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Supporting students' self-directed learning in senior vocational education

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Voor Milan

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Chapter 1

General Introduction

Students in senior vocational education find themselves in a world where knowledge is volatile. It is no longer sufficient to receive good grades. To succeed in the current day and age students have to become lifelong learners (Tuijnman, 2003). To prepare students to become lifelong learners, educators have made adaptations to senior vocational education, such as the introduction of competency-based education. In competency-based education students acquire the necessary skills, knowledge, and attitudes they require for carrying out real-life tasks (Bartram & Roe, 2005). These adaptations require students to take more responsibility over their own learning, they need to self-direct their learning. In self-directed learning (SDL) students self-assess their performance, diagnose their own learning needs, and select learning activities that fit their learning needs (Knowles, 1975). However, when students enter senior vocational education, they generally possess poorly-developed SDL skills (Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004).

Portfolios are often used to help students develop reflective skills that are essential for SDL. These portfolios are usually referred to as development portfolios because they help students document their development of skills and enable them to reflect on those skills for further development (Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009). Development portfolios typically consist of a set of documents that are structured in such a way that students can determine how they are performing, what they should do to improve their performance, and what the next steps should be to attain their learning goals. Research shows that portfolios can be used successfully to help students develop SDL skills (e.g., Liang, Chang, Shu, Tseng, & Lin, 2015; Oner & Adadan, 2011; Sung, Chang, Yu, & Chang, 2009).

Portfolios can only be successful when students are given some degree of autonomy in the learning process (Williams, 1996). Autonomy refers to self-determined behavioral regulation and is a key element of intrinsic motivation (Ryan & Deci, 2000). In turn, intrinsic motivation has been related to various positive learning outcomes, such as increased academic performance (Pintrich & Degroot, 1990). In a learning environment that allows for some autonomy, portfolios are thus likely to positively impact students' intrinsic motivation to learn. Indeed, research demonstrates that the use of portfolios increases intrinsic motivation to learn (e.g., Abrami, Venkatesh, Meyer, & Wade, 2013). To counteract possible negative effects of insufficient autonomy, portfolios can for example promote a sense of ownership, which makes learning more personally relevant (e.g., Garrett, 2011). Portfolios can also support students' autonomy by pre-selecting learning tasks that suit their personal learning needs (Corbalan, Kester, & van Merriënboer, 2009).

While research demonstrates that portfolios can be used successfully to help students develop SDL skills, not a lot is known about the factors that influence effective portfolio use. Among others, the available empirical evi-

dence suggests that students should have enough new learning experiences to reflect upon and that the portfolio should provide students with a structured approach to reflection (Driessen, Van Tartwijk, Overeem, Vermunt, & Van der Vleuten, 2005). However, the majority of the available research has not been specifically aimed at investigating effective development of SDL skills with portfolios. Furthermore, most research has not focused specifically on the use of *electronic* portfolios (e-portfolios). Yet, such research is needed, because e-portfolios may be more successful at supporting the development of students' SDL skills, because they contain features that regular portfolios lack. These features include automated overviews of personal development (e.g., Kicken et al., 2009) and supported selection of relevant criteria for self-assessment of performance (e.g., Fastré, van der Klink, Sluijsmans, & van Merriënboer, 2012).

Perhaps the most crucial factor influencing effective portfolio use is the presence of teacher coaching (e.g., Dannefer & Henson, 2007). Such coaching is aimed at providing feed-up (i.e., by answering the question "Where am I going?"), feedback (i.e., by answering the question "How am I going?"), and feed-forward (i.e., by answering the question "Where to next?") on a regular basis (Hattie & Timperley, 2007). However, coaching students is a time-consuming process. To reduce the amount of time that teachers have to spend on coaching their students it is important to find alternative coaching strategies. One possible way to do this is by incorporating a student self-coaching protocol (i.e., a set of questions to be answered by students to reflect on their performance) into an electronic development portfolio. Student self-coaching is aimed at mimicking the routine parts of the teacher coaching sessions, in which standard questions are asked, which are the same for all students. This way, the teacher has more time to focus on non-routine parts of the coaching sessions, in which questions are asked that relate to unique, individual learning needs.

The main aim of this dissertation is to examine if routine parts of teacher coaching can be substituted with student self-coaching, while positive effects of portfolio use on the development of students' SDL skills and motivation are retained. Three research questions are central in this dissertation:

1. What factors influence the facilitation of the development of SDL skills with an e-portfolio?

2. How do these factors influence the facilitation of the development of SDL skills with an e-portfolio?

3. What are the effects of using an electronic development portfolio with limited teacher coaching and a student self-coaching protocol in senior

vocational education on students' development of SDL skills and their motivation to learn?

Together the answers to these research questions will help to reach the main aim. Furthermore, the studies conducted in this dissertation will help inform the design and implementation of electronic development portfolios with limited teacher coaching and a student self-coaching protocol. The design and implementation of these portfolios will be informed so that they foster the development of students' SDL skills and their intrinsic motivation. In the upcoming sections we discuss how the research questions will be answered in the forthcoming Chapters.

1.1 Overview of the dissertation

Figure 1.1 depicts an overview of the forthcoming Chapters in which we show how the research questions will be answered in the individual Chapters and what kind of studies are conducted to do so. Chapter 2 describes a systematic review into the factors that influence the development of SDL skills with an e-portfolio. Chapter 3 describes the design and a small scale evaluation of an electronic development portfolio (PERFLECT) aimed at facilitating the development of SDL skills. PERFLECT's design is based on theory and insights from the systematic review conducted in Chapter 2. In Chapter 4 the effects of using PERFLECT on students' development of SDL skills and their motivation to learn are evaluated in a quasi-experimental study. Chapter 5 presents a mixed-method study that also evaluates the effects of using PERFLECT on students' development of SDL skills and their motivation to learn, but the study reported in this Chapter also attempts to understand these effects through focus group interviews.

Chapter 2 addresses research questions 1 and 2 and describes a systematic review of articles that is aimed at identifying factors that influence students' development of SDL skills and at understanding how the identified factors influence this development. Relevant articles are selected by reading abstracts and subsequent full-text reviews. At the end of full-text review a total of 17 articles are scrutinized for factors that influence the development of SDL skills. A synthesis of findings is presented.

In Chapter 3 the design of PERFLECT and a small scale evaluation are described. This Chapter addresses research question 3. The design of PERFLECT is founded on findings from Chapter 2 and guidelines from the 4C/ID model (four-component instructional design model; Van Merriënboer & Kirschner, 2013). It has functionalities that facilitate the development of SDL, including self-assessment of performance, formulation of points for improvement (PfIs), and selection of future learning tasks. The small scale eval-

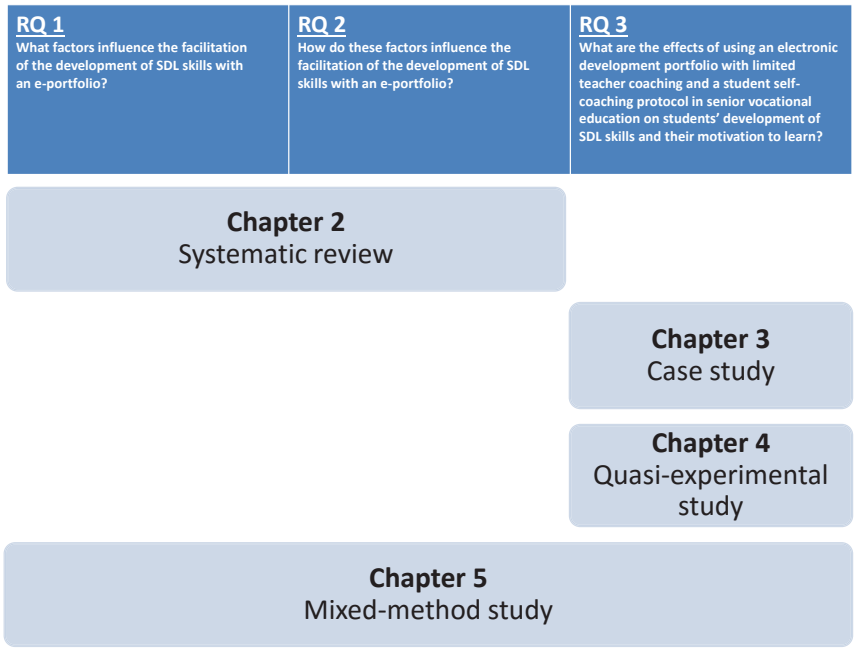

Figure 1.1: An overview of the forthcoming Chapters and the studies conducted in the Chapters with associated research questions.

uation is aimed at recording students' perceptions of PERFLECT's ability to help them self-direct their learning and PERFLECT's general usability and utility.

Findings from the study in Chapter 3 are used to improve PERFLECT before the start of the quasi-experimental study, described in Chapter 4. This study investigates the effects of using PERFLECT with limited teacher coaching and a student self-coaching protocol in senior vocational education on students' development of SDL skills and their motivation to learn. It is aimed at answering research question 3. Two conditions were compared. Students followed either the regular educational program and did not use PERFLECT (the REGULAR condition), or students followed the educational program and part of the program was substituted with the use of PERFLECT to help them develop SDL skills (the PERFLECT condition). Students in the PERFLECT condition were expected to be more self-directed than students in the REGULAR condition and also to be more motivated for learning. Furthermore, it is expected that students in the PERFLECT condition demonstrate development of their SDL skills (i.e., improve their self-assessment skills and formulate higher quality PfIs).

All research questions are addressed in Chapter 5 which presents a mixed-method study. This study is also aimed at investigating the effects of using PERFLECT with limited teacher coaching and a student self-coaching protocol in senior vocational education on students' development of SDL skills and their motivation to learn. As in the previous study, in this study it is expected that students demonstrate development of their SDL skills and that they become more intrinsically motivated. Furthermore, the reported effects are explained with findings from focus groups that are aimed at capturing students' perceptions of PERFLECT's ability to help them self-direct their learning.

Finally, Chapter 6 presents the main findings and conclusions of the studies conducted as part of this dissertation. Theoretical and practical implications are discussed, as well as limitations and directions for future research.

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Chapter 2

e-Portfolios enhancing students' self-directed learning: A systematic review of influencing factors

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Abstract

e-Portfolios have become increasingly popular among educators as learning tools. Some research even shows that e-portfolios can be utilized to facilitate the development of skills for self-directed learning. Such skills include self-assessment of performance, formulation of learning goals, and selection of future tasks. However, it is not yet clear under which conditions e-portfolios optimally facilitate the development of these skills. We conducted a systematic review aimed at identifying and understanding influences on the development of self-directed learning with an e-portfolio. Inclusion criteria were used to select recent, high quality studies that focused on e-portfolios and reported an influence on self-directed learning. There were 17 articles that met the inclusion criteria. Institutional factors, curriculum factors, learning process factors, personal factors, and portfolio factors were identified. Portfolios are used most effectively when faculty development aimed at supervising self-directed learning skills development is provided, when the portfolio is integrated into the educational routine, when teachers coach students regularly, when scaffolding is applied to increase motivation, and when the portfolio is designed to facilitate at least goal-setting, task-analysis, plan implementation, and self-evaluation.

Self-directed learning (SDL) is an umbrella term for various learning processes related to goal-directed, self-controlled learning behavior (e.g., Fisher & King, 2010; Garrison, 1997; Grow, 1991; Schmidt, 2000). As a pioneer in the field, (Knowles, 1975) defines self-directed learning as:

> A process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 15)

One way to facilitate the acquisition of SDL skills is by using portfolios. Portfolios come in various shapes and forms. Moreover, portfolios are used in a multitude of different settings and for different purposes. In the broadest sense, a portfolio can be described as a file container, either electronic or non-electronic. When a specific type of portfolio is considered, the definition narrows. In a showcase portfolio, for example, the container is used to display completed work to a target audience. In a learning portfolio, the container is used to document and support the learning process. While the former is focused on the learning product, the latter is focused on the learning process. Many other types of portfolios exist. Furthermore, there is a large number of often overlapping definitions for the various types of portfolios, which can make it hard to see the forest for the trees.

