the infrastructure must support its use. Therefore, stakeholders must be made familiar with the portfolio beforehand and special attention should be devoted to the ICT infrastructure in case the portfolio is digital or web based. In addition, Wade and Yarbrough (1996) point out that the portfolio should be implemented according to well-defined guidelines and a clear structure. Finally, Tillema and Smith (2000) argue that feedback, based on the portfolio's content, should be provided to the student to make the use of the portfolio effective.

STEPP: a development portfolio supporting SDL

Portfolios have been introduced in on-demand education for different purposes, including summative and formative assessment, stimulation of reflection, and planning and monitoring students' development (Wolf, 1989). In this chapter, the focus is on helping students to become self-directed learners. Using the guidelines described in the previous section, a Structured Task Evaluation and Planning Portfolio (STEPP) was developed for the domain of hairdressing in secondary vocational education. It is a webbased, digital development portfolio with four functionalities which students can use to direct their own learning: making assessments of performance (including self-assessments), formulating learning needs, selecting new learning tasks, and studying structured overviews and summaries. In order to provide a sound basis for SDL, STEPP was designed to be wellstructured and highly informative to students (Wade & Yarbrough, 1996). The next sections discuss the design of the four main functionalities of STEPP in more detail.

Assessment of performance

To develop the assessment functionality of the portfolio, first all skills and sub skills performed in the profession of hairdressing were analysed (e.g., washing, cutting, permanent waving, communicating with clients, giving advise on hair styles, selling hair products, etc.). These skills are shown in a hierarchical menu on the assessment page of STEPP (see left side of Figure 3.1). Next, for each of the 10 skills and 48 sub skills, performance standards (i.e., criteria, values, and attitudes) were defined in agreement with two expert hairdressers and two instructors. On STEPP's assessment page, the standards are provided in matrices (see right side of Figure 3.1). After performing a particular learning task, a student can fill out the assessment page him/herself (i.e. self-assessment) and/or request other assessors (e.g., teacher, instructor, clients, peer students), who were given access to the student's portfolio beforehand, to update the portfolio with their assessments of the skills and sub skills performed as part of the learning task.

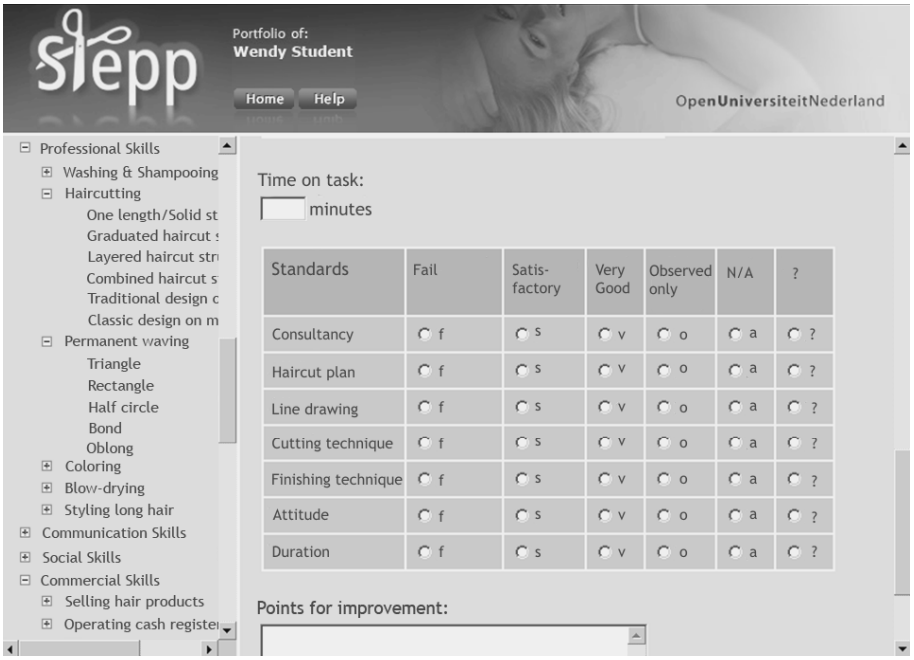


Figure 3.1. Self-assessment and formulation of learning needs functionality in STEPP: Overview of skills (left column), standards (table) for performance assessment, and possibility to formulate learning needs (text-box).

To fill out the assessment page, by clicking on particular entries, the assessor (i.e., the student or another assessor) selects from the list with all hairdressing skills the sub skills that were practiced as part of the learning task. Then, a list of standards relevant to the assessment of the selected sub skills appears and the assessor

indicates on a 3-point scale (fail, satisfactory, very good) how well these sub skills were performed according to the presented standards. For dying hair, for instance, the assessor has to indicate whether the hair-dye was distributed evenly, applied fast enough, washed out thoroughly, and so forth. The assessor may also consult a 'dictionary' of standards in which the meaning of each standard is explained and illustrated.

Formulation of learning needs

The functionality 'formulation of learning needs' is implemented in STEPP using a textbox. It allows multiple inputs from the student and is positioned directly under the list of standards used to assess sub skills (see bottom of Figure 3.1). Students can use the textbox to describe as many learning needs as they prefer, using their own words. For example, if a student indicates that with respect to her communication skills she failed on the standard 'keep the conversation with the client going', her formulated learning need might be to find out which topics can be interesting to talk about with different groups of clients. Displaying the textbox together with the list of standards with rating scales prevents students from assessing their performance only according to a predefined set of standards by means of rating scales. It prompts students to think about why particular standards are not yet met and what could be done to improve their performance according to those standards. Further-more, displaying the textbox on the same page as the list of standards provides students with some direction for formulating learning needs. In addition, students may also ask other assessors (teacher, instructor, peer students, clients) to formulate learning needs for them, in the same way as they may ask other assessors to fill out the relevant rating scales.

Selection of learning tasks

The task-selection functionality is implemented in STEPP as a structured format students use to indicate which future learning task(s) they want to perform (Figure 3.2). The format distinguishes four relevant criteria. First, students indicate the required level of difficulty or complexity of the future tasks, for instance, whether they want to practice to apply one color of hair-dye, two or more colors, or how to apply highlights. Second, they indicate the level of support and guidance they would like to receive, for instance, do they want to observe an experienced hairdresser who is performing the task, do they want to perform the task under direct guidance of an expert, or do they want to perform the task independently? Third, students indicate the authenticity of the task they perform, for instance, whether they will perform the task on a dummy, a human model, or a real client. Fourth, they indicate which learning needs they want to meet, that is, which sub skills they want to focus on during the performance of future learning tasks. For instance, a student may select the task 'cutting hair in one length'. For this particular task, she may indicate that

she wants to perform the task on the hair of a human model (e.g., her sister), without any help of the instructor, and with a focus on handling the scissors quicker and more fluently to prevent irregularities in the haircut (i.e., meeting this particular learning need).

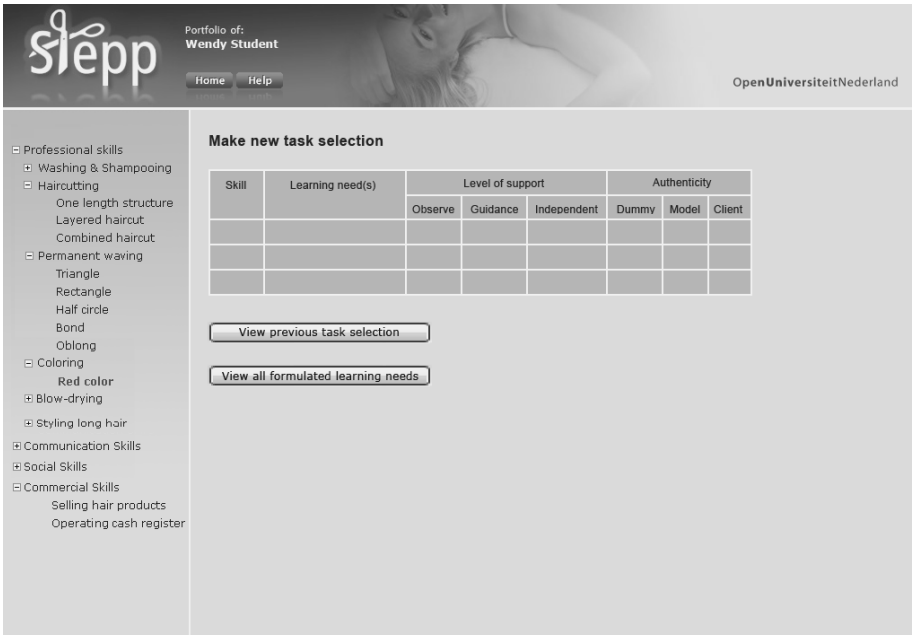


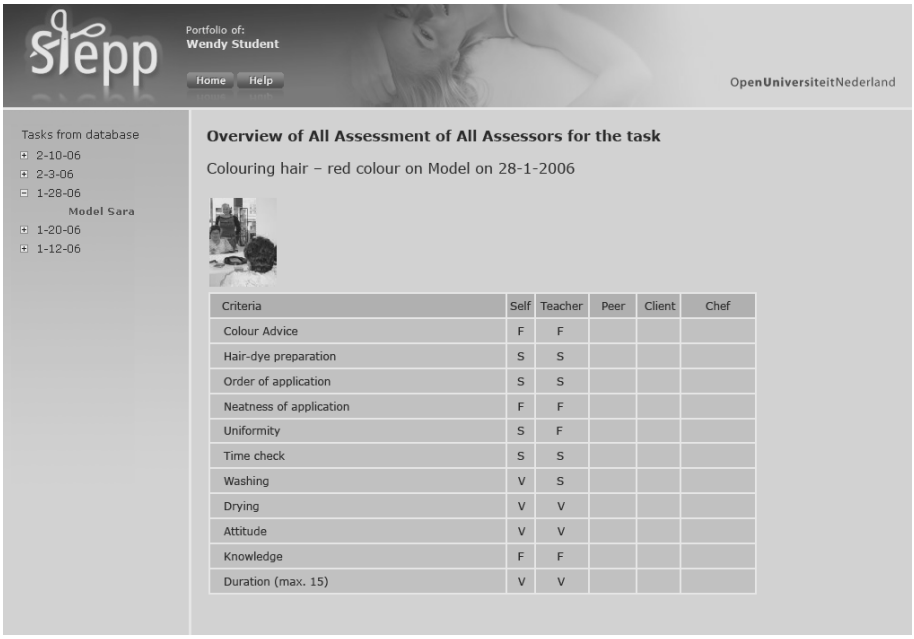
Figure 3.2. Task selection functionality in STEPP: Overview of skills (left column), table to indicate the selected task(s) in terms of skill, level of support, authenticity and learning needs (top right), and options to view all formulated learning needs and the previous task selection (bottom right).

To provide students with sufficient information to base their task selections on, STEPP provides students with task metadata. All sub skills are listed on the same page as the task selection format, starting with the most simple skills and ending with the most complex skills, thus informing students on their relative level of difficulty (see Figure 3.2). In addition, while thinking about new learning tasks to select, students can always refer to previously formulated learning needs and previous task selections. Students can use this information to decide on the difficulty level, available support and guidance, and focus of the next learning task(s).

Overviews

In addition to the functionalities specifically designed to execute one of the three basic SDL skills, STEPP also has a functionality of providing students with overviews and summaries of all entered information. Students can review all assessments of all sub skills, by all assessors, sorted by sub skill or by learning task (see Figure 3.3). They can also review all formulated learning needs and specific information on all

learning tasks performed in a specific period. The assessments and learning needs provided by other assessors are shown next to the student's self-assessment to facilitate comparison between different assessments. Students can use the overviews and summaries to become better informed on, for instance, recurrent learning needs, deviations between different assessors of a specific learning task, weaknesses in performance as indicated by repeatedly failing to meet specific standards of a sub skill, and so forth. In addition, when students have supervision meetings the overviews and summaries can be used as a starting point for the discussion on what has been done in the previous period and what should be done in the coming period.



Criteria	Self	Teacher	Peer	Client	Chef
Colour Advice	F	F			
Hair-dye preparation	S	S			
Order of application	S	S			
Neatness of application	F	F			
Uniformity	S	F			
Time check	S	S			
Washing	V	S			
Drying	V	V			
Attitude	V	V			
Knowledge	F	F			
Duration (max. 15)	V	V			

Figure 3.3. An overview page in STEPP: All assessments by all assessors (right column in matrix) of the performance on one particular task (left column in matrix). F = fail, S = satisfactory, V = very good.

Case study

To investigate the use and effectiveness of STEPP, a case study with 10 students was conducted in the domain of hairdressing. A mixed-method approach was used to collect both quantitative and qualitative data from the students and their supervisor. Collected data pertain to (a) the actual use of STEPP, (b) students' and supervisor's perceptions of STEPP's usability as well as factors that influence its use, and (c) STEPP's perceived effectiveness to improve SDL skills.

Method

Participants

Ten first-year students (8 female, 2 male; ethnicity: 4 Dutch, 2 Turkish, 4 Surinam; age *M* = 18.9 years, *SD* = 1.9) of a hairdressing program in secondary vocational education participated in the study. All participants had the same supervisor. The supervisor held individual supervision meetings with the students.

Materials

Educational program. STEPP was implemented and introduced as a formative assessment tool in an on-demand educational program. Students and teachers were informed about its purpose and received instructions for its use. Data were gathered over a period of 10 weeks. Students were allowed to direct their learning by selecting learning tasks from a predefined database with tasks, and so plan their individual learning trajectories. To develop their hairdressing skills students were free to perform learning tasks in any desired order and as often as they preferred. Based on the principles of the four-component instructional design model (4C/ID-model; van Merriënboer 1997; van Merriënboer & Kirschner, 2007; van Merriënboer, Jelsma, & Paas, 1992), tasks in the database differed in level of difficulty (e.g., colouring hair in one colour is easier than in two colours; cutting a one-length haircut is easier than a layered-length haircut), level of support (e.g., performing the tasks with or without help of a teacher), and authenticity (e.g., using a dummy head, a model, or a real client; performing the task with or without a time limit). Students had 3 training sessions per week in which they practiced particular hairdressing skills by performing self-selected tasks.

Students were free to use or not to use STEPP as a tool helping them to direct their learning. They could use STEPP to self-assess practiced skills, to add assessments made by a teacher or peer student, to formulate their learning needs, to study overviews of performed skills, and to indicate which learning task(s) they preferred to perform in the coming week. Students could fill out STEPP during or after skills training at one of the computers in the classroom, during a scheduled lesson once every two weeks, or during their spare time at home.

Finally, students also largely determined the amount of supervision available to them. Students could sign up for a weekly meeting with their supervisor. During these meetings they could discuss progress and task selections with their supervisor, making use of the overviews and summaries provided by STEPP. The supervisor then provided feedback on the student's performance and gave advice on the selection of learning tasks for the coming week.

Prior skills questionnaire. To gain insight in students' prior skills, for eight hairdressing skills (e.g., cutting hair, washing hair) students indicated on a 4-point scale (0 = never; 3 = many times) how often they had performed these skills before

starting the program. Reliability of the questionnaire was determined by Cronbach's Alpha, α = .91. Convergent validity of the questionnaire with the number of days working in a hairdressing salon and/or attending a hairdressing course was high (r_s = .89, $p < 0.01$)

Student interview. A semi-structured interview was developed. The interview consisted of four parts concerning (a) the actual use STEPP, (b) reasons to use it, (c) its perceived usability, and (d) its perceived effectiveness on the development of SDL skills. The first part of the interview consisted of open-ended questions regarding the frequency of use of STEPP (e.g., once per week) and for which SDL skills it was used (i.e., which functionalities of STEPP are used). After the interview students' answers were compared to their log files to determine the truthfulness of their responses.

In the second part of the interview the reasons why students used STEPP were explored by means of an open-ended question asking why they used STEPP (i.e., to reflect, to gather proof of learning). In the third part, concerning the perceived usability of STEPP, three yes/no questions were asked with respect to (a) the ease of operating the STEPP software, (b) the ease of interpreting the information on the different input screens, and (c) the clarity of the output screens (i.e., overviews). Students were asked to explain their answers and provide any other information pertaining to usability aspects.

The fourth part, concerning the perceived effectiveness of STEPP, consisted of one yes/no question, namely, if STEPP had helped to become a more proficient self-directed learner. If students answered this question with "yes", three follow-up yes/no questions were asked to specify which SDL skill(s) improved: (a) assessing own performance, (b) formulating learning needs, and (c) selecting learning tasks. If students again answered with "yes" on one or more of these sub questions, they were asked to indicate how STEPP had contributed to improving this skill. If students answered with "no" to the main question, they were asked to indicate why STEPP did not contribute to improving their SDL skills. In addition, students were asked to indicate on a 5-point rating scale (1 = not at all; 5 = excellent) how well they (a) were able to self-assess hairdressing skills, (b) could formulate learning needs, and (c) were able to select new learning tasks.

All student interviews were taped and typed out transcripts were analysed. Answers concerning the reasons to use STEPP were assigned to six categories: (a) daily/weekly routine (e.g., "every Thursday I fill out STEPP with all the skills I practiced", or "sometimes the teacher reminds us to use STEPP, but otherwise I forget"); (b) personal approach to direct own learning (e.g., "I do not need STEPP to know what I do right or wrong or to think about what I will be doing, I always used my agenda or knew it by heart", or "STEPP is like a guide who helps me to think about what I did and will be doing"); (c) affinity with computers (e.g., "I use my computer a lot, especially for MSN or to check my email, then I usually fill out STEPP too", or "I do not use my computer a lot so it costs me extra effort to switch it on to use STEPP"); (d) use of STEPP to reflect on own learning (e.g., "I use it so I can see my

weaknesses and can work on those"); (e) use of STEPP as a checklist for examinations (e.g., "I use it to see what skills I need to practice for my exam and what standards they have to meet"), and (f) use of STEPP as a file or diary (e.g., "I use it so my teacher can see what I did last week", or "I think it is nice to look back in STEPP after one year or so to see how I was doing, what I did and how it went").

The interviews were reread after assigning answers to categories and students received a score for each category depending on whether they indicated in the interview that this factor had influenced their use of STEPP (score 1) or not (score 0). If the transcribed interviews did not provide sufficient information to assign a score, students were asked for additional information and received a score based on this information.

Log files. To gather data on the actual use of STEPP, log files were automatically generated with information on (a) self-assessments of learning tasks and the particular skills relevant for these tasks, (b) formulated learning needs, and (c) submitted task selections. The information from the log files was used to compute for each student the number of learning tasks assessed per week, the number of skills assessed per task, the percentage of assessed skills for which a learning need was formulated, and the number of actually submitted task selections over the whole period of 10 weeks.

Supervisor interview. A semi-structured interview was conducted with the supervisor, who was available for the weekly, voluntary supervision meetings with the students. The interview consisted of three parts pertaining to (a) the perceived usability of STEPP for coaching purposes, (b) perceived effects of the use of STEPP on the quality of students' SDL skills, and (c) the number of supervision meetings each student participated in.

For the perceived usability of STEPP, one yes/no question was asked whether STEPP was perceived as a useful tool to follow students' progress or not. In addition, the supervisor was asked to explain which aspects of STEPP did or did not contribute to monitoring progress. For the perceived effects of the use of STEPP, the supervisor was asked one yes/no question whether STEPP did or did not contribute to the development of students' SDL skills and to explain her answer. In addition, the supervisor was asked to indicate on a 5-point rating scale (1 = not at all; 5 = excellent) how well each student was able to (a) self-assess hairdressing skills, (b) formulate learning needs, and (c) select new learning tasks. Again, the supervisor was asked to explain her answers. Finally, the supervisor was asked to indicate the number of supervision meetings that were initiated by each student (ranging from a minimum of 0 to a maximum of 10 meetings).

Procedure

Students first filled out the prior skills questionnaire. Then, they participated in an instruction lesson in which the use of STEPP and its functionalities were explained and explored. During 10 weeks students worked in the on-demand educational

setting and used STEPP to self-assess their learning, formulate learning needs, and select learning tasks. Students were free to sign up for the weekly supervision meetings. The use of STEPP was logged. After the 10 weeks all students and their supervisor were interviewed.

Results

This section describes the results with regard to the actual use of STEPP, its usability, and its effectiveness according to the students and their supervisor.