To avoid dealing with triviality created by a surplus of portfolio types and definitions, it is useful to apply some form of classification. Smith and Tillema (2003) classify different types of portfolios by purpose (selection vs. learning) and volition (voluntary vs. mandatory). Using this classification, four types of portfolios are distinguished: a dossier, a reflective portfolio, a training portfolio, and a personal development portfolio. The dossier is characterized as a mandated portfolio detailing records of achievement for selection or promotion purposes. An example of a dossier is the portfolio that professional models use to showcase photographs of earlier work. Potential employers use the information in the portfolio to check for compliance with their standards. The reflective portfolio is also used for selection and promotion purposes but on a voluntary basis. This kind of portfolio is typically used to determine whether a candidate is eligible for promotion to a higher position within a company. The training portfolio is characterized as a mandated portfolio for learning purposes. Examples of these portfolios can be found in many school settings. As part of their curriculum, students are mandated to document their learning throughout the year and reflect upon the process. The personal development portfolio is also characterized by learning purposes but its use is voluntary. This kind of portfolio is usually not an official part of a curriculum, but can be used to assist in learning. Figure 2.1 depicts the four different kinds of

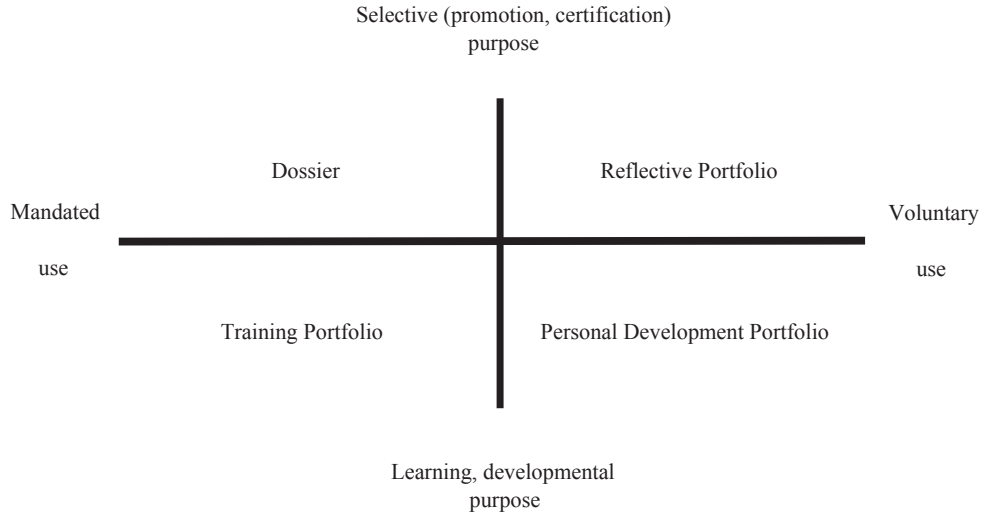

Figure 2.1: A portfolio classification by purpose and volition of use (adapted from Smith and Tillema (2003); p. 628).

portfolios. The purpose of the portfolio is placed on the vertical axis. Volition of use is placed on the horizontal axis.

Nowadays electronic portfolios (e-portfolios) are increasingly being used to support SDL, because they are thought to offer several advantages over traditional paper-and-pencil portfolios. Among the advantages are ubiquitous portfolio access, the ability to include multimedia, and facilitated overviews of personal development (i.e., some e-portfolios can automatically aggregate input data into overviews of personal development). Moreover, e-portfolios have also been found to motivate students more so than paper-and-pencil portfolios (Driessen, van Tartwijk, van der Vleuten, & Wass, 2007). This is not to say that the process of supporting SDL is radically different between the two. The process of doing so with e-portfolios is likely more efficient.

Previous research has shown that the development of SDL skills can be facilitated with an e-portfolio (e.g., Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009a). However, little is known about the exact conditions under which e-portfolios effectively facilitate the development of SDL skills. To make the use of e-portfolios evidence informed and to optimize their current use, it is necessary to identify and understand influencing factors.

We aim to identify and understand these factors through a systematic review of the available literature with the following research questions:

1. What factors influence the facilitation of SDL skills development with an e-portfolio?

2. How do these factors influence the facilitation of SDL skills development with an e-portfolio?

2.1 Methodology

2.1.1 Search parameters

We used the Web of Knowledge search engine to search the Social Sciences Citations Index (SSCI) and the Science Citation Index (SCI). Combined, both indices cover over 9,000 of the world's learning journals and over 200 different disciplines. As such the search engine was expected to yield a representative sample of high quality studies. The goal was to identify all relevant literature connecting e-portfolios to SDL. We used portfol* as our first search keyword to include as many portfolio-like constructs as possible. To include all constructs related to SDL, we chose learn* as the second search keyword. The full search term was thus: portfol* AND (Boolean) learn*.

2.1.2 Inclusion criteria

Six inclusion criteria were defined to generate a collection of recently published articles that specifically addressed our research questions.

- We only included articles in the SSCI categories Education and *Educational Research* and *Educational Psychology* and the SCI category *Education: Scientific Disciplines*
- We only included articles published within the last 10 years (2003-2013)
- Articles had to deal with portfolios
- Articles were only included if they addressed e-portfolios or if the conclusions were aimed at e-portfolios
- Articles were only selected if an influence on SDL skills was researched
- Articles had to contain empirical data

2.1.3 Selection process

Initial results were automatically restricted by category and publication year using filters in the Web of Knowledge search engine. Abstracts were subsequently scanned to find information about the other inclusion criteria. If the information in the abstracts met the inclusion criteria, the corresponding articles were selected for full-text review. If, based on the information in the

abstract, it was unclear whether the article would meet the inclusion criteria, it was also selected for full text review. All other articles were discarded. Finally, we reviewed the full texts of the selected articles. In the full text we established the precise nature of the portfolio and whether the articles reported empirical data. We also investigated if the reported influence on SDL skills actually pertained to goal-setting, task analysis, plan implementation, or self-evaluation.

2.1.4 Identifying influencing factors

After we selected articles to review, we started identifying influencing factors. We created a table to summarize the most important information from each paper, such as design, aim, findings, context, and reported influence on SDL. The emerging themes were further analyzed and subsequently discussed in the whole group of authors to reach a better understanding of the themes and their relationships. Finally, we identified the actual factors by describing the reported influence with a short key sentence. The following section displays the results of our review of the literature.

2.2 Results

2.2.1 Search results

Figure 2.2 portrays the selection process. The initial search yielded 1331 publications. After restricting results to only include articles published from 2003-2013, 1070 articles remained. The selection was then further refined by only including categories of interest, which left 480 articles for abstract review. During the abstract review, 370 articles were discarded because they were not about portfolios, the portfolios were not electronic, no influence on SDL was reported, or there was a combination of these issues. Finally, after ascertaining the exact influence on SDL through full-text reviews, 17 publications were included in the systematic review.

2.2.2 Study characteristics

Table 2.1 shows several characteristics of the portfolios reviewed in this article. The leftmost column lists the studies associated with the portfolios. If a portfolio had a specific name, it is listed in the next column. In the middle column, the portfolios are classified according to the previously described taxonomy (Smith & Tillema, 2003). To illustrate the relationship with SDL, all relevant outcome variables are specified in the penultimate column. Finally, the study context is described in the rightmost column.

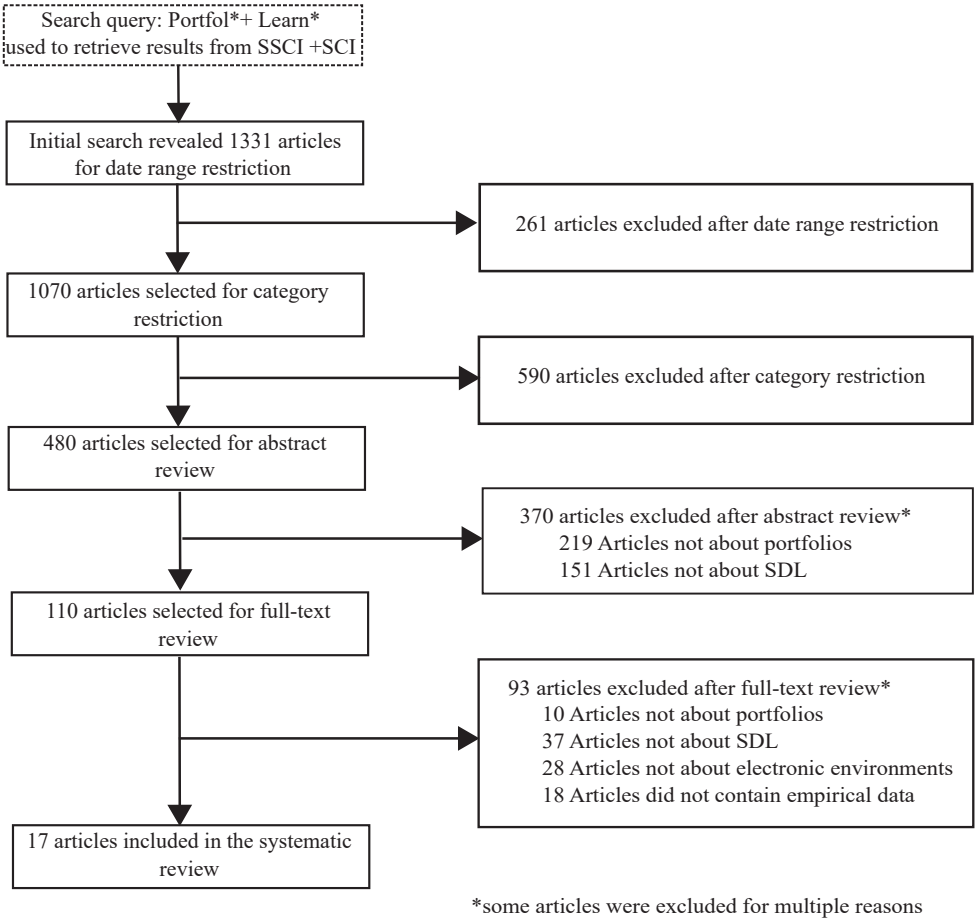

Figure 2.2: The article selection process.

Table 2.1: Description of portfolio characteristics, SDL outcome variables, and study context.