Actual use of STEPP

Comparison of the students' responses to the interview questions to their log files indicated that all students answered truthfully. In the hairdressing program, students performed about three learning tasks per week, covering about three relevant skills each (e.g., washing hair, cutting hair, communicating with the client). The log files indicate that the median for the number of assessed learning tasks per week was .45 (range = .10 – 1.00) and for the number of assessed skills per learning task the median was 1.15 (range = 1.00 – 3.33). Thus, for assessment purposes (reflection) STEPP was used to assess less than one task per week and the number of skills assessed per task was less than two. In the interview, students mentioned to use the portfolio only once per week. They would update their portfolio at home or at school, depending on available time and/or access to the Internet at home. For most of the assessed skills (78%) students formulated learning needs in addition to the assessment of the performance using the predefined standards. With respect to the use of STEPP for its task selection functionality (planning), the log files indicate that the median for the number of task selections for the whole period of 10 weeks was .50 (range = .00 – 4.00). Thus, for task selection purposes (planning), STEPP was used to make a task selection only once every five weeks. In the interviews students also indicated that they mainly used STEPP for reflection purposes and that they used their own diary to make their task selections (i.e., write down when to perform what tasks).

Perceived usability of STEPP

Answers to the closed questions from the student interview indicated that all 10 students judged STEPP as easy to operate, the input screens as easy to interpret, and the output screens as clear and informative. In addition, the supervisor indicated that the overviews of STEPP provided a good basis for the supervision meetings: "… If a student has updated STEPP, together we discuss the overviews. We start with the overview of assessed tasks and next we have a look at the formulated learning needs. Finally we discuss the selected learning tasks. I provide them with feedback

on what I read and advise them if necessary. It is very efficient to discuss their progress in this way."

Students were grouped for each of the six factors that, according to the interview data, affected the use of STEPP. Two groups were composed per factor; one group with students to which the particular factor did apply and one to which it did not. Table 3.1 presents per factor and per composed group an overview of the median and range of the three variables indicating the actual use of STEPP: Number of tasks assessed per week, number of skills assessed per task, and number of submitted task selections for the whole period of 10 weeks. The percentage of assessed skills per learning task for which a learning need was formulated was not used as a variable, because it did not provide an appropriate indication of quantitative STEPP use. For example, a student who assessed only two skills and formulated also two learning needs, would receive a 100%-score on this variable. On the contrary, a student who assessed 15 skills and formulated 13 learning needs would only receive a 80%-score, whereas the latter used STEPP more frequently and effectively.

Kolmogorov-Smirnov Z tests were used to compare the groups of students to which a particular factor did or did not apply (i.e., whether the groups have the same continuous distribution). The tests show that the number of tasks assessed per week is higher for students who indicated to fill out STEPP as part of a weekly routine, z = 1.58, $p < .05$; for students who filled out STEPP because they did not have a strong personal approach to directing their own learning, z = 1.58, $p < .05$; for students who liked working with computers, z = 1.45, $p < .05$, and for students who mentioned to use STEPP to reflect on their progress, z = 1.29, $p < .10$. The number of skills assessed per task is higher for students who indicated to like working with computers, z = 1.45, $p < .05$. In addition, students who mentioned to use the computer for reflection also tended to actually submit a higher percentage of learning tasks, z =1.29, $p < .10$. No significant differences were found for the factors pertaining to using STEPP as a checklist for the examination or as a file for storing all performed tasks.

The influence of students' prior hairdressing skills on the actual use of STEPP was also investigated. Table 3.1 presents for students with high (n =5, *Mdn* =1.25, *Range* =1.00 – 3.00) and low prior hairdressing skills (n =5, *Mdn* =.50, *Range* =.13 –.88) an overview of the median and range of the variables that indicate portfolio use. Mann–Whitney U tests show that students with high prior skills assess less tasks per week than students with low prior skills, z =-2.15, $p < .05$. In line with this, students also differ in the number of visits they pay to their supervisor (high prior skills: *Mdn* =2, *Range* =2–5; low prior skills: *Mdn* =6, *Range* =3–10). Students with high prior skills pay less visits to their supervisor than students with low prior skills, z =-2.23, $p < .05$. Thus, students with lower prior skills make more extensive use of STEPP and pay more visits to their supervisor to discuss the overviews created by STEPP.

Table 3.1. Overview of actual use of STEPP for students grouped per indicated factor and prior skills.

	Routine		Personal approach to SDL		Affinity with computers		Reflection		Exam Checklist		File		Prior Skill	
	No (n=5) *Mdn* *Range*	Yes (n=5) *Mdn* *Range*	No (n=5) *Mdn* *Range*	Yes (n=5) *Mdn* *Range*	No (n=3) *Mdn* *Range*	Yes (n=7) *Mdn* *Range*	No (n=4) *Mdn* *Range*	Yes (n= 6) *Mdn* *Range*	No (n=6) *Mdn* *Range*	Yes (n=4) *Mdn* *Range*	No (n=8) *Mdn* *Range*	Yes (n=2) *Mdn* *Range*	Low (n =5) *Mdn* *Range*	High (n= 5) *Mdn* *Range*
# Tasks Assessed per Week	.10 .10-.30	.60* .60-1.00	.60* .60-1.00	.10 .10-.30	.10 .10-.10	.60* .30-1.00	.10 .10-.30	.60** .30-1.00	.20 .10-.60	.70 .30-1.00	.30 .10-1.00	.60 .60-.60	.60* .30-1.00	.10 .10-.60
# Skills Assessed per Task	1.00 1.00-2.33	1.17 1.10-3.33	1.17 1.10-3.33	1.00 1.00-2.33	1.00 1.00–1.00	1.33* 1.10-3.33	1.00 1.00-1.33	1.25 1.10-3.33	1.08 1.00-3.33	1.23 1.10-2.33	1.11 1.00-2.33	2.25 1.17-3.33	1.33 1.10-3.33	1.00 1.00-2.33
# Submitted Task Selections per 10 Weeks	0.00 .00-2.00	1.00 .00-4.00	1.00 .00-4.00	0.00 .00-2.00	0.00 .00-.00	1.00 .00-4.00	.00 .00-.00	1.50** .00-4.00	.00 .00-1.00	.20 .00-4.00	.50 .00-4.00	.50 .00-1.00	1.00 .00-4.00	.00 .00-2.00

** = p < .05; ** = p < .10*

Furthermore, using a Spearman's rank correlation test it was found that the number of visits paid to the supervisor (maximum of 1 visit per week, i.e., between 0 and 10 visits in total) is positively related to the number of tasks assessed per week, r_s =.88, p < .001, to the number of skills assessed per task, r_s =.66, p < .05, and to the percentage of actual task selections, r_s =.68, p < .05.

Perceived effectiveness of STEPP

To investigate whether frequent users of STEPP perceived the effectiveness of STEPP differently than infrequent users, based on the number of tasks assessed per week students were assigned to either a frequent user group (*n* =5, *Mdn* =.60, *Range* =.60 – 1.00) or an infrequent user group (*n* =5, *Mdn* =.10, *Range* =.10 – .30). The answers to the closed questions indicated that four out of five frequent users perceived STEPP to positively affect their ability to self-assess their performance: "… I now know what I should pay attention to when evaluating my work". Three out of five frequent users indicated that STEPP helped them to formulate learning needs: "… the standards help you when thinking about your learning needs", and to make a task selection: "… the list of skills reminds me of what I still need to do for my exams". Only one infrequent user indicated "… although I do not use STEPP often, it does help me to self-assess my performance and to think about what I want to do next week". The remaining infrequent users stated that they did not perceive STEPP to contribute to the development of any of their SDL skills because they already knew how to direct their learning, for instance, by stating that: "… I know by myself how well I am doing and what I need to do for my exam".

According to the supervisor, STEPP contributes to the development of students' SDL skills. She explains that students who frequently use STEPP have a better understanding of their strengths and weaknesses, know what standards to use when assessing their performance, and are very specific in selecting their learning tasks, relating them to their weaknesses.

Table 3.2 presents for the infrequent and frequent users the median and range of the quality of self-assessments, formulated learning needs, and task selections—split between student self ratings (top of Table) and supervisor ratings (bottom of Table). A Spearman's rank correlation test showed a significant correlation between the supervisor's rating of the quality of students' task selections and the number of assessed tasks (r_s =.86, p < 0.01).

The supervisor's rating of the students' learning needs also correlated with the number of assessed tasks (r_s = .64, p < 0.05). To investigate this correlation in more detail, Kolmogorov–Smirnov Z tests were used to compare the supervisor's ratings for infrequent and frequent users of STEPP. Frequent STEPP users are rated somewhat higher on the quality of their task selections than infrequent users (z =1.27, p <.10), and frequent users are rated slightly higher on the quality of their formulated learning needs than infrequent users (z =1.27, p <.10). When asked to explain the higher rating for the quality of task selections of frequent users the supervisor

explains that "… thse student have a better understanding of all the standards they have to meet and the skills they need to develop, and they use this information to base their choices on". With respect to the quality of formulated learning needs she explains that "… the quality of learning needs of the infrequent users is lower, because they formulate their needs in less detail than the frequent users. The latter have a better understanding of what is expected from them and use this information to indicate their learning needs. This makes their learning needs useful because they are formulated specifically".

Table 3.2. Perceived effectiveness of STEPP (5-Point Rating Scales).

	Infrequent Users (n = 5)		Frequent Users (n = 5)		Total Group (N = 10)	
	Mdn	Range	Mdn	Range	Mdn	Range
Student Interview						
Quality of Self-assessments	5	3-5	4	4-4	4	3-5
Quality of Formulated Learning Needs	5	3-5	4	4-4	4	3-5
Quality of Task Selections	4	4-5	4	3-4	4	3-5
Supervisor Interview						
Quality of Self-assessments	2	2-4	4	4-4	4	2-4
Quality of Formulated Learning Needs	3	2-4	4	4-4	4	2-4
Quality of Task Selections	2	2-3	4	3-4	3	2-4

5-Point Rating Scales; 1 = Very bad, 2 = bad 3= good/bad, 4= good, 5 = very good

As indicated above, some infrequent users stated that they did not perceive STEPP to contribute to their SDL skills because they were already well able to direct their own learning. We investigated if this was a legitimate reason for not using STEPP. A Wilcoxon signed ranks test was used to compare the supervisor's rating to the students' rating of SDL skills. The analysis shows that their scores differ slightly. Infrequent users appear to rate themselves higher than their supervisor: they especially overestimate the quality of their task selections (z =-2.032, p <.05). In addition, they tend to slightly overestimate the quality of their self-assessments (z =-1.86, p <.10). For frequent users, no differences between their own ratings and the supervisor ratings of SDL skills were observed.

Because prior skills slightly influenced the use of STEPP, it was investigated if prior skills also influenced perceptions of its effectiveness. Comparing answers of students with high and low prior skills, it appeared that one student with low prior skills (who was an infrequent user) did not perceive STEPP as contributing to the development of his SDL skills. The remaining four students mentioned to perceive positive effects of using STEPP on their SDL skills, because it informed them on the standards they had to meet, the skills they needed to develop, and their progress on these standards and skills. Two out of the five students with high prior skills answered that STEPP was a helpful tool in making self-assessments, thinking explicitly

about learning needs, and selecting learning tasks. The other three students did not think STEPP to have any surplus value to their own strategies for directing their learning.

To sum up, STEPP was not frequently used, although it was used more frequently by students with low prior hairdressing skills than by students with high prior hairdressing skills. Its use is not influenced by the fact that it is too difficult to use, because all students and their supervisor indicated that STEPP is easy to operate and that it is informative. Factors that did influence its use, as indicated by students, are routine building, affinity with computers, the absence of a strong personal approach to directing own learning, and use for purposes of reflection. Use of the portfolio was perceived by both frequent users and the supervisor as a contribution to the development of SDL skills. In addition, the supervisor rated the SDL skills of frequent users higher than the SDL skills of infrequent users, and stated that the frequent users formulated better learning needs and selected more appropriate learning tasks.

Discussion

On-demand education in secondary vocational education offers students the opportunity to adapt learning tasks and particular aspects of the learning environment to their needs, but at the same time it demands from students to direct their learning. Unfortunately, research results reveal that SDL skills of students who enter secondary vocational education are not well developed. In agreement with this finding, students in our study also reported to feel not well prepared to function effectively in on-demand education, and the supervisor reported several examples of students who failed to appropriately direct their learning. Thus, support and guidance is needed to develop at least three basic SDL skills on which on-demand education makes an appeal: assessing own performance, formulating learning needs, and selecting learning tasks. A promising approach to support students in the development and effective use of SDL skills is to provide them with useful information and tools by means of a development portfolio. Based on an analysis of problems students encounter with performing SDL skills, guidelines for the design of such a portfolio were formulated.

These guidelines were used to design STEPP, a web-based development portfolio which was implemented in a hairdressing program in secondary vocational education. The portfolio has three functionalities directly related to the three basic SDL skills. First, STEPP informs students on relevant performance standards and provides example assessments that apply those standards. All standards are explained and illustrated in a 'dictionary'. It also provides tools to easily assess all skills that are relevant for particular learning tasks and to monitor progress on those skills. Second, STEPP asks students to formulate learning needs in their own words, and it provides tools to keep track of those learning needs. Third, it informs students on the meta-

data of learning tasks, such as their difficulty, authenticity, and available support and guidance, and provides tools supporting a systematic selection of future tasks. In addition to these three functionalities, a fourth functionality pertains to the generation of summaries and overviews that give an impression of overall progress and provide a basis for supervision meetings.

The case study revealed that making STEPP available in an on-demand hairdressing program does not automatically result in its regular use. Examination of factors influencing the actual use of STEPP indicates that the low frequency of use cannot be attributed to usability problems because all students thought STEPP's tools are easy to operate and the presented information is clear and understandable. The frequency of use seems to be related mainly to student characteristics. Students with relatively high prior hairdressing skills do not use STEPP to direct their learning. These students report that they are already familiar with the performance standards and already developed a personal approach to direct their learning, which makes the use of STEPP more like a burden than an aid to them. According to the reports from their supervisor, however, the positive perceptions of these students on their SDL skills are at best partially justified. Whereas the supervisor confirms that students with high prior hairdressing skills are able to assess their own performance, their ability to select suitable learning tasks is considered to be low, that is, they often select tasks that do not match their learning needs. Compared to high-prior skills students, students with low prior skills appreciate using STEPP much more, because it provides them with new information (e.g., performance standards) and a structured approach to direct their learning.

Not surprisingly, another factor with a positive effect on the frequent use of STEPP is making its use part of a weekly routine. Right from the start of the educational program, its use should therefore be clearly embedded in the educational process and be monitored (e.g., with fixed times for updating it, consulting it in supervision meetings, etc.). Embedding the use of the portfolio in the educational process will help students build routines of which the use of the portfolio is an essential part, enhancing the chance that it will still be used if monitoring decreases. The study also shows that the number of visits paid to the supervisor is positively related to the number of tasks assessed, number of skills assessed per task, and the percentage of actual task selections. It could be concluded from this that it is important for students to act according to a routine, in which both the use of STEPP and the weekly meetings with the supervisor are incorporated.

Furthermore, the degree to which students have already developed their SDL skills might be taken into account. Students with well developed SDL skills, according to their supervisor and/or teachers, might be allowed to use the portfolio in a less detailed manner, for instance, by reflecting on a longer period of time (e.g., 3 or 4 weeks) and planning more learning tasks ahead, or by reflecting only after experiencing difficulties rather than reflecting on each learning task.

To conclude the discussion of factors influencing the use of STEPP, it should be mentioned that students who find the portfolio helpful to reflect on their past performance and students with affinity with computers use it relatively frequently. This supports the claim of Van Tartwijk et al. (2007), already discussed in the Introduction, that the purpose of a portfolio should be made clear to students beforehand and that they must be made familiar with its working in order to reach an effective implementation. Thus, students should be trained in the use of the portfolio and be explained that its purpose is to help with reflection, in such a way that learning needs can be identified and suitable future tasks to meet these needs might be selected. As a result, the portfolio should be perceived by students as an aid or even a necessity to be able to perform well in on-demand education.

Our study also reveals the importance of supervision meetings, in which students are provided with feedback and advice on the progress reported in their portfolio. This confirms Tillema and Smith's concern (2000) that often insufficient attention is paid to delivering feedback on portfolio information. Unfortunately, supervision meetings were not recorded in our study. This limitation makes it difficult to draw firm conclusions about the characteristics of the information provided during these meetings, and about how this information contributed to the positive attitudes students reported towards these meetings and to the development of students' SDL skills as reported by the supervisor. In future research, an in-depth analysis of supervision meetings should provide more insight in these issues.

Other limitations of the case study pertain to the small number of participants, the low usage of the portfolio by students in both conditions, and the short period of data collection. With regard to the number of participants, it should be clear that follow-up studies must use more participants and stronger experimental designs to gain more insight in the mechanisms underlying effective portfolio use. Relevant variables to study pertain to the specific design characteristics of the portfolio, different ways to embed the portfolio in the educational process, and to its use in supervision meetings as well as the student-supervisor ratio that is desirable in on-demand education.

With respect to the low usage of the portfolio in general, a consequence of not making the use of the portfolio compulsory in this case study, results should be interpreted with caution. Student characteristics and environmental factors might also have played a role in the positive effects on the SDL skills of the frequent user group. In future research the use of the portfolio should be made compulsory and integrated in the educational process of the school to assure frequent use by all participants.

With regard to the duration of the case study, the period of 10 weeks is relatively short to expect substantial progress on—the highly complex—SDL skills. Longitudinal research is needed to give students better opportunities to become acquainted with a new learning environment (i.e., SDL in on-demand education supported by the use of a portfolio), and to reach a better understanding of the

developmental processes of SDL skills. Furthermore, using longitudinal research, the critical process of scaffolding SDL could be further investigated. This should provide practical guidelines for gradually handing over more and more responsibilities over the learning process to students.

Concluding, this article showed that in order to make it successful, the use of a portfolio in on-demand education should be seamlessly integrated in the educational process, and best be made compulsory so that regularly updating it becomes a routine for all students. In addition, portfolio use is best complemented with regular, scheduled supervision meetings in which progress reports are discussed and feedback or advice is given on the development of domain skills, SDL skills, and effective portfolio use. Scaffolding should be used for both portfolio use, for instance by reflecting on and planning for increasingly larger time periods, and supervision meetings, for instance by gradually decreasing the amount of meetings. But most important, this study provided more insight in how the use of development portfolios offers a promising approach to promote the development of SDL skills in on-demand secondary vocational education.

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CHAPTER 4

The Effects of Portfolio-based Advice on the Development of Self-directed Learning Skills in Secondary Vocational Education[1]

This experimental study investigates whether supervision meetings, in which students receive specific advice on how to use a development portfolio to monitor their progress and plan their future learning, helps them to develop self-directed learning skills and improve their learning in the domain. In the first year of a hairdressing program in vocational education, supervision meetings were used to provide students with either specific advice or not. Students in the advice condition (n = 21) formulated better learning needs, selected more suitable learning tasks, completed more practical assignments, and acquired more certificates than students in the feedback-only condition (n = 22). Interviews also showed that students in the advice condition appreciated the supervision meeting higher and perceived them as more effective than students in the feedback-only condition. Guidelines are provided for the use of development portfolios and the organisation of supervision meetings in on-demand vocational education.

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Introduction

In Dutch secondary vocational education, many institutes introduce on-demand education because it is nowadays acknowledged that students should be given more control over and responsibility for their own learning. In on-demand education, students are given the opportunity to direct their learning by selecting learning tasks that fit their needs and interests. From a theoretical perspective, giving students the opportunity to direct their own learning may have positive effects on learning results because it gives them the opportunity to adapt the learning tasks to their learning needs, that is, students only need to learn what is directly relevant for them. This makes learning also more personally relevant and stimulates intrinsic motivation (Williams, 1996). In addition, letting students experience responsibility for their learning helps them to develop self-directed learning skills, and to prepare them for lifelong learning as independent learners (Kriewaldt, 2001).

However, from an empirical perspective it has been found that students experience difficulties in directing their own learning, and that self-directed learning often has a negative influence on students' learning results (Van Velzen, 2002; Williams, 1996). In secondary vocational education, students often come from a tradition of teacher-directed learning in which it is mainly the teacher who assesses their performance, indicates their learning needs, and selects appropriate learning tasks for them to fulfil these needs (Shephard, 2000). A teacher-directed learning environment often makes little or no appeal to students' self-directed learning (SDL) skills, which may hamper students to develop skills such as self-assessment of performance, formulation of learning needs, and selection of suitable learning tasks (Knowles, 1975). When students who are used to a teacher-directed learning environment suddenly enter an educational setting which demands them to direct their learning, their lack of SDL skills may impede them to become successful independent learners. It is therefore of utmost importance that students who enter on-demand education are provided with sufficient support to develop their SDL skills.

An educational tool often provided to students as part of a system of on-demand education is a portfolio used for formative assessment. Different types can be distinguished, such as development portfolios, learning portfolios, and process-folios (Driessen, van Tartwijk, Overeem, Vermunt, & van der Vleuten, 2005; Järvinen & Kohonen, 1995; Klenowski, 2002; Seidel et al., 1997). In this chapter the term *development portfolio* is used to refer to a digital portfolio students use to describe and document multiple aspects of their own professional development over time. It may contain, for instance, reflections on prior performance, photographs or video clips of performance and products, formulations of weaknesses and strengths in performance, and decisions about courses of actions to improve performance.

Several studies reported that development portfolios are effective tools to help students reflect on their learning and to think about the development of their skills

(Chen, Liu, Ou, & Lin, 2000; Driessen et al., 2005; Mansvelder-Longayroux, Beijaard, & Verloop, 2007; Zeichner & Wray, 2001). Especially in the field of teacher training, the construction of so-called 'teaching portfolios' by student teachers has been found to encourage them to think more deeply about teaching and to focus on key issues (Wade & Yarbrough, 1996), and to understand and improve their skill development (Mansvelder-Longayroux, Beijaard, & Verloop, 2007). In addition, research has shown that students who developed a habit of reflection through the use of a portfolio, continued to reflect on their own performance well after the initial experience of portfolio construction (Grant & Huebner, 1998).

Studies on the effectiveness of portfolio use, however, also indicate limitations of the development portfolio as a tool to improve students' self-directed learning (Driessen et al., 2005; Wade & Yarbrough, 1996). Student characteristics and/or environmental factors can negatively influence the frequency and/or quality of portfolio use (Chen et al., 2000; Levett-Jones, 2005). For instance, students may lack experience in using a portfolio to direct their learning, the portfolio may provide insufficient structure because of its open nature, or the learning environment may offer too little guidance on how to use the portfolio adequately. All these factors may lead to a suboptimal use of the portfolio or even no use of it at all, or they will mean that students add only superficial and short reflections to the portfolio, undermining its positive effects.

Recommendations to realize effective use of development portfolios pertain, on the one hand, to the proper introduction of the portfolio in the educational setting, and, on the other hand, to the guidance given to students once it has been introduced. When introducing the portfolio, students should be well informed on the concept of self-directed learning, and the aims and use of the portfolio to help them direct their learning (Kicken, Brand-Gruwel, van Merriënboer, & Slot, in press; Levett-Jones, 2005; van Tartwijk, Driessen, van der Vleuten, & Stokking, 2007). Next, the use of the development portfolio should be properly guided by including structured aspects or providing formats to balance its open-ended nature (Wade & Yarbrough, 1996). Ideally, the portfolio should be structured in such a way that it helps students to systematically assess their own performance (i.e. self-assessment), formulate their learning needs, and select suitable future tasks to fulfil these needs. In particular, Driessen et al. (2005) revealed that coaching by a supervisor is one of the most crucial conditions for successful use of portfolios in medical education. Several other studies confirm this finding (Dagley & Berrington, 2005; Kjaer, Maagaard, & Wied, 2006; Smith & Tillema, 2003), showing that students are best guided, and also prefer to be guided, by a supervisor or mentor when constructing a development portfolio.

A related promising way to guide students in their use of a development portfolio is to provide them with specific advice on how to improve their SDL skills. Research in the field of computer-assisted learning has shown positive effects on learning when students are provided with advice on tool use (Clarebout & Elen, 2008; Gräsel,

Fischer, & Mandl, 2000; Lee & Lehman, 1993) or advice on their development and on what their instructional needs are (Bell & Koslowski, 2002; Tennyson, 1980, 1981). For self-directed learning skills, similar positive effects may be expected of advice providing students with direction to effectively improve these skills through 'deliberate practice', which is defined as time spent with the intention to improving one's performance and which requires students to remain focussed on the task and to monitor performance to retrieve cues for further improvement of performance (Ericsson, Krampe, & Tesch-Römer, 1993). The advice may, for instance, pertain to students' ability to assess own performance (e.g., "the task you performed is assessed very differently by you and your peer: Ask why s/he thinks your performance is weak"), to formulate learning needs (e.g., "you do not prioritize your weak points: decide what is for this moment the most important aspect of your performance that needs to be improved"), and to select new learning tasks (e.g., "you frequently choose tasks that are not relevant for your learning needs: familiarize yourself with relevant features of tasks available to you before making your final selection"). Well-designed advice consists of both feedback and feedforward. In this way, advice indicates strengths and weaknesses (i.e., verification) and, especially, provides constructive individualised information to improve learning (i.e., elaboration, see also Black & William, 1998).

Giving portfolio-based advice to students combines the advantages of on-demand education and teacher-directed education. The advice provides students with the necessary information to effectively direct their learning, and at the same time it gives them control over their own learning because they are free to choose whether and how to use the given information. Research on the use of advice has shown that students who direct their own learning on the basis of given advice perform equally well as students who learn under program or system control (Santiago & Okey, 1992). Thus, giving specific advice seems to be a fruitful approach to making on-demand education more 'safe', limiting the risk that students undertake activities that do not contribute to learning at all.

The study described in this chapter investigates the effects of giving students specific portfolio-based advice on the development of their SDL skills. In an on-demand hairdressing program in secondary vocational education, one group of students only receives feedback and another group receives specific portfolio-based advice (i.e., feedback and feedforward) in regular supervision meetings. Effects are studied on the development of self-directed learning skills (i.e., self-assessment of performance, formulating learning needs, and selecting new learning tasks), learning results, and students' perceptions of the effectiveness of the supervision meetings. First, it is hypothesized that students who receive advice will better develop self-directed learning skills than students who receive feedback only. Second, it is hypothesized that students who receive advice will show higher learning results. Third, it is hypothesized that students who receive advice will appreciate the supervision

meetings more and perceive them as more effective than students who receive feedback only.

Method

Participants

Forty-three students (42 female, 1 male; age *M* = 18 years, *SD* = 1.2) in their first year of a three-year hairdressing program of a school for secondary vocational education in the South of the Netherlands participated in the study. They were randomly assigned to the advice condition (*n* = 21) and the feedback-only condition (*n* = 22).

Four supervisors (all female; age *M* = 32 years, *SD* = 6.78) participated in the study. Because experience in supervising differed between supervisors, first the two experienced and next the two less experienced supervisors were randomly assigned to the conditions.

Materials

Educational program. To become a certified hairdresser, students must – in a period of three years – acquire eight main skills and 57 sub skills. The eight main hairdressing skills are, in order of complexity: (1) caring and diagnosing hair (with 3 sub skills, i.e., washing and shampooing the hair, massaging the scalp, and diagnosing the condition of hair and scalp); (2) permanent waving (with 6 sub skills); (3) cutting hair (with 12 sub skills); (4) blow-drying hair (with 4 sub skills); (5) reformatting hair (with 11 sub skills); (6) colouring hair (with 5 sub skills); (7) slicing hair (with 6 sub skills), and (8) styling long hair (with 10 sub skills).

The pedagogy of the program may be characterized as on-demand education with a mix of theoretical and practical work inside and outside school. A typical school week consists of two days of practical lessons at school, one day of theoretical lessons at school, and two days of internship at a hairdressing salon. Students choose the main skill and sub skills they want to develop and select the learning tasks to develop these skills. The learning tasks vary in complexity, authenticity, and amount of given support (van Merriënboer & Kirschner, 2007). With regard to *complexity*, learning tasks differ in the difficulty of practiced skills (e.g., cutting hair is more difficult than permanent waving) and combinations of skills (e.g., washing and cutting hair is more difficult than only washing hair). With regard to *authenticity*, learning tasks differ in the object on which the skills are performed (e.g., performance on a hairdressing dummy, a peer student, or a real client), the context in which they are performed (e.g., in school or in the hairdressing salon), and the constraints under which they are performed (e.g., with or without time pressure). With regard to *task support*, learning tasks differ in the level of students' independency (e.g.,

observing the teacher or peer student performing the task, performing only a part of the task, or independently performing the whole task).

After performing a number of equivalent tasks without support (called 'practical assignments'), a student may ask the teacher to summatively assess her performance on the main skill and sub skills central to these tasks. When all sub skills of a particular main skill (e.g., slicing hair, reformatting hair) are up to the mark and approved by the teacher, students are allowed to register for a formal examination of that main skill conducted by an external test institute. They receive a certificate after successful completion of the examination. During the school year, students have several opportunities to participate in a formal examination. Per examination opportunity, students can register for a maximum of two formal examinations.

The current study was conducted in the first year of the hairdressing program. For this first year, which consists of 40 study weeks, students are advised to fully develop at least three main hairdressing skills (i.e., take the formal examinations), and to start developing two other main skills.

Development portfolio. To help students take responsibility over their own learning process and make effective choices, a web-based development portfolio called Structured Task Evaluation and Planning Portfolio (STEPP; Kicken et al., in press) was designed and implemented. STEPP (Figure 4.1) has three functionalities, helping students to (a) assess their own task performance, (b) formulate learning needs based on assessed shortcomings in task performance, and (c) select future learning tasks with characteristics that help to fulfil the formulated learning needs. The first and second functionality are presented in Figure 4.1.

To assess their own performance on particular learning tasks, students select the performed skills from a hierarchical menu with all possible hairdressing skills and sub skills. Next, they assess the quality of the performed skills in relation to given performance standards (i.e., criteria, values, and attitudes), which are automatically shown by STEPP as soon as the student has selected a skill. Performance standards pertain to *criteria*, which indicate straightforward requirements in terms of time, accuracy, and order of activities (e.g., apply hair-dye in no more than 10 minutes); *values*, which indicate particular conventions and ways of working in the hairdressing profession (e.g., wear gloves during application of hair-dye), and *attitudes*, which indicate desirable aspects of behaviour (e.g., be friendly to clients). For each selected skill, STEPP provides a matrix with standards on one dimension and scales for rating the performance in relation to each standard on the other dimension. Students assess their own performance (i.e., self-assessment) by filling out the matrix. In addition to their self-assessments, students may also ask their teacher to assess their performance by filling out the same matrix. The self-assessments form the basis for the identification of learning needs. The students can formulate their needs for future learning in a separate textbox. For instance, a student may enter the text "I need to learn to apply hair-dye in less time" into the textbox.

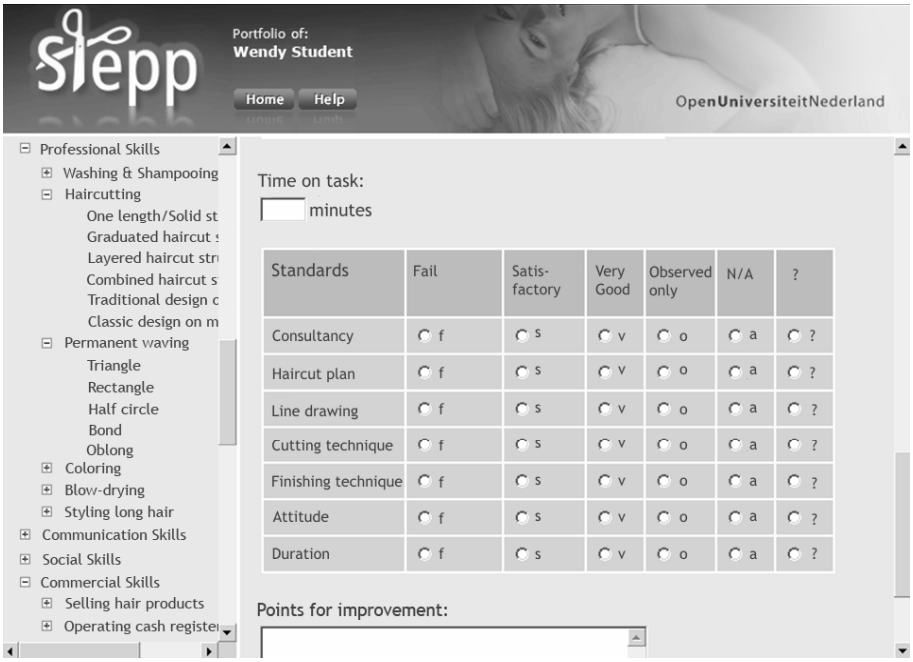

Figure 4.1. Self-assessment and formulation of learning needs functionality in STEPP: Overview of skills (left column), standards for performance assessment (table), and possibility to formulate learning needs (text-box).

For the selection of future learning tasks, STEPP offers students the opportunity to select skills and sub skills that need further practice to meet the formulated learning needs. For all learning tasks that offer the opportunity to improve the selected skill(s) the student can indicate the desired level of complexity, authenticity, and available support. For instance, the student who wants to speed up hair-dying skills may do so by observing the teacher performing the skill of dying hair, by dying the hair of a dummy, by dying the hair of a real client, and so forth. This yields a working plan with learning tasks for every forthcoming week.

Finally, STEPP provides three structured overviews with all portfolio data necessary for discussing a student's progress during supervision meetings. The first screen presents all learning tasks performed by the student, together with the corresponding self-assessments and, if applicable, teacher assessments. The second screen gives an overview of all formulated learning needs. The third screen presents the working plan for the forthcoming week.

Supervision meetings. In both the advice and the feedback-only condition the supervisor provided feedback on the student's progress report and planning of learning over the last two weeks, while discussing the three above mentioned STEPP overview screens in a fixed order. In the advice condition, the supervisor provided not only feedback but, in addition, advice on how to improve SDL skills. Using the first overview (assessments), advice was given on how to improve the quality of the

self-assessments. For instance, if discrepancies between self-assessments and teacher assessments occurred, students were advised to consult their teacher and ask for clarification. Using the second overview (learning needs), advice was given on how to trace and formulate learning needs. For instance, when needs were formulated in a general and abstract way (e.g., I should talk more), students were given tips on how to make them more specific (e.g., I need to think about interesting topics I could talk about with clients). Using the third overview (working plan), advice was given on how to select learning tasks appropriate to fulfil the formulated learning needs. For instance, when selected learning tasks were already mastered and mainly chosen because a student liked them, the student was advised to include also tasks that offered the opportunity to practice new skills or skills not yet mastered at an adequate level.

The supervisors in the feedback-only and advice condition structured their meetings according to different protocols (see the Appendix). All supervisors were trained to use the condition-specific protocol appropriately before data collection started. First they studied the protocol and discussed it with the experimenter. Then the experimenter demonstrated the use of the protocol and answered any remaining questions of the supervisors. For each supervisor, the experimenter also organised a simulated supervision meeting and provided feedback on the use of the protocol.

Measurement Instruments

Observation scheme supervision meetings. An observation scheme was constructed to check for the correct use of the protocols during the supervision meetings. For each observed supervision meeting the supervisor could receive points for (a) each of the three discussed screens (min-max: 0-3), (b) providing feedback on students' progress, (c1) refraining from providing advice in the feedback-only condition, or (c2) providing effective advice in the advice condition. If supervisors scored less than the maximum of 5 points, the supervision meeting was marked as inadequate.

Student interviews. A semi-structured interview consisting of four parts was conducted to measure: (a) actual portfolio use, (b) the contents of the supervision meetings, (c) perceived self-directedness in learning, and (c) perceived effectiveness of the supervision meetings. The questions concerning Part 1 and Part 2 served as control variables. The aim was to control for possible differences in portfolio use between the conditions, and to verify whether the contents of the supervision meetings for both conditions were in agreement with the condition-specific protocols. The other two parts (Part 3 and Part 4) measured dependent variables.

In Part 1, open-ended questions were asked concerning the usability of the portfolio and the degree to which students had integrated its use in their daily routine. Answers regarding the use of the portfolio were scored as (a) irregular use, (b) use only when reminded by the teacher, or (c) routine use. Regarding usability, students' answers were simply scored as (a) easy to use, or (b) difficult to use. In

Part 2 of the interview, students were asked to describe the topics that were discussed during the supervision meetings and the information given by the supervisor. Answers provided to this question were scored as (a) appropriate, or (b) inappropriate according to the condition-specific protocol.

To examine students' perceived self-directedness, Part 3 of the interview consisted of one open-ended question asking students to explain why they either had been able (success) or not been able (failure) to participate in one or more of the formal examination opportunities. Students' explanations of their *success* to participate in a formal examination were assigned to four categories: (a) frequent deliberate practice while focusing on inadequate aspects of performance, (b) drawing up a good year plan (i.e., what examinations do I want to register for and which practical assignments do I need to accomplish when) and acting according to this plan, (c) taking care of practical preconditions to be able to carry out the work plan and year plan (e.g., make appointments with human models to practice hairdressing skills), and (d) intrinsic motivation or ask for help in case of declining motivation. Students' explanations of their *failure* to participate in a formal examination were assigned to three categories: (a) not being able to develop skills sufficiently before the deadline of the examination because the skill is experienced as difficult or complex, (b) not drawing up a year plan or lack of the discipline to act according to this plan, (c) not taking care of practical preconditions to be able to carry out the plan, and (d) lack of motivation.

In Part 4 of the interview one open-ended question was asked on the perceived effectiveness of the supervision meetings, that is, if the meetings were useful and helped to learn to direct own learning. The answers were categorised as (a) meetings were superfluous, (b) the supervisor helped me to analyse my performance, (c) the supervisor helped me to improve my process of task selection, and (d) the supervisor motivated me to further develop skills and to carry out my planning of tasks.

Quality of self-assessments. To rate the quality of students' self-assessments, log files were used to calculate the proportion of agreement between student and teacher assessments. The hairdressing skill 'permanent weaving' and its three sub skills (i.e., three different weaving patterns) were used to calculate the proportion of agreement. This skill was selected and assessed at least five times, in both conditions, by both the students and their teacher. Each time the student performed the skill or one of its sub skills, it was assessed by scoring the corresponding performance standard, ranging from fail, via satisfactory, to very good. The proportion of agreement between student and teacher was calculated per performed task, separately for each of the three sub skills.

Diagnostic formulated learning needs. The coding system of Mansvelder-Longayroux, Beijaard and Verloop (2007) was adapted to code the learning needs retrieved from the log files. A learning need was coded as an 'assessment result' when it literally repeated the performance standard which was rated as insufficient.

For instance, if a student scored 'fail' for 'time on task' and then formulated the learning need "shorten the time" or "work faster", this learning need was coded as an assessment result. The learning need was coded as 'diagnosis' if students identified potential causes of insufficient performance. For instance, taking the previous example, the learning need "I should better master the technique of holding the comb and scissors in one hand to speed up my performance" is diagnostic in nature because the student has diagnosed a possible reason for slow performance. The learning needs were independently coded by two raters, based on a coding scheme provided by the experimenter (interrater-reliability κ = .72) . The proportion of learning needs formulated as a diagnosis was calculated for each student.

Quality of task selection. Students received a score ranging from 0 to 4 for each task selection retrieved from their log files. For each task selection, points were given for selecting (a) a relevant skill, (b) for a relevant learning need, (c) at an appropriate level of difficulty, and (d) with an appropriate level of authenticity. The relevance and appropriateness of a task selection were based on the registered assessments and formulated learning needs from the previous weeks. Take, for instance, a student who selects a task in which the skill of permanent weaving is practiced on a human model, with help from a teacher to improve the correctness and firmness of the pattern. If the overviews in the portfolio show that this student has indeed reported difficulties in placing the curlers according to the pattern and firm enough on a human model, the student receives four points for this particular task selection.

Learning results. The number of acquired certificates (max. = 4) and the number of practical assignments approved by the teacher (max. = 16) were counted for each student.