Study	Portfolio name	Portfolio type	Relevant SDL outcome variables	Context
Abrami et al. (2013)	ePEARL	Personal development portfolio	SDL related questionnaire (SLSQ)	Primary education (Grades 4-6, Canada)
Altahawi et al. (2012)	-	Training portfolio	Students' perspectives on assessment with e-portfolios	Tertiary education (medicine students)
Barbera (2009)	Netfolio	Dossier	Amount of self-revision of work in e-portfolio	Tertiary education (graduate students in a basic research competences course)
Chang et al. (2013)	-	Training portfolio	Accuracy of self-judgment	Secondary education (Grade 11, USA)
Chau and Cheng (2010)	-	Reflective portfolio	Students' and teachers' perspectives on e-portfolio mediated independent learning	Tertiary education (undergraduate students from multiple disciplines)
Cheng and Chau (2013)	Elgg	Personal development portfolio	Students' reflective ability	Tertiary education (undergraduate students from multiple disciplines)
Hadwin et al. (2005)	-	Dossier	Shift in self-regulatory control from teacher to student in discourse about a research portfolio	Tertiary education (Graduate students in research methods course)
Hudson et al. (2012)	-	Training portfolio	Amount of reflection	Tertiary education (graduate medical students)

Kabilan and Khan (2012)	-	Dossier	Teacher perspectives on using an e-portfolio for learning and self-assessment	Tertiary education (undergraduate teaching students)
Kicken et al. (2009a)	STEPP	Personal development portfolio	Quality of self-assessment, diagnostically formulated learning needs and quality of task selection	Tertiary education (hairdressing students)
Kicken et al. (2009b)	STEPP	Personal development portfolio	Perceived effectiveness for improving SDL skills	Tertiary education (Hairdressing students)
Kjaer et al. (2006)	-	Training portfolio	Postgraduate students' perceptions of the use of an online portfolio and its effect on their learning	Tertiary education (general practitioner trainees)
Meyer et al. (2010)	ePEARL	Personal development portfolio	SDL related questionnaire (SLSQ)	Primary education (Grade 4-6, Canada)
Van Schaik et al. (2013)	-	Training portfolio	Mentors' perceptions of what constitutes SDL	Tertiary education (Undergraduate medicine students)
Wang (2010)	-	Dossier	Amount of self-revision of work in e-portfolio	Tertiary education (graduate students of educational leadership)
Welsh (2012)	Pebblepad	Training portfolio	Students' perceptions of the influence of portfolio usage on their ability to self-regulate learning	Tertiary education (undergraduate students of educational sciences)
Ziegler and Moeller (2012)	LinguaFolio	Training portfolio	Accuracy of self-assessment	Tertiary education (Undergraduate students in Spanish and French classes)

Five of the reviewed studies used a personal development portfolio, seven studies used a training portfolio and four studies used a dossier. The reflective portfolio was only used in one study. This implicates that the majority of portfolios in the studies were used for learning purposes. Fourteen studies were conducted in the context of tertiary education, one study was conducted in the context of secondary education, and two studies in the context of primary education. While the majority of studies were conducted in the context of tertiary education, this does not mean the sample was homogeneous. In fact, there was considerable variation between various tertiary education types, including vocational education, undergraduate education and graduate education. Medicine (four studies) and education (three studies) were most prevalent in graduate and undergraduate education.

Seven studies were of a quasi-experimental nature, while 10 studies were of an exploratory nature. All studies reflected the richness of the SDL concept, because they used a wide variety of approaches to measure it. The experimental studies were largely aimed at capturing quantifiable scores on SDL measures. These included scores on validated questionnaires that were aimed at measuring all aspects of SDL, but also scores on measures that were aimed at certain aspects of SDL. These included number of self-revisions, number and quality of formulated learning goals, and accuracy of self-judgments. While mixed- method designs were amongst the exploratory studies, they employed qualitative designs for the larger part. With the exception of the Hadwin et al. (2005) study, all qualitative studies measured perceptions of teachers and students about the effectiveness of e-portfolio mediated learning. The Hadwin et al. (2005) study described an in-depth exploration of changes in self-regulation strategies over time. The following section discusses the synthesis of results into factors and factor groups.

2.2.3 Factors influencing facilitation of SDL skills with e-portfolios

Five groups of factors that influence the facilitation of SDL skills development with an e-portfolio were identified: institutional factors, curriculum factors, learning process factors, personal factors, and portfolio factors. Factor groups and their respective factors are depicted in Figure 2.3. This figure shows the five factor groups, each of which contain between two and five interrelated factors. The institutional group contains two factors that are related to institution-wide policies. The four factors in the curriculum group encompass choices in assessment and portfolio implementation. The learning process group comprises three factors, which are concerned with support given to the learner, such as complementary coaching. The five personal factors mostly reflect personal attributes such as lack of motivation. Finally, the two factors

in the portfolio group all refer to portfolio characteristics, such as ability to scaffold. The number next to each respective factor describes how many studies reported results about it. Finally, Figure 2.3 also denotes whether or not factors were associated with a positive or negative influence on the facilitation of SDL skills development.

This group exists of two factors, untrained teachers and unaligned institutional policy. Both factors influence portfolio use on an institution-wide level. The first factor concerns the negative influence of untrained teachers on effective acquisition of SDL skills. Two explorative studies reported on teachers' varying conceptions of what constitutes SDL and their struggle to understand how it is best taught. In the Van Schaik et al. (2013) study mentors teaching SDL all had different conceptions of the SDL concept and what is required to become a successful self-directed learner. Moreover, some mentors believed that SDL skills are innate features much like traits which cannot be changed nor taught. In the Chau and Cheng (2010) study, teachers reported to understand what was expected from them in their traditional directive role, but they did not fully understand what was expected from them in their new facilitative role. One quasi-experimental study illustrates the importance of sufficiently trained teachers. Ziegler and Moeller (2012) showed that students who were taught by teachers with limited knowledge of effective e-portfolio use, were less accurate at self-assessing their performance than students who were taught by teachers with more extensive knowledge of effective e-portfolio use. We recommend providing faculty development for all staff involved, aimed at delineating how students' development of SDL skills should be supported. Steinert et al. (2006) demonstrated that faculty development designed to improve teaching effectiveness can lead to changes in attitude, knowledge and skills.

Institutional factors

This group exists of two factors, untrained teachers and unaligned institutional policy. Both factors influence portfolio use on an institution-wide level. The first factor concerns the negative influence of untrained teachers on effective acquisition of SDL skills. Two explorative studies reported on teachers' varying conceptions of what constitutes SDL and their struggle to understand how it is best taught. In the Van Schaik et al. (2013) study mentors teaching SDL all had different conceptions of the SDL concept and what is required to become a successful self-directed learner. Moreover, some mentors believed that SDL skills are innate features much like traits which cannot be changed nor taught. In the Chau and Cheng (2010) study, teachers reported to understand what was expected from them in their traditional directive role, but they did not fully understand what was expected from them in their new facilitative role.

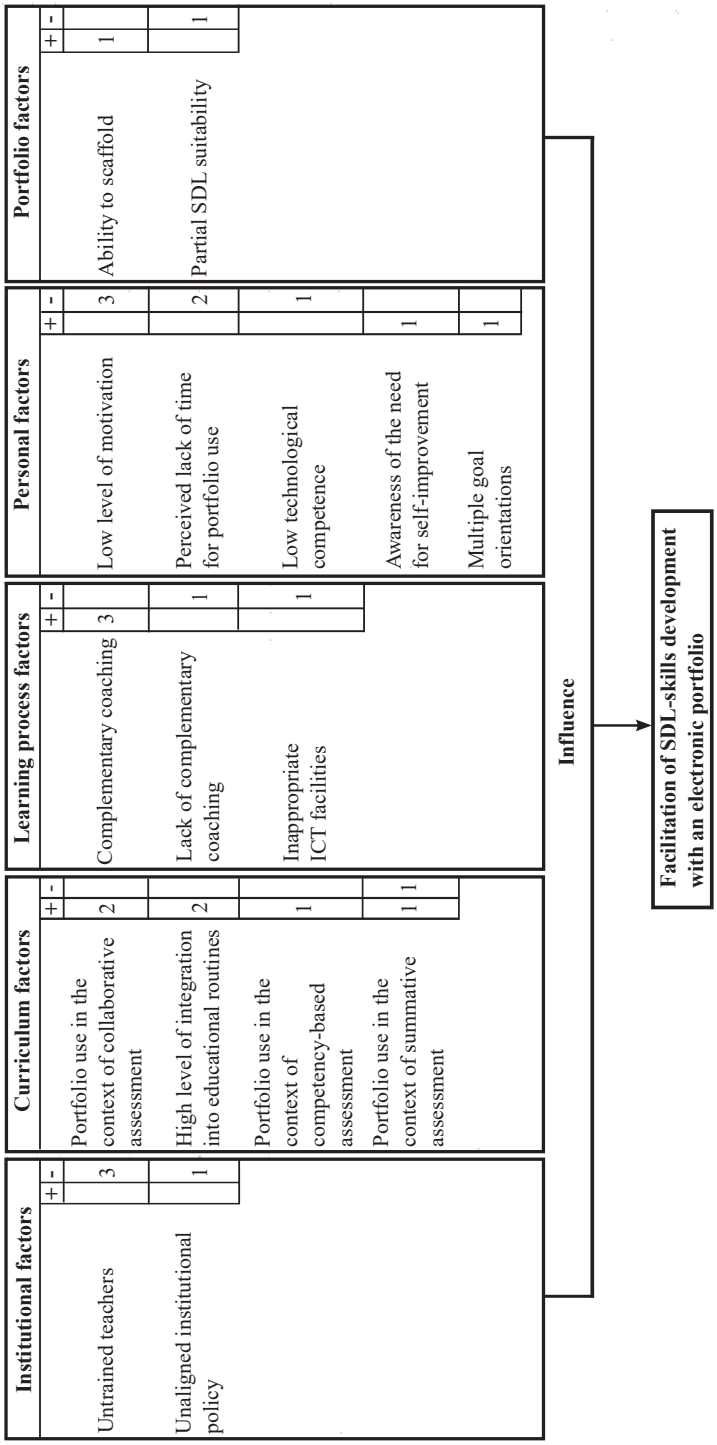

Figure 2.3: Overview of factors influencing facilitation of SDL with an e-portfolio. A positive influence on SDL as reported in the study is represented by a plus sign in the figure. A negative influence is represented by a minus sign. Factors are ordered by the number of articles they appear in.

One quasi-experimental study illustrates the importance of sufficiently trained teachers. Ziegler and Moeller (2012) showed that students who were taught by teachers with limited knowledge of effective e-portfolio use, were less accurate at self-assessing their performance than students who were taught by teachers with more extensive knowledge of effective e-portfolio use. We recommend providing faculty development for all staff involved, aimed at delineating how students' development of SDL skills should be supported. Steinert et al. (2006) demonstrated that faculty development designed to improve teaching effectiveness can lead to changes in attitude, knowledge and skills.

The second factor in this group is unaligned institutional policy. When institutional policy is not aligned with educational goals of a portfolio, this creates a tension. The Chau and Cheng (2010) study discussed possible negative effects of this tension. In this study students were expected to demonstrate deep reflection in their portfolio while at the same time they were awarded with cash prizes for the best portfolios. Unsurprisingly, results showed that some students prioritized producing portfolios that fit the evaluation criteria over producing portfolios that expressed their individual learning. While conclusions cannot be drawn based on this single study, there is an indication that misalignment of institutional policy with educational goals of a portfolio leads to unfavorable outcomes. With reserve, we thus recommend aligning institutional policy with the educational goals of a portfolio.

Curriculum factors

These factors reflect the influence of curriculum-level educational choices on the effectiveness of e-portfolio facilitated development of SDL skills. Included are choices of portfolio assessment forms and portfolio implementation strategies. The curriculum factors comprise portfolio use in the context of collaborative assessment, a high level of integration into educational routines, portfolio use for competency-based assessment, and portfolio use in the context of summative assessment.

The first factor in this group illustrates the positive influence of collaborative assessment on the development of SDL skills with an e-portfolio. Two quasi-experimental studies compared the effectiveness of working on e-portfolios in a traditional assessment context (i.e., mostly individually) with working on e-portfolios in a collaborative assessment context. Barbera (2009) and Wang (2010) found that students who engaged in collaborative assessment revised significantly more of their work than the students who did not engage in collaborative assessment (a traditional e-portfolio group). They also revised their work significantly more often. Additionally, both Barbera (2009) and Wang (2010) analyzed the messages that students sent to each other on a dedicated on-line message board. It was found that students' messages to each other con-

tained significantly more high-level comments (messages targeted at synthesis, evaluation and analysis) for the group engaging in collaborative assessment. Considering the positive results from both studies, we recommend integrating collaborative assessment into an e-portfolio work-flow.

The second factor in this group points towards the benefits of seamlessly integrating portfolio use into existing educational routines. One quasi experimental study compared students' effectiveness of developing SDL skills with and without an e-portfolio. Meyer et al. (2010) found that students who used an e-portfolio reported higher levels of certain SDL processes than students who did not use an e-portfolio. These processes included but were not limited to students setting their own process goals, revising goals when necessary, and using teacher feedback to improve their work. However, this was only true for students in classes where portfolio use was well-implemented. Students in classes where portfolio use was not well-implemented made minimal, no, or incorrect use of SDL processes. In the Kicken et al. (2009b) study students were allowed to use an e-portfolio voluntarily to support their learning. However the availability of the portfolio alone was not enough to ensure regular use among the students. The students barely used the portfolio.