Procedure

For data collection, two periods were distinguished: a familiarisation period of 10 weeks and the intervention period of 20 weeks. At the beginning of the familiarisation period, all students followed two lectures in which the concepts of on-demand education and self-directed learning were explained. The use of the development portfolio and the attendance of supervision meetings in relation to the development of SDL skills were also discussed. All students received two training sessions in the use of STEPP and were advised to update their portfolio at least once a week in order to practice their self-assessment skills, think about their learning needs, and plan future learning tasks. In the familiarisation period extra training sessions were scheduled for students who needed additional practice in using STEPP (e.g., students with low computer skills). The supervisors were also trained in the use of STEPP. During simulated supervision meetings they practiced the use of the condition-specific protocol in combination with the three overviews from the portfolio (assessments, learning needs, and task selections). In the familiarisation period, the collection of log files and approved practical assignments started and continued until the

end of the intervention period. However, there was no opportunity for participation in a formal examination in the familiarisation period.

In the intervention period, every two weeks a supervision meeting was scheduled for each student. These meetings were set up according to the condition-specific protocol for the advice condition and the feedback-only condition. The experimenter attended at random four supervision meetings of each supervisor (i.e., 16 meetings in total) to observe whether the protocols were correctly used. During the intervention period, students had two opportunities to participate in a formal examination. For each examination students could acquire a maximum number of two certificates. After this period individual interviews were held with 15 randomly selected students from each condition. All student answers were directly typed out and the respondents were asked to verify the transcripts. Next, the answers were categorised and scored.

Results

To gain insight in how students used the portfolio, this section first provides information on the actual use of STEPP. Observation results regarding the correct implementation of the protocols for the supervision meetings in the two conditions are presented next. Then, the results concerning the effects of giving advice in supervision meetings are described for (a) self-directed learning skills, (b) learning results, (c) perceived self-directedness, and (d) perceived effectiveness of the supervision meetings.

Actual Use of STEPP

Students participated in two practical sessions per week. This allowed them to perform at least three learning tasks per week, which could be assessed by themselves and, on request, by their teacher. Learning needs could be formulated for each task. In addition, student could select tasks to be performed in the next week(s). If students updated STEPP weekly, this would yield at least 30 self-assessments, teacher assessments, and formulated learning needs after the familiarisation period, and another 60 after the intervention period. Actual STEPP-use was determined by analysing the log files and Part 1 of the student interview.

For the conditions within each period, Table 4.1 presents the means and standard deviations of the number of self-assessed tasks, the proportion of teacher assessments (i.e., the number of tasks assessed by both the teacher and the student, divided by all self-assessed tasks), the number of formulated learning needs, and the number of task selections made. During the familiarisation period, students in the feedback-only and advice condition updated STEPP with, in order, about 10 and 13 self-assessments. They asked for a teacher assessment in only 11 and 14

percent of the cases, respectively. In the intervention period students in both conditions updated STEPP with somewhat more than one self-assessment every two weeks and asked for teacher assessment in 27 to 35 percent of the cases. Again, the number of formulated learning needs was close to the number of self-assessments. Students updated STEPP with about one task selection every three weeks. In the familiarisation and intervention period ANOVAs showed no significant differences in actual STEPP use between conditions.

Table 4.1. Means and standard deviations for the actual use of stepp in both conditions for both periods.

	Feedback-only condition		Advice condition	
	M	*SD*	*M*	*SD*
Familiarisation Period				
# Self-assessments	9.77	7.50	12.95	9.27
Proportion of teacher assessments	.11	.11	.14	.15
# Learning needs	11.36	9.93	11.95	7.66
# Task selections	4.59	4.10	5.24	3.24
Intervention Period				
# Self-assessments	13.41	14.73	13.43	7.80
Proportion of teacher assessments	.35	.28	.27	.14
# Learning needs	15.82	21.10	14.48	9.20
# Task selections	6.32	7.8	8.62	10.29

The interview results (Part 1) concerning integration of STEPP in daily routine reveal that 53 percent of the students in the feedback-only condition and 60 percent of the students in the advice condition integrated STEPP in their daily or weekly routine. In both conditions, 27 percent of the interviewed students only used STEPP when the teacher reminded them to use it. Finally, 20 percent of the students in the feedback-only condition and 13 percent of the students in the advice condition reported irregular use. All students in both conditions reported that STEPP was easy to use. Chi-square analyses showed no significant differences between conditions.

Because actual STEPP use did not significantly differ between conditions in neither the familiarisation period nor the intervention period, no covariates have been included in further analyses on the dependent variables.

Observation of the Supervision Meetings

To verify if the supervision meetings were held according to the condition-specific protocols the experimenter observed and scored 16 supervision meetings (four of each supervisor). All 16 meetings received the maximum score of five points, indicating that all meetings were in agreement with the protocol. Moreover, results from Part 2 of the student interview revealed that the discussed topics during the meetings were in line with respect to the condition-specific protocol (mentioned by 95% of the students in both conditions). From these results it can be concluded that the condition-specific protocols were successfully implemented.

Self-Directed Learning Skills

To answer the question concerning the effects of giving advice during supervision meetings on students' self-directed learning skills the proportion of agreement between the students' self-assessments and the teachers' assessments, the proportion of diagnostic learning needs, and the quality of task selections were determined for both conditions (see Table 4.2). As expected no significant differences between conditions were found during the familiarisation period. So, these variables were not added as covariates when analysing the data of the intervention period.

Table 4.2. Means and standard deviations for self-directed learning skills in both conditions for both periods.

	Feedback-only condition		Advice condition	
	M	*SD*	*M*	*SD*
Familiarisation Period				
Quality of self-assessment	.46	.25	.59	.11
Diagnostic formulated learning needs	.46	.31	.48	.27
Quality of task selections	3.72	.25	3.80	.24
Intervention Period				
Quality of self-assessment	.55	.16	.63	.16
Diagnostic formulated learning needs	.32	.22	.61	.20
Quality of task selections	3.70	. 33	3.91	.17

Quality of self-assessments. The lower part of Table 4.2 indicates that the self-assessment skills are not fully mastered during the intervention period, because the proportion of agreement with the teacher is for both conditions below .65. Contrary to our expectations, ANOVA showed no significant difference between conditions, $F(1,30) = 2.395$, $MSE = 0.63$, *ns*.

Diagnostic formulated learning needs. During the intervention period students in the advice condition formulated significantly more learning needs with a diagnostic nature (61% of all formulated learning needs) than students in the feedback-only condition (32%), $F(1, 41) = 24.97$, $MSE = .043$, $p < 0.001$, $\eta^2 = .390$. In addition, no supervisor within condition effect was found, meaning that the positive effect on the proportion of diagnostic learning needs was not caused by a specific supervisor.

Quality of task selections. Table 4.2 indicates that the average scores in the intervention period are above 3.5, meaning that students are quite capable to select suitable tasks. Students in the advice condition show a marginally higher quality of task selections ($M = 3.91$, $SD = .17$) than students in the feedback only condition ($M = 3.70$, $SD = .33$), $F(1,20) = 3.49$, $MSE = .070$, $p < 0.10$, $\eta^2 = .162$. No supervisor within condition effect was found.

Learning Results

The number of practical assignments approved by the teacher were counted to measure students' learning results. In the intervention period students in the advice condition completed significantly more assignments ($M = 10.05$, $SD = 4.68$) than

students in the feedback-only condition (M = 6.32, SD = 3.70), $F(1, 41) = 12.04$, MSE = 16.531, $p < 0.01$, $\eta^2 = .236$. No supervisor within condition effect was found. The number of acquired certificates was also counted as an indication of learning results (certificates could only be acquired in the intervention period). Students in the advice condition acquired slightly more certificates (M = 1.14, SD = 1.42) than students in the feedback-only condition (M = 0.59, SD = 1.10), $F(1, 41) = 3.04$, MSE = 1.602, $p < 0.10$, $\eta^2 = .072$. Again, no supervisor within condition effect was found.

Perceived Self-Directedness

To determine students' perceived self-directedness, they were asked to explain the reason for their success or failure to participate in one of the formal examinations. Table 4.3 presents the percentages of student answers categorised according to the eight categories described in the Method section (student interview, Part 3). All 5 students from the feedback-only condition who participated in a formal examination reported that drawing a year plan helped them to participate. All 9 students from the advice-condition who participated in a formal examination mentioned deliberate practice as the most important success factor, and all but one (89%) also mentioned drawing up a year plan as an important success factor. Chi-square analyses showed no significant differences between the two conditions regarding their explanations for success.

Table 4.3. Perceived self-directedness expressed as reasons for success and failure to participate in formal examinations.

Reasons for Success	Feedback-only condition (n = 5)	Advice condition (n = 9)
Success because of deliberate practice	60 %	100 %
Success because of year plan	100 %	89 %
Success because of practical preconditions	40 %	78 %
Success because of motivation	40 %	11 %
Reasons for Failure	(n = 13)	(n = 12)
Failure due to skill difficulty	53 %	33 %
Failure due to lack of year plan	62 %	17 %
Failure due to practical preconditions	62 %	58 %
Failure due to lack of motivation	31 %	8 %

Students' explanations for *not* participating in a formal examination reveal that 62 percent of the 13 students in the feedback-only condition mentioned not drawing a well-defined year plan as the most important failure factor, whereas only 17 percent of the 12 students in the advice condition gave this as a reason, $\chi^2(1, N = 25) = 5.04$, $p < .05$. Thus, especially students in the feedback-only condition blame their lack of planning skills. The other factors were not significantly different between conditions. As can be seen from Table 4.3, students in both conditions mentioned

not taking care of practical preconditions and, to a somewhat lesser degree, difficulty with skill performance as important failure factors.

Perceived Effects of the Supervision Meetings

Results regarding the perceived effectiveness of the supervision meetings (student interview, Part 4) showed that significantly less students in the advice condition (20%) than in the feedback-only condition (67%) perceived the supervision meetings as superfluous, $\chi^2(1, N = 30) = 6.65$, $p < .05$. More students in the advice condition (73%) than in the feedback-only condition (13%) mentioned that the supervision meetings had helped them to analyse their own performance, $\chi^2(1, N = 30) = 11$, $p < .001$. Finally, more students in the advice condition (67%) than in the feedback-only condition (13%) mentioned that the meeting helped them to improve their task selections, $\chi^2(1, N = 30) = 8.89$, $p < .001$. In both conditions, 73 percent of the students perceived the supervision meetings as motivating for further skill development and for carrying out their learning plans.

Discussion

The current study investigated the effects of providing students in secondary vocational education with portfolio-based advice on their ability to self-assess performance, formulate diagnostic learning needs, and make appropriate task selections. The hypothesis that students who receive advice develop their self-directed learning skills better than students who only receive feedback is largely confirmed by the reported results. The effect of giving advice was evident in students' ability to formulate learning needs. Students who received advice were better able to diagnose possible causes of their weaknesses and formulated relatively more diagnostic learning needs than students who only received feedback. Regarding task selection skills a small effect was found in favour of the advice condition. No difference was found between the two conditions, however, on self-assessment skills.

Our second hypothesis that students in the advice condition would show higher learning results than students in the feedback-only condition was confirmed. Students receiving advice checked off more assignments and passed more formal examinations than students who only received feedback.

Finally, the third hypothesis that students who receive advice during supervision meetings will appreciate these meetings more and perceive the sessions as more effective than students who only receive feedback was also confirmed. Students apparently do not only want to be informed on the appropriate or inappropriate application of their self-directed learning skills (i.e., verification), but also want to be supported in learning how to improve these skills (i.e., elaboration).

It appeared from this study that supervision meetings in which students receive advice (i.e., feedback and feedforward) had differential effects on the development

of different self-directed learning skills. With respect to self-assessment skills, students did not reach a stage where they were able to assess their own performance at a sufficient level. The proportion of agreement with the teacher assessments was only about 65 percent. Training more extensively, observing the modelling of assessment skills by an expert, and discussing the differences between expert and own assessments are examples of instructional methods that might contribute to a better development of self-assessment skills. Research by McDonald and Boud (2003) reveals that self-assessment skills can well be trained; in their study, students who received systematic self-assessment training outperformed students who had not been involved in this training. In addition, research by Falchikov and Boud (1989) reveals that learning to assess own performance is a complex cognitive process that develops over a relatively long period of time, and its accuracy depends on how well-defined the assessment standards are. Possibly, the training period in the current study was too short and/or students had too much difficulty with interpreting the given standards in order to obtain the desired effects.

With respect to task selection skills, it appears that providing feedback on task selection is to some extent effective, provided that students select tasks from a limited number of available tasks as in the current study. When the number of tasks to choose from is higher, it so happens that linking the information from the development portfolio (i.e., performance and learning needs) to the tasks' metadata (i.e., task features) in order to select the most appropriate task(s) is more difficult for learners (Kicken, Brand-Gruwel, & van Merriënboer, 2008). Thus, when the number of learning tasks students may choose from increases, the need to provide good advice will probably also increase.

Regarding the formulation of diagnostic learning needs, it appears that providing advice was clearly more effective than only providing feedback. Receiving advice prompted students to formulate diagnostic learning needs rather than learning needs which merely repeated the performance standards. In addition, results reveal that there was an effect of advice on students' learning results. This is in line with findings on the effects of feedback (Black & William, 1998), which state that more elaborate feedback has a positive effect on performance. Advising students to formulate learning needs in terms of cancelling—possible—causes of weak performance can help them to gain more insight in the quality of their own performance. Identifying the causes of weak performance provides more direction for subsequent learning, resulting in a higher quality of deliberate practice which, in turn, has a positive effect on performance improvement (Ericsson et al., 1993). In on-demand education, the ability to formulate proper learning needs should therefore be one of the main topics to discuss with students in supervision meetings. This is also confirmed by the supervisors in our study, who mentioned that students often experienced problems with diagnosing their own performance.

Some critical remarks should be made regarding the design and course of the present study. First, the actual use of the development portfolio was rather low for

all students, especially with respect to the number of selected learning tasks. In the interviews, students explained that they experienced the use of the portfolio as more and more superfluous, because after some time they "knew the assessment criteria and their learning needs by heart". A second limitation concerns the task selections made by the students. Due to practical reasons, such as problems finding human models to practice hairdressing skills on, the number and variety of learning tasks students could make their selection from was rather small. This resulted in only small differences in quality of task selections between students in both conditions. To overcome these limitations future research should be conducted in a learning environment in which demands are made on the use of the development portfolio, and in which students can develop their skills by choosing appropriate learning tasks from a well designed, large database with tasks. The tasks in the database should be linked to metadata, such as difficulty level, support level, and focus of the task. Research on effects of different kinds of advice in a highly structured and well designed learning environment can provide more insight in the effects of advice on students' task selection behaviour in relation to the quality of their performance.

A promising future approach to help students learn to direct their learning is the use of reflective dialogue. Isaacs (1999) describes reflective dialogue as a process "where you become willing to think about the rules underlying what you do – the reasons for your thoughts and actions. You see more clearly what you have taken for granted" (p. 38). This technique was occasionally used during the practical training sessions. In the interviews, several students and supervisors indicated to appreciate this communication technique because it systematically guides students in their thinking process. Future research could examine the different effects of reflective dialogue during instruction sessions, scheduled group sessions, and individual supervision meetings on students' SDL skills and learning results.

Another line of future research starts from the observation that, in addition to the three prompted SDL skills, making a planning for a longer period of time is also an important skill on which advice should be provided in the early stages of learning. Many students experienced problems with planning their learning trajectory for a longer period of time and/or with carrying out activities according to their plan. This resulted in slow development of hairdressing skills and hence a small number of checked-off assignments and no permission to participate in formal examinations. Both students and supervisors indicated that the skill to plan a learning trajectory (e.g., for a semester or a whole school year) and to carry out activities according to plan are important skills that should be developed for efficient and effective learning in on-demand education. Future research should therefore also examine the effects of advice (e.g., learning contracts; Beitler, 2000; Knowles, 1986) on the ability of students to plan their learning over a longer period of time.

It can be concluded from this study that the combination of using a development portfolio to stimulate students' SDL skills and providing them with advice is a promising approach to improve their self directedness. It helps students to formulate

directions for future learning which enhances the quality of their deliberate practice. However, to prevent students in secondary vocational education from practicing skills that are too easy or too difficult, with too much or too little support, or in an inappropriate context, it is advisable to gradually shift the responsibility for directing the learning process from the teacher to the students. Only when students demonstrate progress in using their SDL skills, they should be given increasingly more responsibility to direct their learning. In this way, students become confident self-directed learners.

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Appendix

Protocols for supervision meetings in both conditions

	Overview screen	Feedback-only Condition	Advice Condition
1. Assessments	Number of assessments	If insufficient: assess at least one sub skill per week	If insufficient: advise to assess at least one skill or sub skill per week and explain that this helps to diagnose the weaknesses.
	Number of teacher assessments	If insufficient: ask at least one teacher assessment for each sub skill per week	If insufficient: advise to ask teacher for assessment because this helps to become aware of (causes for) weaknesses.
	Agreement between teacher assessments and self-assessment	If 2 or more discrepancies: point out differences and tell to try to minimize the differences in assessment If 0-1 discrepancies: point out difference	If 2 or more discrepancies: point out differences and advice to ask the teacher for clarification of the assessment to understand the differences in assessment If 0-1 discrepancies: point out the difference
2. Learning needs	Number of learning needs	If learning needs are not always formulated, tell to always formulate at least one learning need	If learning needs are not always formulated, advise to always formulate a learning need, because this helps to become conscious of weaknesses.
	Formulation of learning needs.	If formulated as assessment result: try to use more own words, not merely copy criteria; formulate more in terms of behaviour, what to do to improve their performance	If formulated as assessment result: formulate more as an indication of what caused the weakness and in terms of behaviour, what the student should be working on. Diagnose the weakness with student to give an example.
	Comparison with learning needs formulated by others	Point out whether they are the same or not	If discrepancy between student and other assessor: ask teacher more often for explanation of learning needs; ask teacher during practical lessons for help during diagnosing own weaknesses; learn from teacher diagnosis of weaknesses.
3.Working plan	Working plan	If nothing is selected: always make a task selection; have the student make a selection directly after the meeting.	If nothing is selected: always make a selection and explain that this helps to deliberately practice weaknesses and helps to remind of practical preconditions.
	Selected skill	If not appropriate: mention that it is not appropriate; student is free to change/not change the selection.	If not appropriate: advice to select an other skill. Explain why the selected skill is not appropriate; provide advice to help student in the process of task selection.
	Selected difficulty level	If not appropriate: mention that it is not appropriate; student is free to change/not change the selection	If not appropriate: advice to select an other difficulty level. Explain why the selected skill is not appropriate; provide advice to help select the appropriate level.
	Selected level of authenticity	If not appropriate: mention that it is not appropriate; student is free to change/not change the selection	If not appropriate: advice to select another level of authenticity. Explain why the selected level is not appropriate; provide advice to help select an appropriate level.

CHAPTER 5

The effects of p/reflection prompts on the development of self-directed learning skills in secondary vocational education[1]

In modern forms of on-demand education, students are expected to direct their learning. In secondary vocational education, first-year hairstylist students (N = 67) received p/reflection prompts to foster the development of their self-directed learning skills (i.e., formulate diagnostic learning needs, draw a plan to improve performance). In a 9-week period, the prompts were provided through questions in a digital development portfolio, reflective dialogue with the teacher during weekly practical lessons, and reflective dialogue with the supervisor during three-weekly supervision meetings. After the intervention, students in the prompt condition (n = 31) formulated more learning needs with a diagnostic nature, drew more specific plans to improve performance, and had more positive perceptions of the effectiveness of the educational program than students in the no-prompt condition (n = 36). Guidelines are provided for the design of digital development portfolios and the use of reflective dialogue to help students become self-directed learners in on-demand education.

[1] This chapter is submitted as Kicken, W., Brand-Gruwel, S., Van Merriënboer, J. J. G., & Slot, W. (2008). *The effects of p/reflection prompt on the development of self-directed learning skills in secondary vocational education.* Manuscript submitted for publication.

Introduction

In Dutch secondary vocational education, on-demand education is becoming increasingly popular because it provides the opportunity to take individual differences between students into account. Students are given the opportunity to direct their learning by selecting *what* they want to learn (e.g., selecting a topic) and *how* they want to learn it (e.g., selecting particular methods), based on their personal needs and interests. The control that is given to students provides them with the opportunity to select learning tasks that best match their prior knowledge (Gagné, 1985; van Merriënboer, Clark, & de Croock, 2002), gives them a feeling of freedom of choice which may make learning more personally relevant and motivating (Keller, 1987; Ryan & Deci, 2000), and, last but not least, gives them the opportunity to develop self-directed learning skills (Knowles, 1975; Zimmerman, 1994).

Self-directed learning (SDL) is both a prerequisite and a desired outcome of effective on-demand education. However, many students have no well-developed SDL skills when they enter on-demand secondary vocational education (Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004). They often come from a tradition of teacher-directed learning, which makes little or no appeal to SDL (Shephard, 2000). Thus, they have not learned to select suitable learning tasks, to assess their own performance, or to formulate learning needs (Knowles, 1975). Nevertheless, teachers in a system of on-demand education often incorrectly assume that freshmen already possess SDL skills, or will simply develop those skills by working in an on-demand learning environment (Levett-Jones, 2005). Therefore, the potential benefits of on-demand education such as positive effects on cognitive, meta-cognitive and affective learning activities (van Velzen, 2002; Williams, 1996) are easily undermined by the lack of SDL skills of students who enter vocational education, the lack of instructional support for *learning* SDL skills, or both (Williams, 1996). At least in the early stages of an on-demand educational program, it is critical that students are well informed on what is expected of them and are supported in their development and use of SDL skills (Kicken, Brand-Gruwel, & van Merriënboer, 2008a).

Often, a portfolio for formative assessment is provided to students as part of a system of on-demand education. Compared to a portfolio with a focus on learning products (e.g., showcase portfolios), a portfolio with a focus on the learning process, such as a development portfolio, a learning portfolio, or a process-folio has been advocated by many researchers as a promising tool to help students become self-directed learners (e.g., Driessen, van Tartwijk, Overeem, Vermunt, & van der Vleuten, 2005; Järvinen & Kohonen, 1995; Klenowski, 2002; Seidel, Walters, Kirby, Olff, Powell, & Veenema, 1997). In this chapter the term *development portfolio* is used to refer to a digital portfolio students use to describe and document multiple aspects of their own professional development over time. It may contain, for instance, reflections on prior performance, photographs or video clips of performance and products,

formulations of weaknesses and strengths in performance, and plans or 'preflections' for how to improve performance.

Research indicates that particular conditions must be met in order to make development portfolios effective in fostering students' ability to reflect on previous performance, and plan or 'preflect' on subsequent learning (Zeichner & Wray, 2001). Students do not automatically reflect on their task performance, and when they work with portfolios they should be explicitly promoted to reach a better understanding of themselves as learners (Borko, Michalec, Timmons, & Siddle, 1997; Wade & Yarbrough, 1996). For instance, a recent study by Mansvelder-Longayroux, Beijaard and Verloop (2007) shows that when updating their portfolio with reflections on performance, student teachers engage in several mental learning activities that can be categorised as either (a) *action-oriented* learning activities, which lead to consciousness-raising of what one has done or knows (e.g., recollection of situations, evaluation), or (b) *meaning-oriented* learning activities, which help to understand the processes that underlie a certain (weak) performance (e.g., analysing, diagnosing). The student teachers were mainly engaged in action-oriented and less in meaning-oriented learning activities. However, especially the latter learning activities foster deep processing which can be perceived as important for building up and structuring knowledge of own strengths and weaknesses based on processing of experiences (Kolb, 1984; Oosterheert & Vermunt, 2001; Vermunt & Verloop, 1999).

Apparently, providing students with a development portfolio may promote action-oriented learning activities and thus help them to develop basic SDL skills such as evaluation of acquired knowledge and assessment of performance. However, a portfolio alone is not sufficient to promote meaning-oriented learning activities which help students develop more complex SDL skills such as diagnosing possible causes of suboptimal performance and making a specific planning for learning activities aimed at performance improvement. Previous research by Kicken, Brand-Gruwel, and Van Merriënboer (2008b) has shown that providing students with portfolio-based advice during supervision meetings is a promising approach to help them use the portfolio more effectively and develop complex SDL skills. During the supervision meetings, students were explicitly reminded to diagnose their own performance, to indicate possible causes for weak performance, and to formulate learning needs based on the results of this diagnosis (e.g., "I would advise you to first diagnose your performance, ask yourself what caused this weak performance, and then write your learning needs") rather than to formulate learning needs in terms of ill-developed aspects of performance. Students who received this type of advice formulated relatively more diagnostic learning needs (i.e., the student has diagnosed a possible cause for weak performance) in their development portfolio than students who did not receive the advice but only worked with the portfolio. In addition, both teachers and students who participated in this study indicated that in addition to the advice the use of *reflective dialogue* (i.e., asking 'why' and 'how' questions) during supervision meet-

ings and during practical lessons, in which students worked on self-selected learning tasks, also fostered the development of SDL skills (ibid).

Reflective dialogue can be described as a process "where you become willing to think about the rules underlying what you do – the reasons for your thoughts and actions. You see more clearly what you have taken for granted" (Isaacs, 1999, p. 38). Past research on human tutoring has shown that students who engage in reflective dialogue with their tutor after or during problem-solving, are more likely to ask questions, discuss their reasoning processes, reason about their own actions, and learn more than students who do not receive reflective questions (Gargallo, 1993; Katz, Allbritton, & Connelly, 2003; Katz, O'Donnell, & Kay, 2000). In our study reflective dialogue will refer to 'why' and 'how' questions. By asking 'why' questions, students are prompted to diagnose their past performance and to become more conscious of possible causes of weak performance (reflection), and by asking 'how' questions students are prompted to draw up plans to improve their performance (preflection). These 'why' and 'how' questions will be called p/reflection prompts.

The mechanism underlying reflective dialogue and the use of p/reflection prompts can be flexibly used. In addition to its use in supervision meetings and practical lessons described above, reflective dialogue can also be used in the actual design of development portfolios (Seale & Cann, 2000). For example, students could be provided with a pre-structured portfolio that contains questions that prompt them to diagnose their performance by unravelling underlying processes that are possible causes of weak performance (e.g., a reflection prompt such as "Why do you think your performance continues to be weak?"), and to plan future activities by drawing up specific plans to improve performance (e.g., a preflection prompt such as "How could you improve your performance in the next practical lesson?").

To sum up, on-demand educational programs that use development portfolios, practical lessons with self-selected learning tasks, and supervision meetings are not always effective in enhancing students' SDL skills because they tend to rely on action-oriented learning activities. The programs can be improved by adding p/reflection prompts that foster meaning-oriented learning activities and so help students develop their SDL skills. These prompts can be based on the principles of reflective dialogue.

The main purpose of this study is to investigate the effects of p/reflection prompts on the development of students' SDL skills and learning results. Three types of prompts will be used simultaneously. First, p/reflection prompts will be added to a digital, pre-structured development portfolio in the form of questions asking students to diagnose their performance ('why' question) and to draw up specific plans for practice based on their diagnosis ('how' question). Second, p/reflection prompts will be added to practical lessons in which students work on self-selected learning tasks. At the beginning of each lesson the teacher discusses the plan for practice with each student, as formulated by the student, using reflective dialogue (asking 'why' and 'how' questions). Third, p/reflection prompts are added to the supervision meetings

in which the contents of the development portfolio are discussed. In these meetings the supervisor uses reflective dialogue to help students diagnose their own performance and draw up specific plans for further practice.

The first research question examines the effects of p/reflection prompts on the development of SDL skills. With regard to the effects of prompts on the formulation of learning needs, it is hypothesized that students who receive p/reflection prompts will engage more in meaning-oriented learning activities and thus come up with relatively more diagnostically formulated learning needs than students who do not receive p/reflection prompts. With regard to the effects of prompts on planning future learning activities, it is hypothesized that students who receive p/reflection prompts will be more prone to base their plans on a thorough diagnosis of performance difficulties and thus come up with more specific plans for practice than students who do not receive p/reflection prompts.

The second research question studies the effects of p/reflection prompts on students' learning results. It is hypothesized that students who receive p/reflection prompts will engage in more meaning-oriented learning activities, unravelling the underlying causes of their weak performance, which will give them more direction for specific - planning of - performance improvement, which will eventually have positive effects on learning results.

The third research question pertains to correlations between diagnostically formulated learning needs, specific plans for practice, and learning results. A positive relation between diagnostically formulated learning needs and highly specific plans for practice is hypothesized, because students who thoroughly diagnose their performance have more detailed information to base their plans for practice on than students who merely evaluate their performance. In addition, a positive relation is expected between diagnostically formulated learning needs and learning results as well as between specific plans for practice and learning results. Students who have better developed SDL skills (i.e., formulate diagnostic learning needs and draw specific plans for practice) have a better understanding of the weaknesses they need to remediate and how this can be achieved. This helps them to select learning tasks according to their zone of proximal development and direct their attention to specific aspects of the learning task, which will have positive effects on their task performance.

The fourth and final research question concerns students' perceptions of the effectiveness of the on-demand educational program. It is hypothesized that students who receive p/reflection prompts will perceive the development portfolio, the practical lessons and the supervision meetings as more effective in helping them to unravel possible causes of weak performance and drawing up specific plans for practice than students who do not receive p/reflection prompts.

Method

Participants

Of 72 students in their first year of a three-year hairdressing program of a school for secondary vocational education in the South of the Netherlands, complete data were collected of 67 students (66 female, 1 male; age M = 17.7 years, SD = 1.66). Students were randomly assigned to the prompt condition (n = 31) and the no-prompt condition (n = 36). Due to technical problems with collecting the portfolio data the number of students in both conditions is not equal.

Eight teachers (all female; age M = 31.87 years, SD = 8.85) participated in the study. Two of these teachers also acted as supervisors of the students in the prompt condition and two other teachers also acted as supervisors of the students in the no-prompt condition.

Materials

Educational program. To become a certified hairdresser, students must – in a period of three years – acquire eight main skills and 57 sub skills. The eight main hairdressing skills are, in order of increasing complexity: (1) caring and diagnosing hair (with 3 sub skills, i.e., washing and shampooing the hair, massaging the scalp, and diagnosing the condition of hair and scalp); (2) permanent waving (with 6 sub skills); (3) reformatting hair (with 11 sub skills); (4) cutting hair (with 12 sub skills); (5) blow-drying hair (with 4 sub skills); (6) colouring hair (with 5 sub skills); (7) slicing hair (with 6 sub skills), and (8) styling long hair (with 10 sub skills).

The pedagogy of the program may be characterized as on-demand education with a mix of theoretical and practical work inside and outside school. A typical school week consists of two days of practical lessons at school, one day of theoretical lessons at school, and two days of internship at a hairdressing salon. Students choose the main skill and sub skills they want to develop and select their own learning tasks to develop these skills. The learning tasks vary in complexity, authenticity, and amount of given support (van Merriënboer & Kirschner, 2007). With regard to complexity, learning tasks differ in the difficulty of practiced skills (e.g., cutting hair is more difficult than permanent waving) and combinations of skills (e.g., washing and cutting hair is more difficult than only washing hair). With regard to authenticity, learning tasks differ in the object on which the skills are performed (e.g., performance on a hairdressing dummy, a peer student, or a real client), the context in which they are performed (e.g., in school or in the hairdressing salon), and the constraints under which they are performed (e.g., with or without time pressure). With regard to task support, learning tasks differ in the level of students' independency (e.g., observing the teacher or peer student performing the task, performing only a part of the task, or independently performing the whole task).

The experiment was conducted during the last semester of the first year of the educational program. The intervention period lasted 9 weeks. To gather data on the development of students' SDL skills during the intervention period, three consecutive periods of three weeks were distinguished and data on students' SDL skills were gathered for each period.

Development portfolio. To help students take responsibility over their own learning process and develop their SDL skills, a web-based development portfolio called Structured Task Evaluation and Planning Portfolio (STEPP) was used (for a full description of STEPP, see Kicken, Brand-Gruwel, van Merriënboer, & Slot, in press). STEPP helps students to (a) assess their own task performance, (b) formulate learning needs based on assessed shortcomings in task performance, (c) make a plan for practice to fulfil the formulated learning needs, and (d) examine overviews of all the portfolio data.

To assess own performance on particular learning tasks, students select the performed skills from a hierarchical menu with all possible hairdressing skills. Next, they assess the quality of the performed skills in relation to given performance standards. Performance standards pertain to *criteria*, which indicate straightforward requirements in terms of time, accuracy, and order of activities (e.g., apply hair-dye in no more than 10 minutes); *values*, which indicate particular conventions and ways of working in the hairdressing profession (e.g., wear cloves during application of hair-dye), and *attitudes*, which indicate desirable aspects of behaviour (e.g., be friendly to clients). For each skill, STEPP provides a matrix with standards on one dimension and scales for rating the performance in relation to each standard on the other dimension. Students assess their own performance (i.e., self-assessment) by filling out the matrix, using the scores failed (F), satisfactory (S), or very good (V). In addition to their self-assessments, students may also ask their teacher to assess their performance by filling out the same matrix. These self-assessments form the basis for the identification of learning needs.

After having assessed their performance on a particular skill, students receive the question to formulate their learning needs and they formulate their learning needs based on the results of their self-assessment. Next, they are asked to formulate a plan for subsequent practice aimed at performance improvement for this skill. Finally, they may examine three structured overviews of all portfolio data, regarding overall progress, progress on specific skills, and the degree to which performance standards are already met.

Plans for practice during the practical lessons. To focus students' attention, at the beginning of each practical lesson, students were asked to write down their plan for practice on a piece of paper. This was done to remind students of the plan for practice they had drawn in STEPP, because commonly 2-3 days would pass between updating STEPP and the next practical lesson.

Supervision meetings. All students were scheduled for a supervision meeting every three weeks (in week 3, 6, and 9). The supervisor provided feedback on

students' progress reports (i.e., self-assessments and learning needs) and plans for practice over the last three weeks, by discussing the three above mentioned overview screens in their development portfolios.

P/reflection prompts. In the prompt condition, p/reflection prompts were given (a) on formulated learning needs and plans for practice in STEPP, (b) on written plans for practice at the beginning of the practical lessons, and (c) on formulated learning needs and plans for practice in students' portfolios during the supervision meetings. First, in the prompt condition, an extended version of STEPP provided p/reflection prompts for the formulation of diagnostic learning needs and the making of highly specific plans for practice (Figure 5.1). The p/reflection prompts for formulating diagnostic learning needs were given to students who scored their performance on a particular standard as 'failed' or 'satisfactory'. To help them diagnose their weak performance they were given the question: "What is the cause for weak performance?". In addition, a list of possible causes of weak performance was provided to the students (e.g., for the skill of blow-drying hair, this list indicates that weak performance on the standard 'time on task' might be caused by (a) not being able to handle the hairdryer both left and right handed, (b) too little sectioning of the hair, (c) lack of concentration and motivation, etc.). The p/reflection prompt for making specific plans for action was the question "What could you possibly do to improve performance related to this standard next time?", directing the student's attention to the unravelled cause for weak performance. In the no prompt-condition, students were working with a degraded version of STEPP and received no list of possible causes of weak performance and instead of specific performance standard-related diagnosis and planning questions, general questions to formulate learning needs and plan future practice are given. In both versions of STEPP, a hierarchical list of to-be-assessed skills is provided (left column in Figure 5.1) from which students can select the skills relevant for the performed learning task. The design of the overviews were the same for the extended version and the degraded version of STEPP.

Second, in the prompt condition, the teacher discussed the plan for practice that students had written at the beginning of the practical lesson in such a way that students were confronted with a possible lack of specificity. Teachers used reflective dialogue to provide p/reflection prompts and to help students formulate an effective, highly specific plan based on a diagnosis of their prior performance. In the no-prompt condition, teachers did not elaborate on the written plans for practice.

Third, in the prompt condition, the supervisor used reflective dialogue in the supervision meeting to help students diagnose their performance and to improve the formulation of learning needs and plans for practice. For instance, students were asked *why*, according to them, a certain performance standard (e.g., time on task, applying hair-dye) was not yet sufficiently developed and *how* they could formulate their learning needs more effectively. In addition, the supervisor asked students how they could improve their performance, why they would choose for a certain plan, or

how they could formulate their plans for practice more specifically. In the no-prompt condition, the teacher did not engage with students in a reflective dialogue, but only asked what their plans for practice were.

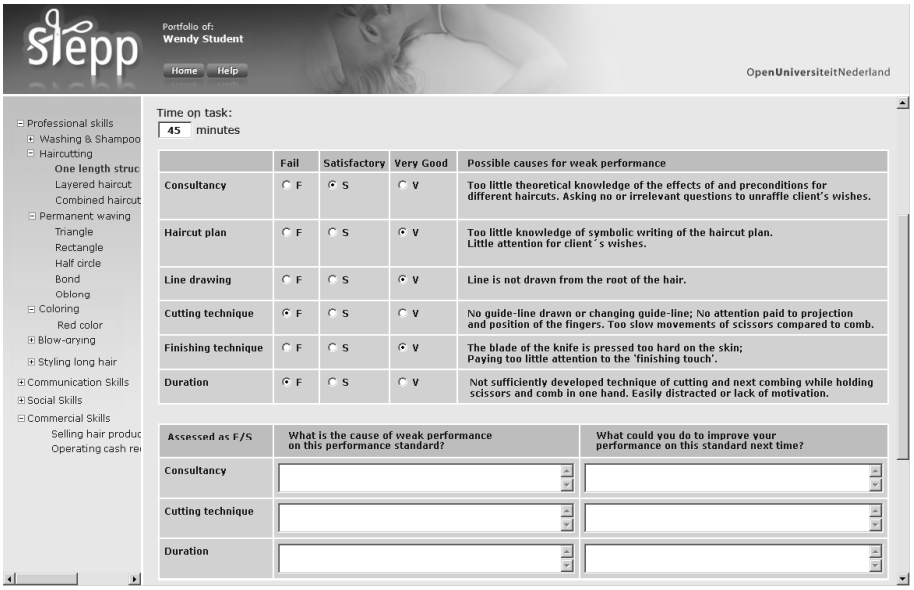

Figure 5.1. Self-assessment functionality in the extended version of STEPP: a list of possible causes of weak performance (top right), questions to diagnose weak performance for standards assessed as fail or satisfactory (bottom left), and questions to plan future practice for standards assessed as fail or satisfactory (bottom right).

Measurement Instruments

Scoring learning needs. Students were asked to formulate their learning needs on a piece of paper both during a practical lesson in the week *before* the intervention (i.e., a paper-and-pencil pretest) and during a practical lesson *after* the intervention period (i.e., a paper-and-pencil posttest). In addition, the formulation of learning needs was measured during the intervention: in all practical lessons, students updated STEPP and formulated learning needs after task performance (e.g., permanent waving, reformatting hair).

For analysing the formulated learning needs, before, during, and after the intervention the coding system of Mansvelder-Longayroux et al. (2007) was adapted. Learning needs were coded as 'assessment result' or 'diagnostic', reflecting whether students had engaged in either action-oriented or meaning-oriented learning activities to formulate the learning need. A learning need was coded as an 'assessment result' when it literally repeated the performance standard which was rated as insufficient or satisfactory or when it was formulated in a broad fashion. For instance, if a student scored 'fail' on 'time on task' and then formulated the learning need "time" or "work faster", this learning need was coded as an assessment result. A

learning need was coded as 'diagnostic' if students identified potential causes of weak performance. For instance, the learning need "I should practice to hold the comb and scissors in one hand to speed up my performance" formulated by a student who scored 'fail' on 'time on task', is diagnostic in nature because the student has diagnosed a possible reason for weak performance.

Students were not limited to formulating a specific number of learning needs, which resulted in a different number of formulated needs per student. Furthermore, the number of formulated learning needs for students in the prompt-condition also depended on the number of performance standards they assessed as 'fail' or 'satisfactory'. Therefore, the *proportions* of diagnostically formulated learning needs were computed per student on the pretest, the posttest, and the updates of STEPP during the intervention. The intervention period was divided into three 3-week periods and the proportion of diagnostically formulated learning needs was computed for each period. All formulated learning needs were independently coded by two raters, based on a coding scheme provided by the experimenter (interrater-reliability $\kappa = .77$).