These two studies provide a solid indication that interventions should strive to seamlessly implement portfolio use into existing educational routines. To reach such a level, we recommend providing good access to technology, gaining support and recognition from school administrators, and providing training and support for teachers involved. A follow-up study by Abrami et al. (2013) demonstrated that these conditions can lead to such a high level of implementation.

The third factor illustrates the positive influence of a competency-based assessment context on the development of SDL skills with an e-portfolio. Competency-based assessment is a holistic form of assessment that is thought to have a number of advantages over more traditional forms of assessment. One exploratory study investigated the effect of using portfolio-based competency assessment on the development of reflective practice. Altahawi et al. (2012) inquired about student perspectives on a portfolio-based competency assessment system that was designed to facilitate SDL skills. The students reported that the competency-based system had helped them become more self-directed learners. A representative quote: "I found my entire approach to my education had changed. I was even actively seeking feedback and acting on it without prompt from the system" (Altahawi et al., 2012, p. 223). However, it has to be noted that students did have trouble letting go off objective external validation offered in traditional grade-based assessment systems at first. Results indicate that the use of competency-based assessment might have a positive influence on the facilitation of SDL skills acquisition with an e-portfolio. On the other hand results from this study also point towards initial skepticism that

students have to overcome. With caution we recommend combining portfolio use with competency-based assessment. To increase chances of successful implementation, educators should actively address students' concerns about letting go off external validation provided by grade-based assessment (i.e., by teaching them to search for feedback outside of their grades).

The last factor in this group illustrates the variable influence that application of summative assessment may have on the development of SDL skills with an e-portfolio. Two exploratory studies on the subject report contradictory results. First, Hudson et al. (2012) report that students' use of reflective logs peak right around the periods of formative and summative assessment. As such, the presence of summative assessment might inspire students to engage in self-reflection. While this is a desired effect, Kjaer et al. (2006) show that the application of summative assessment can also have negative effects. They investigated general practitioner trainees' perceptions about using an e-portfolio in combination with summative assessment. The trainees did not consider this to be a viable combination because they feared that the portfolio would be used to teach them a standard: "It could act like a kind of mind control teaching 'the right opinions'" (Kjaer et al., 2006, p. 711). Based on these two studies, it is not yet clear what influence application of summative assessment has on the development of SDL skills with an e-portfolio. On the one hand there is an indication that assessment is needed to stimulate students to actually engage in learning; possibly, students do not take the portfolio seriously without an assessment status (Driessen, Van Tartwijk, Overeem, Vermunt, & Van der Vleuten, 2005). On the other hand, teaching a standard might interfere with sense of ownership. We recommend giving portfolios an assessment status. To promote sense of ownership, we propose a combination of summative assessment with formative assessment in a programmatic assessment structure (see van der Vleuten et al., 2012).

Learning process factors

These factors are nested in the daily practice of the classroom and all directly support the learning process. Ensuing, we will describe three factors including complementary coaching, lack of complementary coaching, and inappropriate ICT facilities.

The first factor, complementary coaching, refers to the positive influence teachers exert on students' development of SDL skills, by offering support when students use e-portfolios. Coaching includes giving feedback on past performance and feed forward on future performance. Three studies have reported results about coaching. In the Altahawi et al. (2012) study students reported that receiving structured feedback early on led them to actively seek feedback later on; furthermore, the provision of formative feedback inspired

a gradual shift from deficit thinking towards proficiency strengthening (i.e., moving from experiencing criticism as disciplinary action towards approaching criticism constructively). Similar findings are reported in the Welsh (2012) study that investigated students' perceptions about using an e-portfolio to help self-regulate their learning. Results from a questionnaire showed that students perceived both tutor and peer feedback to be helpful to their learning process. Finally, Kicken et al. (2009a) investigated the effectiveness of different forms of supervision meetings that were aimed at supporting the development of SDL skills with an e-portfolio. They found that students who received elaborate advice on how to use portfolios formulated significantly more diagnostic learning needs than students who received limited advice. Furthermore, students who received elaborate advice were somewhat more proficient at selecting tasks that fit their learning needs than students who received limited advice. In line with other research, the three previous studies indicate that coaching is very important if not essential for facilitating the development of SDL skills with an e-portfolio. We thus advise to incorporate coaching into interventions aimed at facilitating SDL skills with an e-portfolio.

The second factor in this group refers to the negative influence that a lack of complementary coaching may have on the effect of developing SDL skills with an e-portfolio. Data from non-users in the Kjaer et al. (2006) study reflected that lack of tutor support was one of the obstacles preventing them from using the e-portfolio. This study reinforces the importance of coaching in the facilitation of SDL skills development with an e-portfolio.

The last factor in this group demonstrates the importance of functional ICT facilities for accommodating efficient portfolio use. This factor is also derived from data of non-users in the Kjaer et al. (2006) study. They perceived inappropriate ICT facilities to be another obstacle preventing them from using the e-portfolio. As is to be expected, ICT facilities need to function well and be readily available for students develop SDL skills with an e-portfolio.

Personal factors

Factors in this group all describe influences participants themselves can exert on the facilitation of SDL skills development with an e-portfolio. These mostly concern cognitive features such as motivation, perception, and attitude. The factors are described in terms of the influence they exert on the development of SDL skills with an e-portfolio, not the other way around. For example, if a casual attitude towards e-portfolios influences SDL skills acquisition, it is possible that the influence also works the other way around. However, the following factors describe the former influence, not the latter. The group comprises five factors including a low level of motivation, perceived lack of

time for portfolio use, a low level of technological competence, awareness of the need for self-improvement, and multiple goal orientations.

The first factor in this group illustrates the detrimental effects of having low motivation. In the Abrami et al. (2013) study, students with low levels of enthusiasm scored significantly lower than students with high levels of enthusiasm on the student learning strategies questionnaire (SLSQ) (Abrami & Aslan, 2007). In the Chang et al. (2013) study, students who were not satisfied with the e-portfolio scored significantly lower than their peers who were satisfied on several SDL measures in the portfolio, including self-judgment. This was defined as: "Learners' belief about whether they have achieved preset goals based on work of peers, criteria set by teachers, and goals set by themselves" (Chang et al., 2013, p. 239). Finally, non-users in the Kjaer et al. (2006) study listed a lack of personal motivation as an obstacle preventing them from using the e-portfolio in the study. In light of the previous three studies, we conclude that motivation influences both actual portfolio use and facilitation of the development of SDL skills with an e-portfolio. As such, we recommend making the e-portfolio and its use as motivating as possible. According to self-determination theory (SDT) (Deci & Ryan, 2008), people are motivated when they feel competent, when they feel related to the task or other people in the group performing the task, and when they feel autonomous. Scaffolding can help students feel competent by ensuring that the task difficulty is appropriate for their skill level. Furthermore, scaffolding can encourage feelings of autonomy, by gradually transitioning from teacher-directed to student-directed learning. Coaching sessions can help students feel related to what they are learning, but also help them feel connected to other students and their teacher.

The second factor represents participants' perceived lack of time to work on their portfolios. Two studies discuss the negative influence of this perceived lack of time on the development of their SDL skills. In the Kabilan and Khan (2012) study, lack of time was a dominant theme in the qualitative analysis of data gathered to identify the benefits and challenges of using an e-portfolio as a tool for learning and self-assessment. One participant commented: "I have many assignments to submit but no free time to open my portfolio" (Kabilan & Khan, 2012, p. 1014). This is strengthened by data from non-users in the Kjaer et al. (2006) study. One trainee commented: "It is a general problem to find time to make notes regarding your learning whether electronically or on paper" (Kjaer et al., 2006, pp. 710-711). These studies offer valuable insights into perceptions of students concerning available time to work on portfolios. Students claim that a lack of time inhibits them from using portfolios to their full potential. From these studies it is not fully clear whether participants' perceptions describe what is actually happening. Are they really confronted with a lack of time, or do they only perceive this to be case? Notwithstanding

this uncertainty, it is already known that time demands of a portfolio should be reasonable (e.g., Buckley et al., 2009). As such we recommend using a portfolio that places reasonable time demands on its users. One way to do this is by scheduling protected time for portfolio use.

The third factor in this group describes the negative influence of lack of technological competence on the development of SDL skills with an e-portfolio. Technological competence can be defined as a level of proficiency in using various forms of modern technology, such as computers or smart phones Students and teachers in the Chau and Cheng (2010) study indicated that being technologically competent is crucial to effective independent learning with e-portfolios. This study provides an initial indication that technological competence is a prerequisite for effective development of SDL skills with an e-portfolio. We recommend educating users with low technological competence.

The fourth factor in this group is awareness of the need for self-improvement. It is a prerequisite to self-improvement. Before improvement can willfully be initiated, one has to be aware that there is a need for it. Awareness for the need of self-improvement was a dominant theme in the qualitative Chau and Cheng (2010) study. Students and teachers commented that the e-portfolio used in the study helped them create awareness of the need for self-improvement. One student commented: "Using the e-portfolio system can help me think more and also let me know which part I had actually worked on and which part I had to do more" (Chau & Cheng, 2010, p. 938). While it is intuitively appealing to assume that awareness of the need for self-improvement will lead to actual self-improvement, this cannot yet be established. With some reserve we advise designing smart portfolios that can alert its users when self-improvement is needed.

The final factor in this group pertains to the various goal orientations students may have. Goal orientations can be characterized as the different motivations students have to engage in study behavior. Generally, two goal orientations are distinguished: Mastery goals and performance goals. Whereas mastery goals can be characterized by intrinsic motivation to master the subject matter, performance goals are very much correlated with extrinsic motivation (e.g., to pass a course). In relationship to SDL, Cheng and Chau (2013) investigated the influence of different goal orientations on students' reflective ability in their e-portfolio. They found that a combination of mastery and performance goals was positively correlated with deeper levels of reflection, more so than separate mastery or separate performance goals. With some restraint we recommend that portfolio users formulate reflective entries that contain a combination of performance and mastery goals.

Portfolio factors

Factors in this group refer to features, attributes, or characteristics of an e-portfolio that influence how effectively it facilitates the development of SDL skills. The two factors in this group include the portfolio's ability to scaffold and its ability to facilitate SDL.

The first factor refers to the positive influence an e-portfolio can have on the development of SDL skills when it has the ability to scaffold. For most students who are starting to acquire SDL skills, the learning process is largely teacher-directed. By gradually fading support and guidance over time, learning becomes more student-directed, a process known as second-order scaffolding (Van Merriënboer & Kirschner, 2013). The Hadwin et al. (2005) study explored whether it is useful to arrange e-portfolios in such a way that they can scaffold learning much like humans do. The researchers analyzed teacher-student dialog about the contents of portfolios. The analysis of the student-teacher dialogs demonstrated that teacher-directed dialog decreased over time, whereas student-directed dialog increased. Furthermore, discourse targeting cognition (i.e., discourse targeting task-solving strategies) decreased, whereas discourse targeting meta-cognition increased (i.e., discourse targeting the various aspects of SDL). Findings in this study indicate that e-portfolios should mimic the scaffolding role that teachers normally fulfill. Based on the study by Hadwin et al. (2005) we suggest that portfolios aimed at facilitating the development of SDL should offer a lot of support (i.e., scaffolds) at the start of a learning task; these scaffolds should gradually fade towards the end of the task. Furthermore at the start of the learning task, scaffolds should be aimed at task definition and cognition. Towards the end of the learning task, scaffolds should be aimed at strategy enactment and meta-cognition.