Scoring plans for practice. To measure students' ability to draw a specific plan for practice aimed at performance improvement, they were asked to write down a plan for practice aimed at performance improvement in the week *before* the intervention (i.e., a paper-and-pencil pretest), in the week *after* the intervention (i.e., a paper-and-pencil posttest), and while updating STEPP during the intervention period. Students also wrote a plan for practice at the beginning of each practical lesson. These plans are not analysed, because in the prompt condition these plans function as the input for reflective dialogue with the teacher and were thus part of this particular p/reflection prompt in the practical lesson.

The plans were coded as either 'non-specific' or 'specific' depending on whether it provided specific directions for performance improvement. For instance, a plan like "practice more" or "keep on trying" to improve time on task was coded as 'non-specific' because it only provides broad directions for improvement and/or is not deduced from a diagnosis of prior performance. A plan like "practice to use the hairdryer both left-handed and right-handed" is coded as 'specific' because it is based on a diagnosis and provides clear directions for improvement of time on task. Students were not limited to formulating a specific number of plans for practice, which resulted in different numbers of plans per student. Therefore, the *proportions* of specific plans drawn on the pretest, the posttest, and the updates of STEPP during the three 3-week periods of the whole intervention were calculated for each student. All formulated plans for practice were independently coded by two raters, based on a coding scheme provided by the experimenter (interrater-reliability $\kappa = .78$).

Observation scheme for practical lessons. An observation scheme was constructed to check if teachers followed the applicable protocol for dealing with students' written plans for practice in the practical lessons. For each observed practical lesson, teachers could receive points for (a) asking students to write down their lesson-plan, (b) discussing the plans for practice with the students individually, and

(c1) for refraining from elaborating on non-specific plans in the no-prompt condition, or (c2) for using reflective dialogue to help students formulate their plans more specifically in the prompt condition. If teachers scored less than the maximum of 3 points, the start of the practical lesson was marked as inadequate.

Observation scheme for supervision meetings. An observation scheme was constructed to check if supervisors followed the applicable protocol during the supervision meetings. For each observed supervision meeting the supervisor could receive points for (a) discussing each of the three overview screens (min-max: 0-3), (b) providing feedback on students' progress, (c1) refraining from using reflective dialogue to improve formulation of learning needs or plans in the no-prompt condition, or (c2) using reflective dialogue to help students improve the formulation of learning needs and plans in the prompt condition. If supervisors scored less than the maximum of 5 points, the supervision meeting was marked as inadequate.

Learning results. To examine the effects of p/reflection prompts on students' learning results, teachers were asked to score for each student the performance of the hairdressing skills this student had been practicing during the intervention period (e.g., permanent waving or reformatting hair). During a practical lesson one week after the 9-week intervention period teachers rated the task performance on a set of performance standards relevant for the assessed hairdressing skills as fail (= score 1), satisfactory (= score 2), or very good (= score 3). The mean of the scores on the relevant performance standards was computed for each student (max. = 3).

Student interviews. A semi-structured interview was conducted to measure: (a) actual portfolio use, (b) perceived effectiveness of the portfolio (with or without prompts), (c) perceived effectiveness of writing the plan for practice at the beginning of a practical lesson (with or without reflective dialogue), and (d) perceived effectiveness of the supervision meetings (with or without reflective dialogue). The questions concerning Part 1 served to control for possible differences in portfolio use between conditions. Parts 2, 3 and 4 measured dependent variables.

In Part 1, open-ended questions were asked concerning the usability of the portfolio and the degree to which students had integrated its use in their daily routine. Answers regarding the use of the portfolio were scored as (a) irregular use, (b) use only when reminded by the teacher, or (c) routine use. Regarding usability, students' answers were simply scored as (a) easy to use, or (b) difficult to use.

In Part 2 of the interview one open-ended question was asked on the perceived effectiveness of the development portfolio to diagnose students' performance and draw a specific plan. Students were asked whether STEPP helped them to look for causes of weak performance and to plan practice aimed at performance improvement. The answers were categorised as (a) the questions made me think more deeply about my performance, (b) the questions helped me come up with a plan for performance improvement, and (c) the questions did not have any added value.

In Part 3 one open-ended question was asked on the perceived effectiveness of writing the plan for practice at the beginning of a practical lesson. Students were

asked whether writing down a plan for practice helped them to focus attention and work effectively on their performance (i.e., plan for performance improvement during the practical lesson). The answers were categorised as (a) the writing was effective, or (b) the writing did not have any added value.

In Part 4 of the interview one open-ended question was asked on the perceived effectiveness of supervision meetings. Students were asked whether the supervision meetings had helped them to formulate more effective learning needs and draw more specific plans for practice. Answers were categorised as (a) the supervisor helped me understand the causes for weak performance, (b) the supervisor helped me formulate my plans for practice in a more specific fashion, and (c) the supervision meetings had no added value.

Design and Procedure

A pretest-posttest design was used to measure the effects of the p/reflection prompts on students' SDL skills. Both the skill to formulate learning needs and the skill to draw specific plans for practice were measured during the pretest and the posttest. In addition, the development of students' SDL skills during the intervention period was measured. For data collection, three consecutive periods were distinguished of three weeks each. The mean proportion of diagnostic learning needs and specific plans was calculated for each of these three periods.

The study was conducted during the second semester of the first year of the hairdressing program. One week before the intervention started all students attended a workshop in which the aim of STEPP in relation to the development of hairdressing skills in on-demand education was explained. The use of STEPP was demonstrated and practiced. The teacher required from students to update their portfolio at least once per week during one of the practical lessons. Teachers were also trained in the use of STEPP. After this familiarisation week, the collection of log files started and lasted for nine weeks. In weeks 3, 6, and 9 of the intervention period a supervision meeting was scheduled for each student. The experimenter attended at random 15 meetings of each supervisor (i.e., 60 meetings in total) to observe whether the applicable protocol was properly applied. The experimenter also attended at random the start of one practical lesson per week for each condition (i.e., 18 practical lesson in total), to observe whether the applicable protocol was properly applied.

After the intervention period individual interviews were held with 12 randomly selected students from each condition. All student answers were directly typed out and the respondents were asked to verify the transcripts. Next, the answers were categorised and scored.

Results

First, results concerning the realization of the intervention (i.e., actual use of p/reflection prompts) are presented. Next, results are provided for the four research questions concerning, in order, the outcomes for SDL, the development of SDL skills, the learning results, and the student perceptions of the effectiveness of the educational program.

Realisation of the Intervention

Actual use of STEPP. Over the whole experimental period of nine weeks, students were required to update STEPP during the practical lessons with a self-assessment at least once per week. This would yield a total of at least nine assessed tasks with identified learning needs and plans for practice. Actual STEPP use was determined by analysing the log files and Part 1 of the student interview. ANOVAs showed that students in the no-prompt condition updated STEPP with significantly more assessed tasks (M = 14.22, SD = 8.94) than students in the prompt condition (M = 7.42, SD = 4.14), $F(1, 65) = 15.139$, MSE = 50.920, p = .00, η^2 = .189.

The interview results concerning the integration of STEPP in students' daily routine revealed that significantly more students in the no-prompt condition (67 %) than in the prompt condition (25 %) reported to update STEPP as part of their daily routine, $\chi^2(1, N = 24) = 4.196$, p = .041. The majority of the students in the prompt condition (75%) reported that they failed or forgot to update STEPP unless they were explicitly reminded to do so by their teacher. With the exception of one student in the prompt condition, all students reported that STEPP was easy to work with.

Because students in the no-prompt condition used STEPP more often than students in the prompt condition, the experiment becomes more conservative in finding possible effects of p/reflection prompts on SDL skills and learning results. Therefore, frequency of STEPP use has not been included as a covariate in the data analyses.

Observation of elaboration prompts in practical lessons. To verify if the practical lessons were held according to the condition-specific protocol the experimenter observed and scored nine randomly selected lessons from each condition. Two lessons in the prompt condition and one lesson in the no-prompt condition did not receive the maximum score of 3 points, indicating that p/reflection prompts were properly used in 77 percent of the lessons in the prompt condition and no prompts were given in 89 percent of the lessons in the no-prompt condition. Chi-square analysis revealed no significant difference between conditions concerning the realisation of the applicable protocol, $\chi^2(1, N = 80) = 3.46$, *ns.*

Observation of p/reflection prompts during supervision meetings. To verify if the supervision meetings were held according to the applicable protocol the experimenter observed and scored 15 randomly selected supervision meetings of each of

the four supervisors. All 60 meetings received the maximum score of 5 points, indicating that p/reflection prompts were properly used in the prompt-condition and not used at all in the no-prompt condition.

Self-Directed Learning Outcomes

To answer the research question concerning the effects of p/reflection prompts on students' SLD skills, the proportion of diagnostically formulated learning needs and the proportion of specific plans for practice were determined for the pretest and the posttest (see Table 5.1). As expected, repeated measures ANOVA revealed a significant interaction between test and condition on the proportion of diagnostic learning needs, $F(1, 64) = 5.950$, $MSE = .063$, $p < .025$, $\eta^2_{part} = .084$. As shown in Figure 5.2A, students in the prompt condition increased their proportion of diagnostically formulated learning needs more ($M = .31$, $SD = .33$) than students in the no-prompt condition ($M = .12$, $SD = .33$). In addition, a main effect of test was found, $F(1, 64) = 28.693$, $MSE = .063$, $p = .00$, $\eta^2_{part} = .306$. Thus, students in both conditions formulated a higher proportion of diagnostic learning needs during the posttest than during the pretest. No main effect of condition was found, $F(1, 64) < 1$, *ns*.

With regard to the proportion of specific plans for practice, repeated measures ANOVA again revealed a significant interaction between test and condition, $F(1, 64) = 4.980$, $MSE = .046$, $p < .05$, $\eta^2_{part} = .072$. As shown in Figure 5.2B, students in the prompt condition increased their proportion of specifically formulated plans more ($M = .48$, $SD = .27$) than students in the no-prompt condition ($M = .29$, $SD = .33$). In addition, a main effect of test was found, $F(1, 64) = 108.903$, $MSE = .046$, $p = .00$, $\eta^2_{part} = .626$. Thus, students in both conditions formulated a higher proportion of specific plans for practice during the posttest than during the pretest. No main effect of condition was found, $F(1, 64) < 1$, *ns*.

Table 5.1. Means, standard deviations and gain scores of proportions of diagnostic learning needs and specific plans for practice on pretest and posttest.

	No-Prompt Condition			Prompt Condition		
	Pretest M (*SD*)	Posttest M (*SD*)	Gain Score M (*SD*)	Pretest M (*SD*)	Posttest M (*SD*)	Gain Score M (*SD*)
Proportion of Diagnostic Learning Needs	.45 (.33)	.58 (.34)	.12 (.33)	.30 (.33)	.63 (.33)	.31 (.33)
Proportion of Specific Plans for Practice	.35 (.25)	.64 (.31)	.29 (.33)	.25 (.24)	.73 (.27)	.48 (.27)

Development of SDL Skills

To answer the research question concerning the development of SDL skills, the proportion of diagnostically formulated learning needs and the proportion of specific plans for practice were determined over each of the three periods (see Table 5.2). In

contrast to our expectations, repeated measures ANOVA revealed no significant interaction between period and condition on the proportion of diagnostic learning needs, $F(2, 98) = 1.904$, $MSE = .045$, *ns*. However, a marginally significant effect of condition was found, $F(1, 49) = 2.894$, $MSE = .229$, $p < .10$, $\eta^2_{part} = .056$. As can be seen from Table 5.2, students in the prompt condition scored in all three periods somewhat higher (in order, $M = .45$, $M = .61$, and $M = 64$) than students in the no-prompt condition (in order, $M = .42$, $M = .44$, and $M = .42$). In addition, a main effect of period was found, $F(2, 98) = 3.595$, $MSE = .045$, $p < .050$, $\eta^2_{part} = .068$. Thus, from period 1 to period 3 students in both conditions showed increasingly higher proportions of diagnostic learning needs.

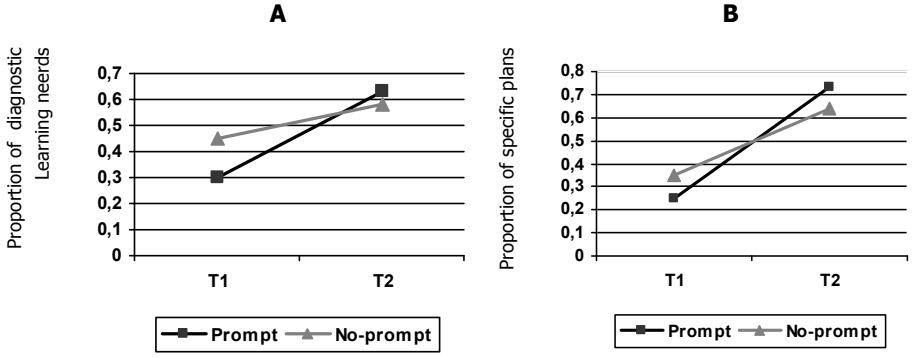

Figure 5.2. Interactions between time of test and condition on the formulation of diagnostic learning needs (A) and the drawing of specific plans for practice (B).

With regard to the proportion of specific plans for practice, repeated measures ANOVA again revealed no significant interaction between period and condition, $F(2, 96) < 1$, *ns*. Although in all three periods there seems to be a tendency for students in the prompt condition to formulate more specific plans than students in the no-prompt condition (see Table 5.2), this effect of condition is not significant, $F(1, 49) = 2.390$, $MSE = .183$, *ns.* There is also no main effect of period, $F(2, 96) < 1$, *ns*.

Learning Results

To answer the research question concerning the effect of p/reflection prompts on hairdressing skills, students' performance was assessed by their teachers. Students in the no-prompt condition received an average score of 1.69 ($SD = .32$) and students in the prompt condition received an average score of 1.67 ($SD = .33$). ANOVA revealed no significant difference between conditions, $F(1, 66) < 1$, *ns*.

Table 5.2. Means and standard deviations of proportions of diagnostic learning needs and specific plans for practice per period.

	No-Prompt Condition			Prompt Condition		
	Period 1 M (*SD*)	Period 2 M (*SD*)	Period 3 M (*SD*)	Period 1 M (*SD*)	Period 2 M (*SD*)	Period 3 M (*SD*)
Proportion of Diagnostic Learning Needs	.42 (*.27*)	.44 (*.35*)	.45 *(.35*)	.45 (*.32*)	.61 (*.34*)	.64 (*.32*)
Proportion of Specific Plans for Practice	.58 (*.31*)	.60 *(.31*)	.62 (*.33*)	.67 (*.28*)	.73 (*.35*)	.74 (*.30*)

Correlations between Learning Needs, Plans for Practice, and Learning Results

To answer the research question regarding the relation between learning results and SDL skills, that is, formulating diagnostic learning needs and drawing specific plans for practice, Pearson correlations between the three variables were computed (see Table 5.3). Over the whole group of students, significant correlations (p set at .01) were found between the proportion of diagnostic learning needs and the proportion of specific plans (r = .787), between the proportion of diagnostic learning needs and learning results (r = .339), and between the proportion of specific plans and learning results (r = .390). This indicates that the diagnostic formulation of learning needs is strongly related with the formulation of specific plans for practice. In addition, both the diagnostic formulation of learning needs and the formulation of specific plans for practice are positively related with learning results. Examination of the correlations per condition reveals that for the no-prompt condition only the formulation of diagnostic learning needs and the drawing of specific plans for practice are significantly correlated (r = .785); in this condition, there are no significant correlations with learning results. In the prompt condition, a significant correlation between the formulation of diagnostic learning needs and the drawing of specific plans for practice is found too (r =.772), but in addition there is a significant correlation between drawing specific plans for practice and learning results (r = .513). Fisher's z-tests indicated no significant differences between the strength of correlations in the two conditions.

Table 5.3. Correlations between proportion of diagnostic learning needs, proportion of specific plans, and learning results for all students.

	Proportion diagnostic learning needs	Proportion specific plans	Learning Results
Proportion diagnostic learning needs	-	.787**	.339**
Proportion Specific plans		-	.390**
Learning Results			-

** p < .01

Perceived Effectiveness of the Educational Program

In order to answer the research question if students perceive the educational program (with and without prompts) to be effective, 12 students from each condition were asked in the student interview to indicate for STEPP, for writing the plan for practice at the start of the practical lesson, and for the supervision meetings, whether it was helpful to develop their skills in formulating diagnostic learning needs and drawing specific plans for practice. Table 5.4 presents the percentages of students' responses to the interview questions.

For STEPP (student interview, Part 2) relatively more students in the prompt condition (9 out of 12) than in the no-prompt condition (3 out of 12) indicated that STEPP helped them to think more deeply about their past performance, χ^2 (1, N = 24) = 6.00, $p < .025$. In addition, relatively more students in the prompt condition (10 out of 12) than in the no-prompt condition (2 out of 12) indicated that STEPP was effective in helping them to plan future practice, χ^2 (1, N = 24) = 8.224, $p <$ .010. There was no significant difference between the number of students in the prompt condition (6 out of 12) and the no-prompt condition (3 out of 12) who indicated that they sometimes experienced difficulties expressing diagnostic learning needs and specific plans, χ^2 (1, N = 24) = 1.600 , $p > .10$.

For writing the plans for practice at the beginning of the practical lessons (student interview, Part 3), significantly more students in the prompt condition (all 12) than in the no-prompt condition (6 out of 12) perceived the writing of the plan for practice to be effective, χ^2 (1, N = 24) = 8.00, $p < .010$.

Table 5.4. Percentages of student answers on the interview questions regarding the effectiveness of the p/reflection prompts.

	No-Prompt Condition (n = 12)		Prompt Condition (n = 12)	
	Yes (%)	No (%)	Yes (%)	No (%)
STEPP helped to diagnose	25	75	75	25
STEPP helped to plan	17	83	83	17
Difficulties experienced during updating STEPP	25	75	50	50
Written plan for practice helped to plan and focus	50	50	100	0
Supervision meetings helped to understand causes of weak performance	50	50	83	16
Supervision meetings helped to formulate more specific planning	50	50	83	16

For the supervision meetings (student interview, Part 4), there was no significant difference between the number of students in the prompt condition (10 out of 12) and the no-prompt condition (6 out of 12) that indicated that the meetings helped them to gain a better understanding of causes of their weak performance. In addition, no significant difference was found regarding the number of students in the prompt condition (10 out of 12) and the no-prompt condition (6 out of 12) that indicated that the meetings helped them to formulate specific plans for practice, χ^2 (1, N = 24) = 3.000, p > .050.

Discussion

The aim of the present study was to examine the effects of p/reflection prompts on students' SDL skills and learning results. P/reflection prompts were implemented in the development portfolio, practical lessons and supervision meetings. For the first research question, regarding the effects of p/reflection prompts on the SDL skills 'formulating diagnostic learning needs' and 'drawing up specific plans for practice', our results largely support the stated hypotheses. After the intervention, students who were provided with the p/reflection prompts formulated more diagnostic learning needs and drew more specific plans for practice than students who did not receive these prompts. During the intervention, there was a tendency in the same direction in favour of the prompt condition. These findings are fully in line with other research that has indicated that prompting is a promising method to elicit p/reflective activities, which help students become aware of what they did or should have done and what and how to do next (Butler, 1998; Chi, de Leeuw, Chiu, & LaVancher, 1994; Sobrol, 2000).

With respect to the second research question, regarding the effects of the p/reflection prompts on learning results, the findings did not confirm our hypothesis. No differences between conditions were found in acquired hairdressing skills. Although, in the prompt condition a positive correlation was found between drawing specific plans for practice and learning results; in the no prompt-condition, there were no significant correlations between SDL skills and learning results. This might possibly suggest that prompting helps students to shape their practice in such a way that it contributes to learning. That,nonetheless, no difference between the conditions on learning results was found may be due to the short duration of the intervention period and the measured type of hairdressing skill. The hairdressing skill used to measure results, permanent weaving, is a relatively easy skill that can easily be developed to a 'satisfactory' level within nine weeks time. So, a ceiling effect occurred. A more difficult hairdressing skill, such as cutting or colouring hair, would probably led to more differentiation between conditions in a period of nine weeks. Future research should focus on more difficult skills, practiced simultaneously with SDL skills over a longer period of time. In addition, the long term effects of

p/reflection prompts and transfer of acquired SDL skills to other domains could be investigated.

Regarding the third research question on the relation between SDL skills and learning results, our hypotheses were confirmed by the results. There appeared to be a positive relationship between the formulation of diagnostic learning needs and drawing specific plans for practice, between the formulation of diagnostic learning needs and learning results, and between drawing specific plans for practice and learning results. This is in accordance with Zimmerman's (1998) notion of the positive effects of diagnosing (reflections) and planning (preflection) on student learning results. It should be stressed, however, that our experimental design does not allow conclusions about the direction of the relationships. Thus, it is not clear if higher SDL skills lead to better learning results, or, if students with better learning results show higher SDL skills. In addition, other factors might have influenced the relations between SDL skills and learning results (i.e., spurious correlation). Future research, using experimental designs, should further examine relationships between SDL skills, learning results and mediating variables such as students' general ability.

The hypothesis for the fourth research question, regarding students' perceptions of the effectiveness of the educational program, was partly confirmed by the interview results. Students who received p/reflection prompts perceived the development portfolio as more effective in helping them to formulate diagnostic learning needs and drawing specific plans for practice than students who did not receive the prompts. Furthermore, all students in the prompt condition perceived the writing of the plan for practice during practical lessons to be effective, whereas only half of the students in the no-prompt condition did. No differences in student perceptions were found for the practical lessons and the supervision meetings.

Additional qualitative findings from the student interviews suggest that a considerable number of students – also in the prompt condition – experienced the formulation of learning needs and the drawing up of plans for practice as a lengthy and effortful process. This is in line with Newton's (2000) notion that undertaking meaning-oriented learning activities, such as diagnosing and planning performance, takes much time and energy.

Furthermore, additional qualitative findings also show that most of the students preferred prompts provided by reflective dialogue in the practical lessons and supervision meetings to prompts provided by questions in the development portfolio. Several students indicated that they did not feel confident or capable of putting their thoughts into words while updating their development portfolio. As one student explained: " … I knew what I wanted to say, but I did not know how to write it. I just could not find the right words". Instead, these students preferred to diagnose their performance or draw up plans for practice together with their teacher or supervisor, because the personal interaction then helped them to put their thoughts into words. At least for some students in on-demand secondary vocational education,

reflective dialogue during practical lessons and supervision meetings seems more desirable than written questions in a pre-structured development portfolio.

A study related to the use of written prompts versus prompting in dialogue was conducted by Van den Boom, Paas, Van Merriënboer, and Van Gog (2004). They used a factorial design with the factors written reflection prompts and tutor feedback. Feedback provided by a tutor had more positive effects on the development of university students' SDL skills than written reflection prompts, and the combination of tutor feedback and written reflection prompts yielded most positive effects. Future research should examine the differential effects of p/reflection prompts provided by tutors and written text and search for guidelines of how both types of prompts could best be combined to help students develop their SDL skills.

The current study had some limitations. First, although the actual use of the development portfolio and the correct implementation of p/reflection prompts in the practical lessons and supervision meetings have been controlled for, our study lacked control for some other variables. For example, we do not know if students reached diagnoses of their weak performance that made sense, or if they actually executed their written plans for practice during the practical lessons. Future studies should pay more attention to these fine-grained processes. Second, as mentioned before, the differential effects of the three types of p/reflection prompts were not investigated. This makes it impossible to draw conclusions on the detached effects of p/reflection prompts in development portfolios, practical lessons and supervision meetings. Future research should aim to disentangle such effects on students' SDL skills and learning results.

To conclude, we have shown that reflection prompts can be included in a development portfolio, in practical lessons where students work on self-selected learning tasks, and in supervision meetings. Our findings reveal that providing students in on-demand secondary vocational education with such p/reflection prompts is a promising approach to help them engage in more meaning-oriented learning activities and develop skills such as formulating diagnostic learning needs and drawing up specific plans for practice. These are important skills to become self-directed learners (Knowles, 1975). In addition to the positive effects on SDL skills, the inclusion of p/reflection prompts also positively influences students' perception of the on-demand educational program. Our results contribute useful guidelines for the design of on-demand educational programs that support the development of SDL skills and help students to become self-directed learners.

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CHAPTER 6

General Discussion

This final chapter first describes the main findings and conclusions of the literature study and the three reported empirical studies. The effects of using the development portfolio and giving portfolio-based advice in the first year of the hairdressing program are discussed for, in order, students' self-directed learning skills, learning results, and students' and supervisors' perceptions of the learning environment. Then, theoretical implications of the reported studies and directions for future research are discussed. Finally, practical implications are provided.

Main findings and conclusions

To address individual differences between students, forms of on-demand education are becoming increasingly popular in secondary vocational education in the Netherlands. This educational approach is based on the idea that students should have the opportunity to plan their own learning trajectory, for example, by giving them control over the selection of learning tasks. In order to plan a good trajectory and direct their learning, students need to possess basic self-directed learning (SDL) skills (Knowles, 1975). However, freshmen often come from a tradition of teacher-directed learning in which they did not have to use or develop SDL skills. Thus, there is a clear risk to incorrectly assume that students already have the basic SDL skills prerequisite for successful learning in on-demand education.

A literature study (Chapter 2) was conducted to identify the factors influencing the effectiveness of on-demand education. The Informed Self-Directed Learning (ISDL) model specifies how on-demand education can be designed in such a way that students are adequately supported to direct their own learning. The model depicts three informational resources supporting students' process of task selection and helping them to develop SDL skills: (1) a structured development portfolio, (2) a protocol for giving advice on how to improve SDL skills, and (3) metadata of the learning tasks from which a selection can be made. The effects of the first two resources were further investigated in three empirical studies, addressing the main research question of this dissertation: *What are the effects of a development portfolio and portfolio-based advice on the development of students' SDL skills in on-demand secondary vocational education?*

With respect to students' SDL skills, three skills were distinguished and examined: (1) self-assessing performance, (2) formulating learning needs, and (3) planning future learning. In a case study and two experimental studies, the digital development portfolio Structured Task Evaluation and Planning Portfolio (STEPP) and protocols for providing advice were implemented in three different ways. In the successive studies, first-year hairdressing students were provided with, in order: (1) STEPP, (2) STEPP in combination with portfolio-based advice (i.e, feedback and feedforward) during two-weekly supervision meetings, and (3) p/reflection prompts (i.e., 'why' and 'how' questions) in an extended version of STEPP, in a reflective dialogue during supervision meetings, and in a reflective dialogue during practical lessons.

In the next sections, the main findings and conclusions regarding the effectiveness of development portfolios and advice protocols are provided for the three SDL skills (assessing own performance, formulating learning needs, and planning of practice), the learning results, and students' and supervisors' perceptions of the learning environment.

Self-directed learning skills

Self-assessment. The effect of STEPP and its combination with portfolio-based advice (i.e., feedback and feedforward) on self-assessment skills were respectively measured in the case study and the first experimental study. In the case study, students' and supervisors' perceived effectiveness of STEPP was determined; in the first experimental study, the proportion of agreement between student assessments and teacher assessments was calculated as a measure of the quality of acquired self-assessment skills.

Results reveal that in the case study students perceived the assessment functionality in STEPP as useful to help them familiarize themselves with the performance standards for assessing the hairdressing skills. Results of the use of STEPP combined with portfolio-based advice (first experimental study) revealed that students not fully mastered the assessment skills during the intervention period, showing only a moderate proportion of agreement between student assessments and teacher assessments. Furthermore, students who received both feedback and feedforward during the supervision meetings did not develop their self-assessment skills to a higher level than students who only received feedback.

It can be concluded that students perceived both STEPP and the given advice as helpful to develop their self-assessment skills, but for the actual development of these skills to an acceptable level an intervention period of 20 weeks, with only 10 supervision meetings, is probably too short. As stated by McDonald and Boud (2003), self-assessment is a highly complex skill that develops over a relatively long period of time. It needs extensive instruction and practice before an acceptable level is reached.

Formulation of learning needs. The effects of STEPP on students' skill to formulate learning needs were measured in all three studies. In the case study, only the perceptions of students and their supervisor regarding the effectiveness of STEPP to formulate learning needs were examined. In the two experimental studies, in addition the perceived effect of advice on the formulation of learning needs was determined. Furthermore, in these two studies the proportion of diagnostically formulated learning needs was calculated, which are learning needs based on a deep diagnosis of weak performance.

Results from the case study showed that both students and their supervisor perceived STEPP to be effective to gain a better understanding of strengths and weaknesses in performance. Results from the first experimental study reveal that students who received advice on how to formulate their learning needs more effectively, formulated more diagnostic learning needs and perceived the supervision meetings as more effective than students who received only feedback on their formulated learning needs. In line with these results, students who received p/reflection prompts in the second experimental study also formulated more diagnostic learning needs, and perceived the supervision meetings and STEPP as more effective than students who did not receive p/reflection prompts.

It can be concluded from these findings that the use of a development portfolio, especially in combination with portfolio-based advice using reflective dialogue, is a promising approach to help students gain more insight in their weaknesses and to formulate diagnostic learning needs. This approach stimulates students to engage in more meaning-oriented learning activities and helps them to formulate their learning needs in a more diagnostic fashion. Providing only feedback appears to be far less effective, resulting in more action-oriented learning activities and the formulation of learning needs in a superficial fashion. These findings confirm the notion that providing students with a portfolio does not automatically result in effective reflection. In order to make it effective, students must discuss the contents of the portfolio with their teacher or supervisor (Tillema & Smith, 2000), they should become engaged in reflection (Borko, Michalec, Timmons, & Siddle, 1997; Wade & Yarbrough, 1996), and they should be stimulated to perform meaning-oriented learning activities (Mansvelder-Longayroux, Beijaard, & Verloop, 2007).

Planning of practice. The effects of the development portfolio on the skill to draw up plans for practice by selecting appropriate learning tasks was measured in all three studies, but with a slightly different focus in each study. In the case study, only the perceived effectiveness of STEPP to help select appropriate tasks was examined. In the two experimental studies, in addition the perceived effectiveness by students and supervisors of STEPP in combination with different types of advice was measured. Furthermore, in the first experimental study, students received a score for the appropriateness of their task selections; in the second experimental study, the emphasis shifted from selecting appropriate tasks to drawing up plans for practice in order to improve future performance.

Results revealed that in the case study STEPP was perceived by students as being effective in helping them to become aware of weaknesses in performance and to make them more prone to select tasks remediating these weaknesses. As for the formulation of learning needs, in the first experimental study it was found that extra support in the form of portfolio-based advice (i.e., feedback and feedforward) on the selection of tasks was an effective supplement to the use of STEPP. Students who received the portfolio-based advice perceived the supervision meetings as more effective than students who received only feedback. Moreover, results from the second experimental study showed that students who received p/reflection prompts drew up more specific plans for practice than students who did not receive these prompts. Furthermore, students who received p/reflection prompts perceived STEPP and the plans for practice during practical lessons as more effective than students who did not receive the prompts.

It may be concluded that providing students with a structured development portfolio like STEPP with both a reflection and a preflection functionality, in combination with portfolio-based advice on making plans for future learning, is a promising approach to help students direct their learning. Furthermore, in line with research on reflective dialogue (e.g., Katz, Allbritton, & Connelly, 2003) and prompting (e.g.,

Sobrol, 2000), adding p/reflection prompts to the educational program, such as extra questions in the development portfolio and reflective dialogue during supervision meetings and practical lessons, is an effective approach to engage students in meaning-oriented learning activities that contribute to drawing up more specific plans for practice.

Learning results

The two experimental studies examined the effects of the development portfolio and advice on students' learning results in the domain of hairdressing. In the first experimental study, the learning results were measured by counting the number of approved practical assignments and the number of acquired certificates. In the second experimental study, learning results were measured by asking the teacher to rate for each student the performance of the hairdressing skills this student had been practicing during the intervention period.

Results showed that in the first study, students in the advice condition who received both feedback and feedforward had more approved practical assignments and slightly more acquired certificates than students in the feedback-only condition. In the second study, results revealed no significant difference between the learning results of students in the prompt and the no-prompt condition. However, the scores on these ratings showed that a ceiling effect occurred, preventing the occurence of differences in learning results between conditions. Nevertheless, in this study a positive correlation was found between the formulation of diagnostic learning needs and learning results, and between drawing up specific plans for practice and learning results for students in the prompt condition.

From the findings of the first experimental study it may be concluded that providing students with portfolio-based advice influences their learning results more positively than providing them with merely feedback. A plausible explanation for this finding is that the advice helped students to engage in more meaning-oriented learning activities (e.g., diagnosis of performance), which in turn enabled them to draw up more specific plans for practice and select more appropriate learning tasks. Obviously, this has positive effects on the number of approved assignments and acquired certificates. The correlations between the formulation of diagnostic learning needs and learning results, and between drawing up specific plans of practice and learning results, also confirm the idea that meaning-oriented learning activities contribute to better learning results. However, no firm conclusions can be drawn on the exact nature of this relationship.

Students' and supervisors' perceptions

From the interviews conducted in the three studies, it was found that the majority of the interviewed students experienced difficulties with directing their learning at the start of the training program. This confirms earlier research findings on learner

controlled instruction, showing that students are often overwhelmed by the amount of choice provided to them (for an overview, see Williams, 1996). Students in the three studies also mentioned that after a couple of weeks, they had become acquainted with the on-demand learning environment and felt less overwhelmed. Students frequently mentioned that especially the supervision meetings in which they received advice in the form of feedback and feedforward (first experimental study), and the supervision meetings and practical lessons in which they received advice in the form of reflective dialogue (second experimental study), helped them to feel more competent to direct their own learning.

Furthermore, students indicated that they perceived STEPP as an effective tool to help them gain a better understanding of relevant performance standards, think about learning needs, and select appropriate learning tasks. Regarding the extended version of STEPP in the second experimental study, students perceived it to be highly effective in helping them to engage in more meaning-oriented learning activities. However, students indicated that although STEPP provided a lot of structure and guidance, they also highly appreciated the portfolio-based advice they received – either by given feedback and feedforward or through reflective dialogue. In line with this finding, it was frequently mentioned by students that they experienced difficulties in putting their thoughts into words when formulating learning needs or causes of weak performance in STEPP: they preferred reflective dialogue to updating their portfolio. Students who received only feedback did not perceive this information to be effective, because it did not provide them with any useful directions to improve their SDL skills.

Supervisors also perceived STEPP and the portfolio-based advice as effective approaches to help students develop their SDL skills. They indicated that, in general, students rarely engage in diagnosing their performance. But through updating STEPP and, especially, discussing STEPP's content with their supervisors students were perceived to be better able to diagnose their performance and unravel underlying causes of weak performance.

It may be concluded from the interviews that both students and supervisors perceived the development portfolio and the portfolio-based advice to be effective measures to help students develop their SDL skills. Especially the portfolio-based advice and the reflective dialogues *in combination with* the use of the development portfolio are highly appreciated by the students.

Theoretical implications and future research

The results of the three empirical studies contributed to verification and further specification of the ISDL-model. According to the model, the cyclical process of self-directed task selection will be more effective if students have at their disposal at

least three information resources: a development portfolio, advice and metadata of available tasks, because these resources help students to develop their SDL skills. The effectiveness of a development portfolio and advice depicted in the model were empirically tested. As described above, the research results confirm that providing students with these two resources helped them to improve their SDL skills. Furthermore the research results also provided directions for further specification of these two resources in the ISDL-model.

With respect to the development portfolio, the second experimental study provided more insight in how the portfolio should be designed to help students engage more in meaning-oriented learning activities. It was shown that adding extra 'why' and 'how' questions to the portfolio to prompt students to diagnose their past performance and plan future learning is an effective approach to help them use the portfolio more effective.

Regarding the advice, the two experimental studies provided more insight in how a strategic advisory model can be implemented using different manners of delivering the advice, and delivering the advice at a different rate of recurrence. Advice can be implemented by (a) providing both feedback and feedforward during supervision meetings every 2-3 weeks, (b) using reflective dialogue during supervision meetings, and (c) using reflective dialogue during practical lessons.

Some elements of the ISDL-model were not yet empirically examined in the three studies described in this dissertation. For further theory building and further specification of the ISDL-model research should focus on at least the following aspects. First, the fading of the procedural and strategic advice needs to be examined in future research. This research might especially focus on standards that indicate when guidance can diminish and what kind of advice should be provided. The outcomes of such studies can yield more specific guidelines for the improvement of students' task selection process. Second, the effects of task metadata was not specifically examined in the empirical studies, but integrated in the development portfolio where students selected new learning tasks on the basis of some basic features. Future research needs to examine the effects of providing task metadata more explicitly, and investigate how those metadata should best be presented (e.g., time, frequency, mode of presentation) in order to be sufficient and necessary for students to make appropriate decisions regarding task selection.

In addition to new research on aspects of the ISDL-model that were not empirically studied in this dissertation, future research should also meet the limitations of the three reported studies. First, future research should investigate long-term interventions to gain more insight in the development of SDL skills over time. The interventions of the studies described in this dissertation lasted only 10 to 20 weeks. This is a relatively short period of time to develop highly complex skills. It may be sufficient to examine short-term effects of the development portfolio and advice on students SDL skills, but it is probably insufficient to reach indirect effects on learning outcomes and transfer.

Second, future quasi-experimental research in real school environments should be complemented with experimental research in controlled settings. The studies reported in this dissertation were conducted in real school environments, and provided insight in the many factors and interacting forces that influence the effectiveness of portfolio use and portfolio-based advice. However, more controlled studies are needed to examine the specific effects of variations in content and design of the development portfolio and portfolio-based advice. Such research on the specific effects of small design variations is necessary for further theory building and to allow for generalisation and standardisation of findings (Norman & Schmidt, 2000).

Third, future research might use process measures to examine the effects of development portfolios and advice on students' SDL skills more closely. The studies described in this dissertation used quantitative measures (logfiles of STEPP) to measure effects on the development of students' SDL skills, in addition to the qualitative measures (supervisors' and students' perceptions) as used in the vast amount of portfolio research (Zeichner & Wray, 2001). However, these measurements provide little information on the actual process of portfolio use. Thinking-aloud protocols (Young, 2005) of students who are updating their portfolio and recordings of reflective dialogues during supervision meetings could provide more insight in the processes that underlie the application and development of SDL skills.

Finally, the number of approved practical assignments, acquired certificates, and performance scores for hairdressing skills were used as measures of learning results. In future research, multiple measurements for assessing students'—development of—domain specific task performance should be used. Using a longitudinal approach and measuring the development of SDL skills and domain-specific skills at regular moments in time will give more insight in how these skills develop and interact.

Practical Implications and Conclusion

From the results of the three empirical studies, several practical implications and guidelines can be provided for the design and implementation of development portfolios and portfolio-based advice in on-demand education.

First, with respect to development portfolios, it is advisable they address the three basic SDL skills prerequisite for successful on-demand education: Self-assessment, formulation of learning needs, and planning of future learning. Self-assessment skills should be facilitated by providing students with the performance standards for assessing all skills relevant for performed learning tasks as well as the possibility to upload not only self assessments but also teacher and peer assessments. With regard to the formulation of learning needs, the portfolio should be structured in such a way that extra support is given for skills assessed as insufficient: This support may consist of additional questions on causes of weak performance and prompts to formulate learning needs in a diagnostic fashion. The formulated needs

should be treated as input for drawing up specific plans for practice, so that they enable an appropriate selection of learning tasks that must also be added to the portfolio.

Second, regarding the implementation of portfolios, it is not only important to explain the aim of regularly updating a development portfolio (cf., van Tartwijk, Driessen, van der Vleuten, & Stokking, 2007), but also to fully embed its use in the educational program, making it compulsory for all students to update their portfolio at scheduled moments in the program. This helps students to make updating their portfolio (i.e., becoming engaged in reflection and preflection) part of their educational routine.

Third, for an effective use of the portfolio students should receive portfolio-based advice to foster their SDL skills. Only using the portfolio will typically not be enough to reach this goal. With respect to the protocol for advice, one should provide feedback on how well the SDL skills are already developed and, even more important, directions on how to improve or further develop these skills. Reflective dialogue is a powerful method for giving such advice.