The second factor in this group pertains to the functional makeup of e-portfolios. Some portfolios are more suitable for facilitating SDL than others. For example, a showcase portfolio is very useful for helping a user showcase qualities and achievements, but less useful when it comes to facilitating the development of SDL skills. An electronic development portfolio is very useful for facilitating SDL skills because it was designed to do so: it offers support for conducting self-assessments, formulating learning goals and selecting learning tasks. Findings in the Welsh (2012) study support the idea that a portfolio aimed at facilitating the development of SDL should be designed to do so. Results in their study demonstrate that the e-portfolio used in the study was only partially successful in facilitating students' development of SDL skills. The researchers attributed this partial success to certain missing features in the portfolio. The portfolio did not allow students to set their own learning goals or allow free progression towards their learning goals. In light of these results and our theoretical view on SDL, we recommend that an e-portfolio should

at least possess functionalities to support the basic elements present in most SDL theories: goal-setting, task-analysis, implementation of a constructed plan and self-evaluation. Further research should focus on how to best design the portfolio to accommodate these basic elements of SDL.

2.3 Discussion

The available empirical research indicates that the use of e-portfolios to facilitate the development of SDL is influenced by factors situated in five main areas: Institutional factors, curriculum factors, learning process factors, personal factors, and portfolio factors.

Successfully facilitating the development of SDL with an e-portfolio skills starts with a solid foundation: support at the institutional level. The institution should have an educational vision that values SDL and actively advocates faculty development. In the adjacent field of professional development plans, which arguably are portfolios, similar findings have already been reported. Janssen (2013) states that in order for professional development plans to be used successfully, teachers working with them should be supported by a clear organizational vision and strategy regarding professional development.

At the curriculum level, assessment should align with learning objectives at the institutional level and instructional strategies at the learning process level. Assessment activities should facilitate SDL, for example, by employing collaborative assessment or an asynchronous combination of formative and summative assessment. Furthermore, a portfolio's success greatly depends on the level of integration into the educational routine (Driessen et al., 2007). Portfolios should not exist parallel to the curriculum but rather be integrated seamlessly into them.

In the general field of SDL it is already known that learners who are new to self-direction should not be immediately thrown into the deep end, but be eased into the process. Similarly, if e-portfolios are used to facilitate SDL, learners should receive frequent coaching that complements portfolio use (Altahawi et al., 2012; Kicken et al., 2009b; Welsh, 2012).

As is illustrated in the previous sections, it is important to align different levels of educational context to accommodate portfolio use. It is equally important to account for factors that influence portfolio use on a personal level. Users should be motivated to use portfolios. When using portfolios they should feel autonomous, competent, and related to the portfolio and other stakeholders (e.g., peers and teachers).

Finally, it is important that a portfolio aimed at supporting SDL is actually equipped to do so. At the least this means that it must facilitate goal-setting, task analysis, plan implementation and self-evaluation. Training and personal

development portfolios are more likely to possess these qualities than dossiers and reflective portfolios.

2.3.1 Theoretical implications

When we count the number of times the various portfolios were associated with a negative or a positive influence, we see the following: The dossier is associated with three pluses and one minus; the reflective portfolios are associated with one plus and three minuses; the training portfolios are associated with four pluses and nine minuses; and the personal development portfolios are associated with four pluses and one minus. This seems to favor using learning process orientated portfolios over learning product portfolios to facilitate students' development of SDL skills. Surprisingly the training portfolio is associated with the highest number of minuses. This is unexpected because this portfolio type also focuses on the learning process. This unexpected result might be explained by a difference in volition of use. The former can be used voluntarily whereas using the latter is mandatory. Future research should focus on investigating the apparent importance of volitional use of e-portfolios.

e-Portfolios are potentially powerful learning aids. They can be constructed so that they offer feedback contingent to the process, offer support tailored to the learner, and are precisely adjusted to personal wishes. However, e-portfolios also present challenges of their own. They are often complex and technically demanding for both the user and the system they are implemented on. Special care has to be taken to ensure that learners know how to use e-portfolios successfully and that the infrastructure exists to smoothly accommodate portfolio use. While e-portfolios present great potential, this potential is yet to be cultivated. Further research should investigate how exactly e-portfolios should be designed to offer the learner real-time feedback and dynamic support.

Despite a large body of research on motivation, lack of motivation still seems to be an issue when it comes to using an e-portfolio to facilitate SDL skills development. While SDT provides valuable insights into what motivates individuals, the guidelines provided remain abstract. We suggest applying scaffolding and complementary coaching to e-portfolio use to enhance motivation. However, further research is needed to clarify how scaffolding and coaching sessions should be applied when facilitating SDL skills development with an e-portfolio.

2.3.2 Practical implications

We used results from this review to formulate practical implications for every identified factor. While some implications are more evident than others,

they all hold practical relevance. Table 2.2 specifies practical advice for each factor group. For the institutional factors group, we provide practical advice pertaining to formulation of institutional policy and teacher roles. Advice on assessment choices and the level of portfolio implementation forms the basis for the curriculum factors group. For the learning process factors group, we provide recommendations on a support structure for portfolio use. Recommendations on educating and motivating users can be found next. Finally, we offer advice on portfolio design choices.

2.3.3 Limitations

While we took great care in guarding the rigor of the review process, some limitations have to be acknowledged. First, a portfolio is a very broad and at times elusive construct. Smith and Tillema (2003) argue that the myriad of portfolios available may be differently named, but are often the same thing. As illustrated earlier, a portfolio can be anything from a simple file container to a rich learning environment facilitating the development of SDL. As such some constructs described in discarded articles may not have been recognized as being portfolios when in fact they were, and vice versa. Because a portfolio can have many different forms, the generalizability of our findings may be limited. That is not to say that conclusions derived from studies using one type of portfolio are incompatible with conclusions derived from using another, but such conclusions are beyond the scope of this review.

Second, a small number of studies were included in the final selection. As such we decided to allow factors to be formed based on outcomes that appeared in only one study. Furthermore the studies in this review varied greatly in design. Some studies were intervention studies, while others were exploratory. Some studies relied on a quantitative paradigm, while others adhered to a qualitative paradigm, or a mixed-method one. Again this means that the scope of conclusions in this review has to be considered. While most conclusions provide a solid basis for further research, they are less solid when it comes to direct application to practice.

Third, findings in this review present a rather fragmented research field. In spite of said fragmentation, we have identified a number of factors that are grounded in multiple studies. Undeniably other factors are grounded in only one study. This signifies that the recommendations provided in this review may not be generalizable across all contexts or types of portfolios. Because of the fragmented field, it might be unclear whether we succeeded in answering our research questions. We conclude that we were able to, partly by discussing the factors that were identified and partly by recognizing that the research field lacks maturity at this point in time. In lieu of offering an exhaustive description of influencing factors, we observe that the field is too fragmented

Table 2.2: Practical guidelines for facilitating SDL skills development with an e-portfolio. Guidelines are specified for each factor group discussed in this review. Guidelines are provided as general pointers, not hard facts.

Institutional level	Curriculum level	Learning process level	Personal level	Portfolio level
Offer faculty development to help teachers adapt to their role in SDL	Combine portfolio use with collaborative assessment	Complement portfolio use with regular coaching	Motivate users to use the portfolio by using scaffolds and coaching sessions	Create a portfolio that can mimic scaffolding behavior
Align institutional policy with educational goals of a portfolio	Implement portfolios in as many classrooms as possible over a long period of time and seek integration with other educational activities	Ensure appropriate ICT facilities are available	Schedule protected time for portfolio use	Create a portfolio that is capable of facilitating goal-setting, task-analysis, plan implementation, and self-evaluation
	Combine portfolio use with competency-based assessment		Educate users with low technical competence	
	Assign an assessment status to the portfolio		Use smart portfolios that alert users when self-improvement is necessary	
			Instruct users to formulate reflective entries that contain a combination of performance and mastery goals	

to draw any definite conclusions about its exact composition. However, other related research that did not fit all of the inclusion criteria (e.g., portfolios that were non-electronic) will likely be useful to help complete the picture. Such findings might be transferable or provide directions for further research

2.3.4 Conclusion

e-Portfolios can be used to facilitate the development of SDL skills. When e-portfolios are used, factors at the level of the institute, the curriculum, the learning process, the user, and the portfolio itself should be accounted for. Successful facilitation of the development of SDL skills is likely to be effectuated when:

- Faculty development aimed at supervising self-directed learning skills development is provided.
- The portfolio is integrated into the educational routine (e.g., it is implemented school-wide, it is aligned with course outcomes).
- Teachers coach their students regularly.
- Scaffolding is applied to increase student motivation.
- The portfolio is designed to at least facilitate basic elements common to most SDL theories: goal-setting, task-analysis, plan implementation, and self-evaluation.

The future of facilitating SDL skills development with e-portfolios looks promising as their full potential has not yet been reached.

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Chapter 3

PERFLECT: Design and evaluation of an electronic development portfolio

Beckers, J., Dolmans, D.H.J.M., & Van Merriënboer, J.J.G. (2016). *PERFLECT: Design and evaluation of an electronic development portfolio.* Manuscript submitted for publication.

Abstract

This article describes the design and evaluation of an electronic development portfolio (PERFLECT) aimed at facilitating the development of self-directed learning skills, including self-assessment of performance, formulation of points for improvement and future learning task selection. A small-scale study with 22 students of senior vocational education was conducted to evaluate PERFLECT's effectiveness and students' perceptions about it. Results show that students regularly used PERFLECT to self-assess their performance and formulate learning goals. This is strengthened by students' positive perceptions about self-assessment and formulation of points for improvement. Students could not actually choose future tasks with PERFLECT, because this was teacher-directed. Interestingly, students still report positive perceptions about PERFLECT's functionality. Students were also satisfied with PERFLECT's usability and user friendliness. Suggestions for improvement were identified, most prominently students request a simplification of language use. PERFLECT is a promising, user-friendly tool for the facilitation of students' development of SDL skills.

Competency-based education can have positive effects on students' motivation and the development of their domain-specific skills (Corbalan, Kester, & van Merriënboer, 2009). The same is true for the development of self-directed learning (SDL) skills, but only when teachers invest a large amount of time and effort in coaching their students (Kicken, Brand-Gruwel, & van Merriënboer, 2008). Intensive teacher guidance is required to ensure that students adequately develop SDL skills, including self-assessment of performance on learning tasks, formulation of points for improvement (PfIs), and selection of future learning tasks.

SDL is not a well-defined concept. It refers to various learning processes related to self-initiated, autonomous learning. There are many different models on SDL, however most of them include some form of self-assessment, learning-needs diagnosis and formulation of learning goals, and selection of learning tasks (e.g., Caffarella, 1993; Candy, 1991; Mezirow, 1985). It is becoming increasingly important to develop SDL skills, because they are essential for lifelong learning (Bolhuis, 2003). One way to facilitate the development of SDL skills is by using an electronic development portfolio, a type of portfolio that was designed to support and guide this process.

The four-component instructional design model (4C/ID model; Merriënboer, 1997) is an instructional design model that can be used to design educational programs in which students are expected to self-direct their learning. It is important that students are supported and guided while they develop SDL skills in these kinds of programs. This support and guidance can be provided by a teacher or another intelligent agent, such as an electronic development portfolio. The 4C/ID model has already been used successfully to inform the design of electronic development portfolios (e.g., Fastré, Van der Klink, & Van Merriënboer, 2010; Kicken et al., 2008). The model suggests a system of shared responsibility for learning. It provides examples of how electronic development portfolios can be used to support a gradual shift in responsibility for learning from teacher to student. This shift is supported through a process of instructional scaffolding, referred to as "second-order scaffolding" (Van Merriënboer & Kirschner, 2013). This kind of scaffolding is aimed at supporting the development of metacognitive abilities, whereas first-order scaffolding is aimed at supporting the development of domain-specific skills (for an overview of research in the field of scaffolding see van de Pol, Volman, & Beishuizen, 2010).

This article describes the design and evaluation of an electronic development portfolio (PERFLECT). It is aimed at facilitating the development of domain-specific skills, the development of SDL skills and increasing motivation amongst students. In contrast with other portfolios, PERFLECT aims to do so with limited teacher coaching. PERFLECT's design is informed by the 4C/ID model, similar development portfolios, and research on effective facilitation of

the acquisition of SDL skills with electronic portfolios (for a comprehensive overview of influencing factors, see Beckers, Dolmans, & Merriënboer, 2016). Ensuing, we will describe PERFLECT's theoretical foundation, its design, and a pilot study conducted to evaluate its successfulness.

3.1 The design of PERFLECT

The first way PERFLECT facilitates the development of SDL skills, is by supporting self-assessment of performance on learning tasks. In PERFLECT self-assessment comprises a four-step process: giving a task description, selecting assessment criteria, self-assessing performance, and answering leading questions. First, students are asked to provide basic information about the learning task they want to assess, including the name of the learning task, the date of execution, the level of received support, and the environment in which the task was executed. Additionally, students have the ability to upload task-related materials, such as documents they used or photographs they took. Second, students are asked to select the relevant assessment criteria for the learning task. These criteria are derived from "qualification dossiers" that describe all relevant assessment criteria on three different levels of specificity (for extensive information about qualification dossiers, please see Van der Sanden, Smit, & Dashorst, 2007). At the most abstract level, "core tasks" describe units of assessment very broadly. These core tasks are somewhat similar to competencies. For example, one core task in an educational program for store managers is "You carry out company policy". At the intermediate level, "working processes" describe all constituents of the core tasks (e.g., "You analyze and interpret sales numbers"). At the most concrete level, "performance criteria" describe all constituents of the working processes (e.g., "You explain the difference between predicted and actual sales numbers"). In Figure 3.1 the selection of assessment criteria is depicted. This figure shows two core tasks and their associated working processes. The associated working processes are depicted directly under the core tasks. Students can select as many core tasks and working processes for assessment as they deem relevant. This is done by placing a check in the adjacent check-box In Figure 3.1 the working process "You manage article presentations" is selected. Please note that students need not select performance criteria for assessment. Performance criteria are automatically generated when students select core tasks and working processes.

In the third step of the process students self-assess their performance on criteria that are generated from their previous selection of core tasks and working processes. Figure 3.2 shows the third step of the assessment process. The student is expected to score each individual criterion by selecting either U (unsatisfactory), Q (questionable), S (satisfactory), W (well), or N/A (not

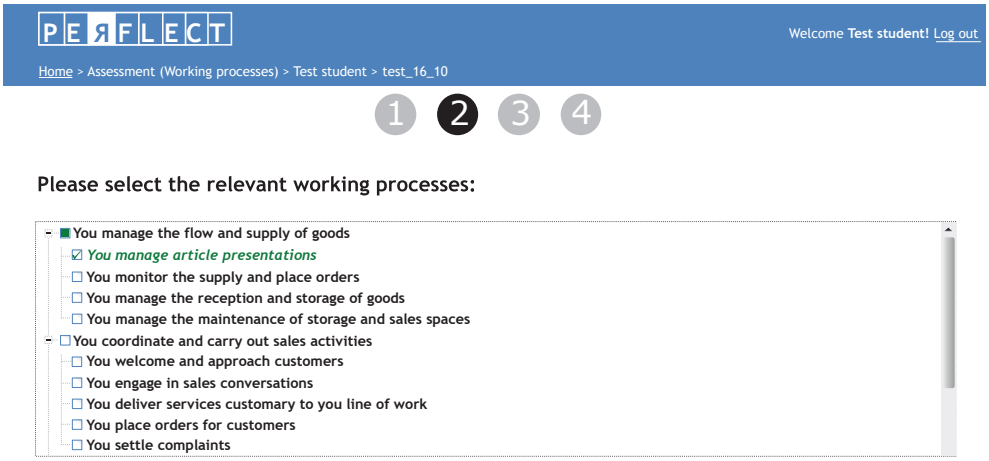

Figure 3.1: A screen-shot of the assessment criteria selection page. Here students select the relevant assessment criteria for their self-assessment. Students can select core tasks and working processes. Performance criteria are automatically retrieved from these choices and shown on the subsequent page (see Figure 3.2).

applicable). Finally, in the fourth step of the self-assessment process, students are presented with a self-coaching protocol. This protocol consists of eight leading questions that are designed to emulate the coaching role. Four questions in the protocol are aimed at training self-assessment skills (e.g., "What went well?"). Two questions are aimed at training formulation of PfIs (e.g., "What do you need to improve on?"). Finally, two questions are aimed at training the ability to identify learning resources that help students improve their performance on future learning tasks (e.g., "What information do you need to realize your PfIs?").

To support a gradual transition from teacher-directed learning to student-directed learning, students should share responsibility for performance assessment with their teacher or another intelligent agent when they start to acquire SDL skills (Van Merriënboer & Kirschner, 2013). PERFLECT facilitates this sharing of responsibility for performance assessment in four ways. First, learning tasks can be assessed by various assessors (i.e., the teacher, a peer student, and other relevant assessors). The availability of multiple assessments allows students to compare assessments on similarities and discrepancies. The student can access this information in assessment overviews that automatically integrate all assessment sources. Second, students can retrieve assessment information on all levels of specificity in PERFLECT, ranging from all scores on a specific performance criterion (i.e., vertical assessments) to integrated scores on whole core tasks (i.e., horizontal assessments). They can thus access

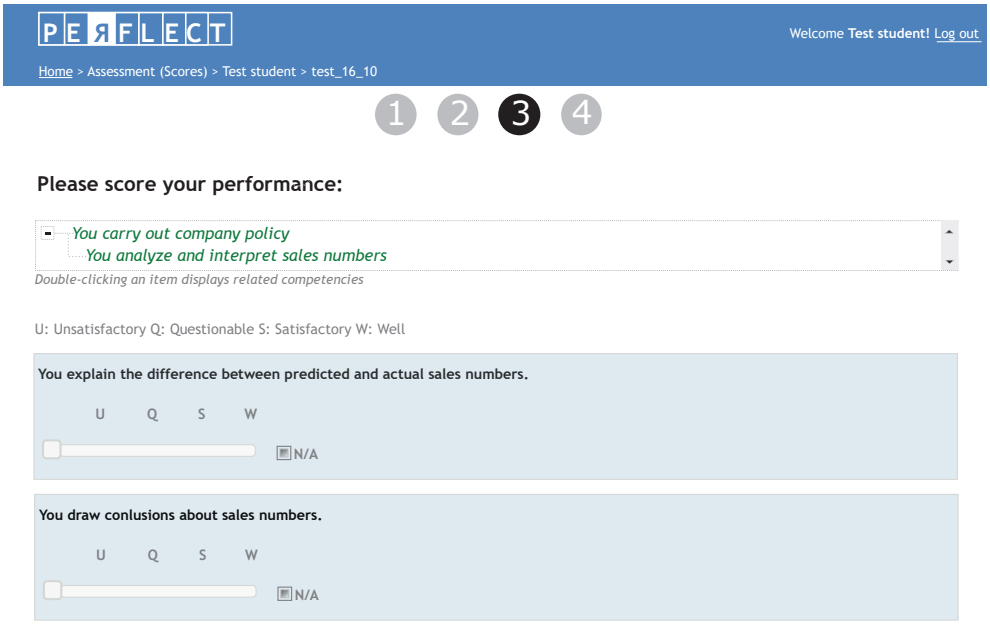

Figure 3.2: A screen-shot of the third step in the self-assessment process. In this step, students score performance criteria based on their previous selection of assessment criteria. They can score their performance on the listed performance criteria with an U(Unsatisfactory), Q(Questionable), S(Satisfactory), W(Well) or N/A (Not applicable).

specific assessment information when they start to acquire a skill and more general information when they become more proficient at it.

A third way responsibility for performance assessment is shared, is by the implementation of coaching sessions into the PERFLECT work-flow These sessions have been found very beneficial, if not essential to the development of SDL skills (e.g., Dannefer & Prayson, 2013; Kicken et al., 2008; Van Schaik, Plant, & O'Sullivan, 2013). In these sessions, teachers systematically discuss the assessed learning tasks with the student in the light of acquiring SDL skills. For the self-assessment part they discuss similarities and differences between their own choices of assessment criteria and scores and those of their student. Whereas these sessions start out as being teacher directed, gradually the student is expected to assume more responsibility over the learning process (see Hadwin, Wozney, & Pontin, 2005). Finally, in addition to quantitative feedback, students can also access qualitative feedback in PERFLECT. This feedback is provided by the teacher after a coaching session. As students become more proficient at the various skills, the associated feedback will gradually become more global to ensure a shift in responsibility for learning.

The second way PERFECT facilitates the development of SDL skills is by supporting the formulation of PfIs. This functionality is integrated in PERFLECT and the associated coaching sessions. The groundwork is laid in PERFLECT, where PfIs are automatically recorded in the final step of the self-assessment process. These recorded PfIs are also automatically integrated into the assessment overview. Subsequently, the quality of formulated PfIs is discussed in the coaching sessions. To exemplify this process, consider the following situation: A store manager trainee poorly manages customers' complaints and many customers feel they are not taken seriously. The student wants to improve his complaint-management skills and formulates the following PfI in PERFLECT: "I need to handle complaints better". This PfI is poorly formulated and needs to be ameliorated. To do so, the teacher focuses on four different aspects. First, specificity is targeted by focusing on the actual problem. A more specific PfI could be: "I will show customers that I take their complaints seriously". Second, the student is coached to make the PfI measurable, for example: "I will show customers that I take their complaints seriously, by ending every conversation with the question: 'Have I handled your complaint satisfactory?'". Third, the teacher will coach the student to form realistic PfIs. In this case, the change from never asking customers if they are satisfied, to asking it every time, is likely to be too drastic and fail. A more realistic goal would be to do it 50% of the time. Finally, a well-formulated PfI is placed in a specific time-frame When all suggestions are combined, the final PfI could be: "Over the course of the next week I will show customers that I take their complaints seriously by ending at least 50% of the conversations with the question: "Have I handled your complaint satisfactory?'".

Kicken et al. (2008) advise to gradually decrease the detail and frequency of advice on the formulation of PfIs. In the PERFLECT work-flow this kind of second-order scaffolding is implemented in the coaching sessions. The first way to do this is by gradually decreasing the number of aspects that advice is given on. Whereas in the beginning the student is offered advice on all four aspects of well-formulated PfIs, later on this might be decreased to three or two aspects and in the end to no aspects at all. Second, the student is stimulated to gradually formulate learning goals that are more ambitious. If the aforementioned store manager trainee has succeeded in asking 50% of his customers about their satisfaction with the way their complaint was handled, he might be suggested to aim for a higher percentage. Finally, the frequency of the advice that was given can be decreased, for example from once every week to once every two weeks.

The final way PERFLECT facilitates the development of SDL skills is by supporting future task selection. In the PERFLECT work-flow this is mainly implemented in the coaching sessions. Future task selection is driven by two questions in these sessions. First, the students are asked if they want

to execute the following learning task with less support, the same amount of support, or more support. Second, students are asked if they think they are ready to perform more difficult tasks. The answers to these questions form the basis for a discussion between the teacher and the students. By discussing similarities and discrepancies between points of view of the students' and their teacher, the students are supported with the selection of learning tasks that fit their learning needs.

Similar to the diminishing advice for the formulation of learning goals, Kicken et al. (2008) advise to gradually decrease the detail and frequency of advice given on future task selection. This means that at first students receive a substantial amount of support and guidance when they answer the two guiding questions. The amount of support and guidance will be slowly diminished. The same is true for the frequency at which advice is dispensed. A second way to apply second-order scaffolding is by limiting the amount of the learning tasks students can choose from. This means that at first, the teacher will pre-select some learning tasks for students so that it is easier to select an appropriate learning task. As the students become more proficient at selecting new learning tasks, the pre-selection will include more learning tasks, until finally the teacher makes no pre-selection at all.