To conclude, the studies reported in this dissertation yield promising findings for portfolio use in on-demand education. In general, providing students with development portfolios in combination with portfolio-based advice has positive effects on their SDL skills and learning results. At least, the reported studies show that it is well possible to help students with their development of SDL skills. While some questions are left unanswered and new ones have risen, this dissertation provides practical guidelines for helping students to direct their own learning in on-demand secondary vocational education.

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Summary

In the first chapter of this dissertation, the main research question is introduced. On-demand education is frequently introduced in secondary vocational education to address individual differences between students. In this educational approach students can plan their own learning trajectory by selecting learning tasks that fit their needs. This requires that students have well developed self-directed learning (SDL) skills. However, students often come from a tradition of teacher-directed education and have ill-developed SDL skills. If students have no SDL skills to begin with, on-demand education should be designed in such a way that freshmen are compensated for their lack of SDL skills and supported to develop these skills throughout the educational program. The studies reported in this dissertation investigate how students in an on-demand hairdressing program in secondary vocational education can be supported to develop SDL skills by (a) a digital development portfolio, and (b) portfolio-based advice. The main research question addressed in the studies in this dissertation is: "What are the effects of a development portfolio and portfolio-based advice on the development of students' SDL skills in on-demand secondary vocational education?".

Chapter 2 describes the theoretical framework on which the empirical studies in Chapters 3-5 are based. From a literature study, the Informed Self-Directed Learning (ISDL) model is deduced, which specifies how on-demand education can be designed in such a way that students are adequately supported to exert control over the selection of learning tasks in an effective way. The mechanisms presented in the ISDL model are based on cognitive, metacognitive, and affective explanations for the positive as well as the negative outcomes of self-directed learning and learner control. According to the model, the cyclical process of self-directed task selection (i.e., performance of the learning tasks, assessment of performance, and selection of the next learning task) will be more effective if students are enabled to make informed task selections. Such selections require that students have at least three information resources at their disposal: a development portfolio, advice on which tasks would best match their learning needs and why, and metadata of available tasks. The first two resources of the model were empirically tested in a hairdressing program in secondary vocational education.

Chapter 3 describes a case study in which 10 first-year hairdressing students were provided with a Structured Task Evaluation and Planning Portfolio (STEPP), which was designed to help them develop three basic self-directed learning skills: assessing the quality of own performance, formulating learning needs, and selecting learning tasks. The chapter gives a detailed description of the design of three functionalities in STEPP to foster these SDL skills. The implementation of STEPP, based

on the theoretical assumptions provided in Chapter 2, is also described. Students were free to use STEPP and could voluntarily subscribe for supervision meetings in which the content of their portfolio was discussed and advice was provided on how to improve their SDL skills. The perceived effectiveness of STEPP to help students direct their learning was examined through individual interviews with all students and their supervisor. In addition, students were asked to indicate factors that influenced their actual use of STEPP.

Results showed that students who frequently used the development portfolio perceived it to be effective in helping them to direct their learning. The supervisor also indicated that students who frequently used STEPP were better able to assess their performance, were more aware of their learning needs, and selected more appropriate tasks than students who used STEPP less frequently. For factors influencing actual STEPP use, it was found that making the updating of STEPP part of the daily routine is the best way to ensure its frequent use. However, students who had prior hairdressing skills, prior SDL skills, or no affinity with computers used STEPP less frequently than students who did not have these characteristics. Furthermore, it was found that students with low prior hairdressing and SDL skills paid more visits to their supervisor. A positive relation was found between the number of times STEPP was updated and the number of visits paid to the supervisor. To investigate the effects of STEPP in combination with compulsory supervision meetings in which students were given portfolio-based advice, an experimental study was conducted with a larger number of participants.

The experimental study described in *Chapter 4* examined the effects of providing first-year hairdressing students (N = 43) with advice during scheduled weekly supervision meetings, in addition to compulsory weekly use of STEPP, on students' SDL skills (i.e., self-assessment of performance, formulating learning needs, and selecting learning tasks) and learning results (i.e., hairdressing skills). Students were randomly assigned to one of two conditions. Students in the advice condition (n = 21) were provided with advice that consisted of both feedback on self-assessments, formulated learning needs and selected tasks, and feedforward on how to improve SDL skills. Students in the feedback-only condition (n = 22) only received feedback. It was hypothesized that students who received advice would develop their SDL skills better than students who only received feedback, because the advice provided them with more directions for the development of their SDL skills. In addition, it was predicted that because of this positive influence of advice on the development of SDL skills, students in the advice condition would be better able to recognize their learning needs and select appropriate learning tasks, which in turn would have a positive influence on learning results (i.e., hairdressing skills).

Results revealed that, in accordance with the hypothesis, students in the advice condition formulated more diagnostic learning needs and selected more appropriate learning tasks than students in the feedback-only condition. However, no significant effects were found on self-assessment skills and task selection. For learning results,

the students in the advice condition completed more practical assignments in which their hairdressing skills were assessed as sufficiently developed, and received more certificates as a proof of fully developed hairdressing skills than students in the feedback-only condition. Interviews revealed that students who received advice appreciated the supervision meetings higher and perceived them as more effective than students who received only feedback. Students apparently do not only want to be informed on the (in)appropriate application of their SDL skills (i.e., verification), but also on how to improve these skills. Furthermore, many students indicated that they preferred the dialogues with their teacher or supervisor about their learning needs and selections of learning tasks to only formulating and writing them in STEPP. In line with this finding, several students and supervisors mentioned that they appreciated the occassional reflective dialogues during practical training sessions. By asking students 'why' and 'how' questions, they are systematically guided in their thinking process. The effectiveness of the technique and principles of reflective dialogue on students' SDL skills and learning results was further investigated in the second experimental study.

Chapter 5 describes an experimental study in which reflective dialogue and the principle of asking 'why' and 'how' questions are implemented as three p/reflection prompts in the educational program: (a) extra questions in an extended version of STEPP to prompt students to formulate diagnostic learning needs and draw up specific plans concerning the focus of future learning tasks, (b) reflective dialogue during supervision meetings to help students diagnose their performance and plan future learning, and (c) reflective dialogue on students' plans for practice during the practical lessons. The effects of these p/reflection prompts on students' SDL skills and learning results in the hairdressing domain are examined. Concerning the SDL skills in this study the focus was on formulating diagnostic learning needs and drawing up specific plans for future learning. Students were randomly assigned to a prompt condition with reflection prompts (n = 31) and a no-prompt condition (n = 36), in which the original version of STEPP was used and students did not engage in any reflective dialogue during supervision meetings or practical lessons. It was hypothesized that students who received the p/reflection prompts would be more engaged in meaning-oriented learning activities (i.e., diagnose and plan performance) and therefore formulate more diagnostic learning needs and draw up more specific plans for practice than students who did not receive the prompts. For learning results it was predicted that students in the prompt condition would achieve higher learning results than student in the no-prompt condition, because the positive effects of the p/reflection prompts on students' skill to diagnose performance and draw up specific plans for practice would enable them to select more appropriate tasks, resulting in higher learning results.

Results confirmed the hypothesis on the positive effects of p/reflection prompts regarding the SDL skills, showing that students in the prompt condition formulated more diagnostic learning needs and drew more specific plans for practice than

students in the no-prompt condition. Regarding the effects of the prompts on learning results, the hypothesis was not confirmed; no significant differences were found between conditions with respect to acquired hairdressing skills. However, a significant correlation between diagnostically formulated learning needs and learning results, and between specific plans for practice and learning results was found for students in the prompt condition. Furthermore, students in the prompt condition perceived STEPP, the supervision meetings, and the plans for practice as more effective in helping them to engage in meaning-oriented learning activities than students in the no-prompt condition.

Finally, *Chapter 6* presents an overview of the results and general conclusions of the studies presented in Chapters 3-5. The general conclusions described in this chapter pertain to the effectiveness of development portfolios and portfolio-based advice on students SDL skills and learning results. It is concluded that providing students with a development portfolio in combination with advice – either provided directly or via p/reflection prompts (e.g., reflective dialogue) – is a promising approach to engage them in meaning oriented learning activities and so help them to develop their SDL skills. Especially skills to formulate learning needs and plan future learning are positively influenced by providing students with advice or p/reflection prompts.

Nederlandse samenvatting

Het eerste hoofdstuk van dit proefschrift beschrijft de onderzoeksvraag. Om tegemoet te komen aan individuele verschillen tussen leerlingen wordt het middelbaar beroepsonderwijs (MBO) steeds vaker vormgegeven volgens de principes van vraaggestuurd onderwijs. Binnen dit type onderwijs krijgen leerlingen de vrijheid zelf hun leertraject uit te zetten en te bepalen welke leertaken ze willen uitvoeren om hun persoonlijke leerdoelen te behalen. Dit betekent dat leerlingen het eigen leerproces goed moeten kunnen sturen en daarvoor ook de benodigde zelfsturingsvaardigheden moeten bezitten. Echter, leerlingen die instromen in het MBO komen vaak van scholen waarbinnen de sturing door de docent wordt gegeven. Zij zijn hierdoor niet geoefend in het zelf sturen van hun eigen leertraject. Ze hebben niet geleerd om hun eigen taakprestaties te beoordelen, verbeterpunten te formuleren gebaseerd op een analyse van de taakprestatie en taken te selecteren die bijdragen aan hun leerproces. Van leerlingen die deze vaardigheden niet of nauwelijks bezitten, mag niet worden verwacht dat ze zonder begeleiding in staat zijn hun leertraject vorm te geven als ze instromen in een vraaggestuurde MBO-opleiding. De opleiding moet daarom op een dusdanige wijze worden ontworpen dat leerlingen vanaf het begin worden ondersteund in het ontwikkelen van deze vaardigheden en dat deze ondersteuning gedurende de opleiding geleidelijk wordt afgebouwd.

In de beschreven studies in dit proefschrift is onderzocht hoe leerlingen van een vraaggestuurde kappersopleiding ondersteund kunnen worden bij de ontwikkeling van hun zelfsturingsvaardigheden door middel van (a) een ontwikkelingsportfolio en (b) advies gebaseerd op de inhoud van het portfolio. De onderzoeksvraag die in alle studies centraal heeft gestaan, is: "Wat zijn de effecten van het werken met een ontwikkelingsportfolio en het geven van advies gebaseerd op de inhoud van het portfolio op de ontwikkeling van de zelfsturende vaardigheden van leerlingen in vraaggestuurd middelbaar beroepsonderwijs?".

Hoofdstuk 2 beschrijft het theoretisch raamwerk waarop de studies die gerapporteerd worden in de hoofdstukken 3 tot en met 5 gebaseerd zijn. De uitgevoerde literatuurstudie richtte zich op cognitieve, meta-cognitieve en affectieve verklaringen voor zowel positieve als negatieve gevolgen van zelfsturend leren en leerlingsturing. Dit resulteerde in het 'Informed Self-Directed Learning' (ISDL) model waarin gespecificeerd is hoe vraaggestuurd onderwijs vormgegeven kan worden. Volgens het model zijn leerlingen beter in staat om hun eigen leerproces te sturen als zij voldoende informatie ter beschikking hebben om goede keuzes te maken met betrekking tot zelfbeoordeling, het formuleren van leerdoelen en het selecteren van taken. Dit betekent dat leerlingen tenminste drie informatiebronnen tot hun beschikking moeten hebben: (a) een ontwikkelingsportfolio, (b) advies over welke leertaak het best

past bij hun leerbehoefte en waarom en (c) metadata van de taken waaruit een keuze gemaakt kan worden. De eerste twee informatiebronnen zijn empirisch onderzocht bij een kappersopleiding binnen het MBO.

Hoofdstuk 3 beschrijft een casestudie waarin 10 eerstejaars kappersleerlingen werkten met een geStructureerd Taak- Evaluatie en Plannings Portfolio (STEPP). Dit portfolio is zo ontworpen dat het leerlingen ondersteunt bij het ontwikkelen van drie basale zelfsturingsvaardigheden: het beoordelen van de eigen prestatie, het formuleren van verbeterpunten en het selecteren van leertaken. Leerlingen bepaalden zelf of ze STEPP al dan niet gebruikten en zij schreven zich vrijwillig in voor supervisiegesprekken. Hierin besprak de leerling met de mentor de inhoud van het portfolio en kreeg hij of zij advies over hoe de zelfsturingsvaardigheden konden worden verbeterd. Op basis van individuele interviews met de mentor en alle leerlingen werd de gepercipieerde effectiviteit van STEPP op het verbeteren van de zelfsturingsvaardigheden van de leerlingen onderzocht. Bovendien werd aan de leerlingen gevraagd welke factoren invloed hadden gehad op het gebruik van STEPP.

Uit de studie blijkt dat leerlingen die het ontwikkelingsportfolio vaak gebruiken, aangeven dat het werken met het portfolio hen heeft geholpen bij het sturen van hun eigen leerproces. De mentor geeft ook aan dat studenten die STEPP frequent gebruiken, beter in staat zijn om hun prestaties te beoordelen, zich meer bewust zijn van hun verbeterpunten en geschiktere taken selecteren dan leerlingen die STEPP minder vaak gebruiken.

Met betrekking tot factoren die van invloed zijn op het gebruik van STEPP blijkt, dat wanneer het gebruik van STEPP behoort tot de dagelijkse routine van de leerling, dit zeer bevorderlijk is voor een frequent gebruik van het portfolio. Echter, leerlingen die al de nodige kappersvaardigheden of zelfsturingsvaardigheden bezitten, of geen affiniteit hebben met computers, gebruiken STEPP minder vaak dan leerlingen zonder deze karakteristieken. Bovendien blijkt dat leerlingen die hun kappersvaardigheden of zelfsturingsvaardigheden nog niet hebben ontwikkeld, zich vaker inschrijven voor de supervisiegesprekken. Een positieve relatie is gevonden tussen het aantal keren dat STEPP is gebruikt en het aantal supervisiegesprekken dat de leerling voert.

Hoofdstuk 4 beschrijft een experimentele studie, waarin het effect van het geven van advies aan eerstejaars kappersleerlingen (N = 43) tijdens wekelijkse supervisiegesprekken als aanvulling op het verplicht gebruik van STEPP onderzocht is op de zelfsturingsvaardigheden (het zelf beoordelen van prestatie, formuleren van verbeterpunten en het selecteren van taken) en de leerresultaten (kappersvaardigheden) van deze leerlingen. Leerlingen werden op basis van toeval toegewezen aan één van de twee condities. Leerlingen in de adviesconditie (n = 21) kregen advies dat bestond uit zowel feedback op de zelfbeoordelingen, geformuleerde verbeterpunten en geselecteerde taken, als feedforward over hoe de zelfsturingsvaardigheden verbeterd konden worden. Leerlingen in de feedbackconditie (n = 22) ontvingen alleen feedback. De hypothese was dat leerlingen die advies ontvangen hun zelfsturingsvaar-

digheden beter ontwikkelen dan leerlingen die alleen feedback krijgen, omdat het advies hen meer handvatten geeft omtrent hoe ze hun zelfsturingsvaardigheden kunnen verbeteren. Verder werd verwacht dat vanwege de positieve invloed van het advies leerlingen in de adviesconditie beter in staat zijn om hun verbeterpunten aan te geven en geschikte taken te kiezen en dat dit weer een positieve invloed heeft op de leerresultaten (kappersvaardigheden).

Resultaten laten zien dat, in overeenstemming met de hypothese, leerlingen in de adviesconditie meer diagnostische leerdoelen formuleren dan leerlingen in de feedbackconditie. Er zijn echter geen significante effecten gevonden voor het zelfbeoordelen van prestatie en taakselectie. Met betrekking tot de leerresultaten blijkt dat leerlingen in de adviesconditie meer praktische opdrachten, waarin hun kappersvaardigheden worden beoordeeld, hebben afgerond en meer deelkwalificaties hebben ontvangen dan leerlingen in de feedbackconditie. Uit de interviews blijkt, dat leerlingen die advies kregen, de supervisiegesprekken hoger waarderen en deze als effectiever percipiëren dan leerlingen in de feedbackconditie. Verder zeggen veel leerlingen dat ze de voorkeur geven aan gesprekken met hun docent of mentor over hun verbeterpunten en taakselecties, boven het formuleren en schrijven hiervan in STEPP. Hierbij aansluitend geven enkele leerlingen en mentoren aan dat ze de reflectieve dialogen die zij soms hadden tijdens de praktijklessen erg waarderen. Door middel van het stellen van 'waarom' en 'hoe' vragen aan de leerlingen begeleidt de docent hen systematisch in hun denkproces.

Hoofdstuk 5 beschrijft een experimentele studie waarin reflectieve dialoog en het principe van het stellen van 'waarom' en 'hoe' vragen geïmplementeerd is in de vorm van drie p/reflectieprompts in de opleiding: (a) extra vragen in een uitgebreide versie van STEPP, om leerlingen te stimuleren tot het formuleren van leerdoelen en het beschrijven van hoe ze hun prestatie gaan verbeteren, (b) reflectieve dialoog tijdens supervisiegesprekken om leerlingen te helpen bij het diagnosticeren van hun prestatie en het plannen van het verbeteren van hun prestatie en (c) reflectieve dialoog over hun planning tijdens de praktijkles. De effecten van deze p/reflectieprompts op de zelfsturingsvaardig-heden en de leerresultaten binnen het kappersvak werden onderzocht. Met betrekking tot de zelfsturingsvaardigheden ligt de focus op het formuleren van diagnostische verbeterpunten en het formuleren van een specifieke planning. Leerlingen werden op basis van toeval toegewezen aan een promptconditie (n = 31) die bovenstaande p/reflectieprompts ontvingen en aan een geen-promptconditie (n = 36), waarin de originele versie van STEPP werd gebruikt en er geen reflectieve dialoog plaatsvond tijdens supervisiegesprekken of praktijklessen. De hypothese was dat leerlingen die p/reflectieprompts ontvangen, meer betekenisgerichte leeractiviteiten uitvoeren en meer diagnostische leerdoelen formuleren en specifiekere plannen van aanpak maken dan leerlingen die geen prompts ontvangen. Met betrekking tot leerresultaten wordt verwacht dat leerlingen in de promptconditie hogere leerresultaten behalen dan leerlingen in de geen-promptconditie, omdat de positieve effecten van de p/reflectieprompts op het diagnosticeren van prestatie en

het formuleren van een specifiek plan leerlingen beter in staat stelt om geschiktere taken te selecteren, wat resulteert in hogere leerresultaten.

Resultaten bevestigen de hypothese met betrekking tot de positieve effecten van de p/reflectieprompts op de zelfsturingsvaardigheden. Leerlingen in de promptconditie formuleren meer diagnostische leerdoelen en maken een specifiekere planning dan leerlingen in de geen-promptconditie. De hypothese met betrekking tot de effecten van de prompts op de leerresultaten is niet bevestigd; er zijn geen significante verschillen gevonden tussen de condities met betrekking tot de verkregen kappersvaardigheden. Echter, voor de leerlingen in de promptconditie is er een significante correlatie gevonden tussen het formuleren van diagnostische leerdoelen en leerresultaten en tussen het maken van specifieke plannen en leerresultaten. Verder blijkt dat leerlingen in de promptconditie STEPP, de supervisiegesprekken en het schrijven van een plan als effectiever percipiëren om hen te helpen meer betekenisgerichte leeractiviteiten uit te voeren, dan leerlingen in de geen-promptconditie.

Tenslotte geeft *Hoofdstuk 6* een overzicht van de resultaten en de algemene conclusies van de studies die beschreven worden in de Hoofdstukken 3 tot en met 5. De algemene conclusies hebben betrekking op de effectiviteit van ontwikkelingsportfolio's en adviezen gebaseerd op de inhoud van de portfolio's op de zelfsturingsvaardigheden en leerresultaten van leerlingen. Geconcludeerd wordt dat een ontwikkelingsportfolio in combinatie met advies – dat ofwel direct wordt verstrekt of via p/reflectieprompts (bijv. reflectieve dialoog) – een veelbelovende aanpak is om leerlingen te stimuleren tot het uitvoeren van betekenisgerichte leeractiviteiten die hen helpen om hun zelfsturings-vaardigheden te ontwikkelen. Met name de vaardigheden om verbeterpunten te formuleren en plannen van aanpak te formuleren worden positief beïnvloed wanneer leerlingen advies of p/reflectieprompts ontvangen.

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