The three functionalities previously discussed are implemented to ensure that PERFLECT facilitates a smooth transition from teacher-directed learning to student-directed learning. The following section describes a small-scale empirical evaluation of working with PERFLECT. The aim of this evaluation was twofold. One part of the evaluation was aimed at investigating whether or not PERFLECT actually facilitates the development of SDL skills. The other part was aimed at identifying ways to improve PERFLECT both in terms of functionality as well as in terms of usability.

3.2 Evaluation

3.2.1 Method

This study comprised a total of 22 students between the ages of 16 and 21 years ($M = 17.7$, $SD = 1.3$). The participants were all students of senior vocational education at an institute in the western region of the Netherlands. Students of pedagogical work (n = 5) and media development (n = 17) participated. The sample included 14 males (70%) and six females (30%). Two teachers participated in the study, one teacher of pedagogical work and one teacher of media development.

We used a coaching protocol to shape the student-teacher conversation during the coaching sessions. This protocol specifies the minimal content of a coaching-session conversation. It is divided in three sections. The first section

is aimed at assessment of performance on learning tasks. This section contained two questions: "Has the student completed at least one self-assessment per day?", and "Has the student selected the relevant core tasks and working processes?". The second section of the coaching protocol was aimed at supporting the formulation of PfIs. The four questions in this section included: "Are the formulated PfIs specific enough?", "Do the formulated PfIs describe concrete behavior?", "Are the formulated PfIs realistic?", and "Are the formulated PfIs time-bound?". The last section is aimed at future task selection and contains one question: "Which future learning task fits the student's learning need?"

The teacher was asked to make short notes during the coaching session on a note sheet. This sheet was designed to complement the coaching protocol. It was divided in the exact same sections as the coaching protocol was. In essence the coaching protocol and the coaching session note sheet were the same document with one important difference. While the coaching protocol contained explanations about its respective sections, the coaching session note sheet contained blank rectangular areas in these places. This allowed the teacher to write down if he agreed with the student, and if necessary explain why or why not.

We used an evaluation questionnaire to record students' perceptions about various aspects of working with PERFLECT. This questionnaire consisted of 10 closed-ended statements and two open-ended questions. The closed-ended statements were aimed at measuring PERFLECT's perceived usability (two items, e.g., "It was easy to use PERFLECT"), its perceived utility (three items, e.g., "Working with PERFLECT was educational"), and its perceived ability to support facets of SDL (five items, e.g., "I was stimulated by PERFLECT to think about my performance on learning tasks"). Students were asked to indicate on a 5-point Likert scale, ranging from 1 (fully disagree) to 5 (fully agree) their level of agreement with the statements. The two open-ended questions inquired what students appreciated about PERFLECT and what they thought could still be improved.

All participating students and teachers attended an introductory workshop about working with PERFLECT. The workshop was divided in two parts. The first part of the workshop was aimed at illustrating the benefits of working with PERFLECT. The second part of the workshop was aimed at instructing students how to use the portfolio. After the workshop students were asked to use PERFLECT over a period of three weeks to self-assess their performance on learning tasks. While students were encouraged to engage in daily self-assessments, they were not obliged to do so. In addition to regularly performing self-assessments some students participated in coaching sessions that were designed to complement the self-assessment process. About halfway through the study, it was tried out with the five students of media devel-

opment. Teacher coaching occurred in 15-minute sessions. The teacher was instructed to discuss all sections of the coaching protocol to ensure a uniform coaching session experience for all students. However, the teacher was allowed to provide additional comments if there was a need to do so.

At the end of the study all students were asked to fill out the evaluation questionnaire. They were individually asked to describe their perceptions of PERFLECT's usability, utility, and ability to support SDL, in an interview using the questionnaire as framework. These interviews were recorded. Finally, the same questionnaire served as basis for discussion with the media development teacher about PERFLECT and its ability to facilitate SDL. This interview was also recorded.The pedagogical work teacher was not available for an interview.

3.3 Results

The 22 participating students used PERFLECT to assess a total of 44 learning tasks, which is about two learning tasks per student ($M = 2.2$, $SD = 1.3$). Additionally, they formulated 44 PfIs. However, not all of these PfIs were meaningful. After subtraction of meaningless PfIs such as "nothing" and "-", 34 PfIs remained. On average, a little less than two PfIs were formulated per student over the study period ($M = 1.7$, $SD = 1.2$). For the most part, these points were broadly formulated. Examples of formulated PfIs include "I need to pay attention more often", "I have to work according to guidelines", and "I have to prepare the activity". As was mentioned before, selection of new learning tasks is an integral part of the coaching sessions in the PERFLECT work-flow It was only a small part of this study because the coaching sessions were not piloted with all students. Analysis of the coaching session note sheets shows that the teacher often had to steer students in the right direction when it came to selecting the appropriate criteria for self-assessments. The teacher noted that none of the five students had selected the appropriate criteria for these assessments before the session. The teacher agreed with all the PfIs the students had formulated. Notes regarding the future task selection only indicated that the topic was discussed, such as "yes", but did not provide any conclusive information as to what was discussed.

The evaluation questionnaire was filled out by 17 of the 22 students. Mean scores and standard deviations are reported in Table 3.1. Results in this table show that students were satisfied about PERFLECT's usability and utility ($M = 3.8$, $SD = 1.0$). Positive perceptions are also reported on PERFLECT's ability to facilitate the development SDL skills. Students were satisfied with PERFLECT's ability to facilitate self-assessment ($M = 3.9$, $SD = 0.9$). The same is true for PERFLECT's ability to facilitate the formulation of PfIs (M

= 3.8, SD = 0.8). Finally, students report very positive perceptions about PERFLECT's ability to facilitate future task selection (M = 4.0, SD = 0.8).

Table 3.1: Mean scores and standard deviations on the evaluation questionnaire.

	Score[a]	
Construct and constituent items	M(1-5)	SD
Perceived usability and utility	3.8	1.0
1. It was clear to me what the aim of PERFLECT was.	4.2	1.0
2. It was easy to use PERFLECT.	3.7	0.9
3. I found it useful to make use of PERFLECT.	3.7	0.9
4. Working with PERFLECT was educational.	3.5	1.1
Perceived ability to support self-assessment	3.9	0.9
5. PERFLECT provided a good overview of my performance on learning tasks.	4.2	1.0
6. I was stimulated by PERFLECT to think about my strong sides.	3.5	0.8
7. I was stimulated by PERFLECT to think about my weak sides.	4.0	0.9
8. I was stimulated by PERFLECT to think about my performance on learning tasks.	3.9	0.9
Perceived ability to support formulation of PfIs	3.8	0.8
9. I was stimulated by PERFLECT to think about how I can improve my weak sides.	3.8	0.8
Perceived ability to support future task selection	4.0	0.8
10. PERFLECT helped me think about what I should pay attention to with new learning tasks	4.0	0.8

Note. Construct means were calculated by averaging construct constituent means.
[a] n=17

3.4 Discussion

This article reported on the design and evaluation of PERFLECT, an electronic development portfolio aimed at facilitating the development of SDL skills. PERFLECT was built to support three iterative phases of SDL: self-assessment, formulation of PfIs and learning goals, and selection of future learning tasks. We aimed to evaluate whether PERFLECT was able to support the three aforementioned phases of SDL, whether it was perceived to be usable and of utility, and what could be improved about PERFLECT.

We found some initial support that PERFLECT facilitates the self-assessment of performance on learning tasks and the formulation of PfIs. Stu-

dents reported that PERFLECT offered them valuable performance overviews and helped them gain insight into their strong and weak sides. This is strengthened by actual usage statistics. PERFLECT helped students to self-assess their performance about once a week and to formulate PfIs regularly. However, students had trouble with selecting the appropriate criteria for self-assessment and often formulated their PfIs poorly. This finding is in line with previous research which demonstrates that students cannot solely rely on an electronic portfolio for their development of SDL skills, they need additional coaching, at least in the beginning (e.g., Dornan, Maredia, Hosie, Lee, & Stopford, 2003; Driessen, Van Tartwijk, Overeem, Vermunt, & Van der Vleuten, 2005).

While students perceived PERFLECT to be able to facilitate the selection of future tasks able to do so, we were not fully able to test this particular functionality. As such it is not yet clear how successful PERFLECT actually is at facilitating the selection of future learning tasks. For one part this is the case because selection of future learning tasks is an integral part of the coaching sessions, and these were only piloted with five students. For the other part, this is the case because PERFLECT was tested in an environment that did not allow students to select their own learning tasks. This means that choosing a future learning task was a fictional exercise, which can be demotivating.

Students are satisfied with the utility and usability of PERFLECT. This is reflected in both the evaluation questionnaire as well as the semi-structured interviews. They mainly appreciate that PERFLECT is well-arranged, which allows them to access information efficiently. The improvement suggestions indicate that some thought has to be given to the organization of information and language use in PERFLECT towards follow-up studies. Connections between the various parts of the qualification dossier and nationwide generic vocational competences should be made apparent. Furthermore, the frequency of self-assessments should be evaluated and PERFLECT's lay-out should be improved.

3.4.1 Limitations

The pilot study had a duration period of only three weeks. It is hard to translate findings of these small-scale, shorter-period studies, to large-scale, longer-period studies. This is not necessarily an issue. The pilot study was explicitly aimed at fine-tuning PERFLECT and identifying possible chances and risks for more ambitious interventions. In those terms the study was successful.

We had expected to test PERFLECT in an on-demand education environment, but this did not turn out to be the case. As such we have limited insight in PERFLECT's ability to facilitate future task selection.

3.4.2 Future research

In order to effectively develop SDL skills it is important that self-assessments of performance are accurate. These cannot be accurate if students do not select the appropriate assessment criteria. Moreover, even if students had selected the right assessment criteria it is likely that they would not have accurately self-assessed themselves without support, this is a consistent finding in the literature (e.g., Dunlosky & Lipko, 2007). To help students improve at selecting the appropriate criteria, they should receive support and guidance. For example, the appropriate assessment criteria could be pre-selected when students start to self-assess their performance. As they progress, the responsibility for criteria selection should then gradually shift towards them. To improve self-assessment accuracy students should be able to access information that describes their performance objectively, when they engage in self-assessment. Possibly students can learn from the discrepancies between their own judgments and those of their teachers. We propose that future studies investigate if self-assessment accuracy can profit from automatically confronting students with such discrepancies and prompting them to explain these differences.

Optimally, students' formulations of PfIs are concrete and meaningful. In our current setup the teacher provides both cognitive feedback and corrective feedback to the students in the coaching sessions about formulating PfIs. The cognitive feedback is aimed at supporting students' understanding of how to formulate PfIs. The corrective feedback is aimed at identifying common errors and misconceptions and reducing these. This is a suboptimal situation. Optimally, corrective feedback on task performance should be provided contingently (Hattie & Timperley, 2007). We propose that future research focuses on developing algorithms that analyze submitted PfIs on common mistakes and offer immediate, corrective feedback.

3.4.3 Conclusion

PERFLECT is a promising tool to facilitate the development of students' SDL skills, including self-assessment of performance, formulation of PfIs and selection of future learning tasks. Additional coaching aimed at providing second-order scaffolds is essential to ensure the students' SDL skills develop effectively.

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Chapter 4

Students, direct thyselves! Developing self-directed learning skills with an electronic development portfolio

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Abstract

This quasi-experimental study investigates the effects of using an electronic development portfolio (PERFLECT) with a student self-coaching protocol and limited teacher coaching on the development of students' self-directed learning skills and motivation. In a twelve-week program in senior vocational education, the PERFLECT group used the portfolio to help self-direct their learning, while the REGULAR group followed the regular educational program. Students in the PERFLECT group reported higher levels of self-direction, intrinsic goal orientation, and self-efficacy than students in the REGULAR group. Furthermore, over time students in the PERFLECT group demonstrated development of their self-directed learning skills: their self-assessments of performance on learning tasks became more accurate and their formulated points for improvement expressed a higher quality. No difference was found with regard to students' satisfaction about the way student self-coaching versus teacher coaching facilitated their development of self-directed learning. Using an electronic development portfolio with a student self-coaching protocol is a promising approach to enhance the development of students' self-directed learning skills and motivation. Through the use of performance related assessment cues and learning analytics the use of electronic development portfolios can likely be made even more effective.

Competency-based education is widely implemented within Vocational Education and Training (VET). This form of education has gained popularity because it is expected to reduce the gap between education and the labor market (Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004) and lead to the development of competencies that can be applied across various contexts (Wesselink, Biemans, Mulder, & Van den Elsen, 2007). In competency-based education students are often given more responsibility for their own learning, for example by giving them more control over their individual learning trajectories. Such increased control over learning likely motivates students through increased autonomy (e.g., Schnackenberg & Sullivan, 2000; Vansteenkiste, Ryan, & Deci, 2008) and gives them the opportunity to develop skills for self-directed learning (SDL, e.g., Knowles, 1975).

Over the past few decades the importance of well-developed SDL skills has been emphasized because they are deemed to be essential for lifelong learning (e.g., Bolhuis, 2003). While SDL is not a clear-cut concept (i.e., many different definitions and closely related concepts exist), most conceptualizations share some form of self-assessment, learning-needs diagnosis and formulation of learning goals, and selection of learning tasks (e.g., Boekaerts & Corno, 2005; Paris & Paris, 2001; Ziegler, Stoeger, & Grassinger, 2011). These SDL skills do not come naturally; out-of-the-box people are notoriously bad at self-assessing their performance (e.g., Carter & Dunning, 2008; Langendyk, 2006; Kruger & Dunning, 1999) and selecting learning tasks that fit their learning needs (e.g., Azevedo, Moos, Greene, Winters, & Cromley, 2008; Stone, 1994; Williams, 1996). Fortunately, research shows that the development of SDL skills can be fostered by proper training (e.g., Kostons, Van Gog, & Paas, 2012; Roll, Aleven, McLaren, & Koedinger, 2011).

While competency-based education can contribute to students' development of SDL skills, it is essential that training programs also include guidance and support during the development process. This is consistent with socio-cognitive learning theories that describe a gradual transition of responsibility for learning from teacher to student (Schunk & Zimmerman, 1997; Winne & Hadwin, 1998; Zimmerman, 1989). This transition is supported by instructional scaffolding techniques such as modeling, coaching, and the use of learning tasks that are sequenced from simple to complex. While these instructional scaffolding techniques are usually aimed at supporting the development of domain-specific skills they can also be aimed at supporting the development of SDL skills. This is a process known as "second-order scaffolding" (Van Merriënboer & Kirschner, 2013). Second-order scaffolding supports students with self-assessment of performance on learning tasks, formulation of points for improvement (PfIs), and selection of future learning tasks. This support is provided by an intelligent agent (e.g., a teacher or a computer algorithm) that helps to determine the complexity of learning tasks and amount of

self-direction that is needed. For example, by providing students with concrete performance standards to help them with self-assessment, or by limiting the number of learning tasks they can choose from to help them with selection of future learning tasks.

Often, competency-based education includes a portfolio aimed at supporting the learning process. These kinds of portfolios are tools that help students reflect on their learning process and document it. Research shows that portfolios used to support the learning process can be used successfully to support the acquisition of SDL skills (Barbera, 2009; Cheng & Chau, 2013; Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009a). One type of portfolio that is used to support learning is the development portfolio. This kind of portfolio has embedded features that are explicitly designed for second-order scaffolding. Among others, these include overviews of past performance on learning tasks, a pre-selection of suitable learning tasks, and advice on how to formulate attainable learning goals.

The use of development portfolios has indeed been linked to various positive results with regard to SDL outcomes. Among others, it has been associated with improved learning-task selection and improved learning-plan formulation skills (Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009b). The use of development portfolios has also been associated with increased levels of student motivation (Abrami, Venkatesh, Meyer, & Wade, 2013). However, effective portfolio use can only be ensured under certain conditions. For example, it is very important that portfolio use is integrated into existing educational activities, it should not be placed in the periphery (e.g., Meyer, Abrami, Wade, Aslan, & Deault, 2010). Furthermore, a portfolio should not only be used as a formative assessment instrument, but also in a summative sense to ensure that students take it seriously (Driessen, Van Tartwijk, Overeem, Vermunt, & Van der Vleuten, 2005). But perhaps reported most consistently in the literature is the importance of complementing portfolio use with regular coaching sessions (e.g., Driessen, van Tartwijk, van der Vleuten, & Wass, 2007; Dornan, Maredia, Hosie, Lee, & Stopford, 2003; Dannefer & Henson, 2007).

Regular coaching sessions are an essential part of the aforementioned second-order scaffolding. In these sessions students seek to discuss the direction of their learning path with their coach by attempting to answer the following important feedback questions: "Where am I going?", "How am I going?" and "Where to next?" (Hattie & Timperley, 2007). The coach helps students answer these questions by offering them advice on how to effectively self-direct their learning on specific learning tasks. This advice may pertain to self-assessment of performance on learning tasks, formulation of PfIs, or selection of future learning tasks. Coaches can for example help students self-assess their performance on learning tasks more accurately by asking them critical questions about their assessment (e.g., "Why do you think you have mastered

this skill?"). They can advise students on the quality of formulated PfIs (e.g., "Please make sure to specify how you aim to improve your performance on this learning task") and they can offer students advice on the appropriateness of selected learning tasks (e.g., "Why do you think this task is right for you at this point in time?").

While coaching is an essential part of second-order scaffolding it is a very time- and energy-consuming process. Electronic variants of development portfolios play a promising role in reducing time- and energy expenditure on the side of the coach. These electronic development portfolios can automate certain administrative aspects of paper-based development portfolios (e.g., automatically adding up performance scores), but perhaps more interesting they can take on the role of a virtual coach by emulating the role a real-life coach fulfills in coaching sessions. In fact, the available research in this area demonstrates that parts of the regular coaching role can be emulated by intelligent software, e.g, *Metatutor* (Azevedo, Johnson, Chauncey, & Burkett, 2010) or *Atgentschool* (Molenaar, van Boxtel, Sleegers, & Roda, 2011). One way to emulate the teacher's coaching role is by integrating routine coaching questions (e.g., "What aspects of this learning task have you completed well?") into a student self-coaching protocol. It is important to investigate if such a student self-coaching protocol can also effectively emulate the teacher coaching role. In other words: Can an electronic development portfolio with limited teacher coaching and a student self-coaching protocol facilitate the development of SDL skills and positively influence students' motivation?

The following sections describe a quasi-experimental study that is aimed at investigating the effects of using an electronic development portfolio with a student self-coaching protocol and limited teacher coaching on the development of students' SDL skills and motivation. To do so the study includes a comparison between a group of students that follows the regular educational program while using the portfolio with the student self-coaching protocol and limited teacher coaching (the PERFLECT group) and a group of students that only follows the regular educational program without additional support (the REGULAR group). In the context of senior vocational education we aim to answer three research questions:

1. Do students in the PERFLECT group demonstrate superior SDL skills and motivation compared to students in the REGULAR group?

2. Do students in the PERFLECT group demonstrate development of their SDL skills?

3. Are students in the PERFLECT group more satisfied about teacher coaching than self-coaching with regard to facilitation of development of SDL skills?

In relation to the first research question we hypothesize that the PERFLECT group will demonstrate superior SDL skills and motivation compared to the REGULAR group. Pertaining to our second research question we expect students in the PERFLECT group to demonstrate development of their SDL skills over the intervention period (i.e., we expect an increase in SDL-skill scores). With regard to the final research question, we expect students in the PERFLECT group to be more satisfied about teacher coaching than about self-coaching, because teachers can help students with non-routine questions and student self-coaching cannot.

4.1 Method

4.1.1 Participants

Fifty-four students from two technical programs of a school for senior vocational education in the Southern part of the Netherlands participated in our study. The sample included 52 males and 2 females with an average age of 20.0 years ($SD = 1.7$). They were students of either "Middle management engineering" or "Middle management functionary building". All students were in their third or fourth year of these four-year programs. Existing class structures were used to assign students to the PERFLECT group and the REGULAR group. Students in the PERFLECT group used the portfolio with the student self-coaching protocol and limited teacher coaching while the REGULAR group followed the regular educational program without the portfolio and self- and teacher-coaching. Four teachers participated in this study.

4.1.2 Materials

PERFLECT

To facilitate students' development of SDL skills an electronic development portfolio was designed and implemented (PERFLECT; Beckers, Dolmans, & Merriënboer, 2016). PERFLECT facilitates students' development of SDL skills by supporting self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks.

To self-assess performance on a learning task in PERFLECT, students start by filling out details about the learning task. Following, students are asked to select assessment criteria they think are suitable for self-assessment of their performance on the learning task. Ensuing, these criteria need to be scored with either *U* (unsatisfactory), *Q* (questionable), *S* (satisfactory), *W* (well), or *N/A* (not applicable). In the final step of this process students are asked to reflect on their performance, by answering eight leading questions

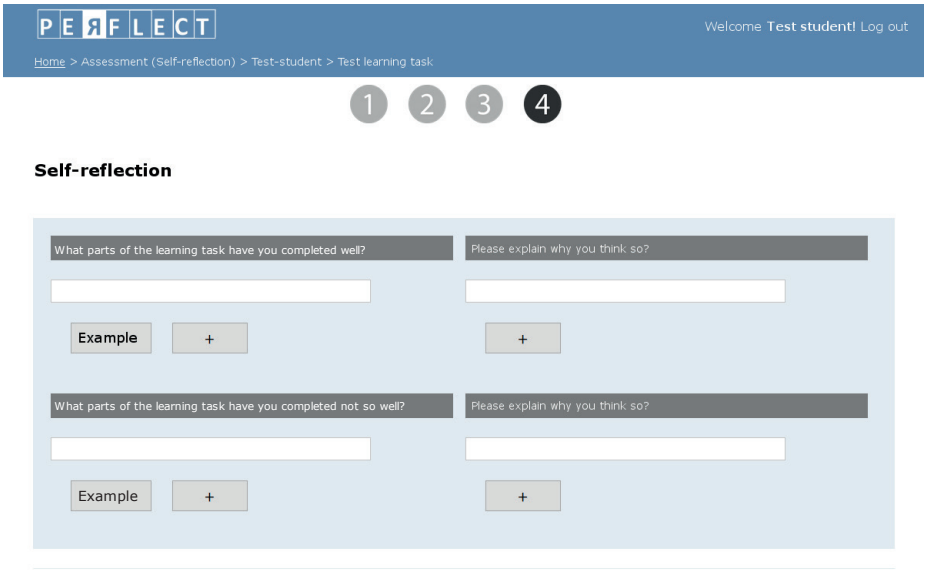

Figure 4.1: The student self-coaching protocol. This protocol contains leading questions that support students' reflection on learning-task performance such as " What parts of the learning task have you completed well?".

(e.g., "What parts of the learning task have you completed well?"). Figure 4.1 depicts part of the student self-coaching protocol that contains leading questions to help students reflection on their learning-task performance in a structured manner (the first four questions are depicted).

Formulation of PfIs is supported in PERFLECT as a part of the self-assessment. One leading question is specifically concerned with formulating PfIs ("Can you formulate a learning goal to improve your performance on the learning task?"). The answer to this leading question is automatically saved by PERFLECT as a PfI. Saved PfIs are later analyzed and discussed with a teacher, in coaching sessions designed to complement the use of PERFLECT.

Support of selection of future learning tasks is also implemented in the self-assessment in the form of two coaching questions. With these questions students determine the appropriate difficulty and the level of support needed for the subsequent learning task. These choices are also discussed in the previously mentioned coaching sessions with the teacher.

Finally, all three functionalities are further supported in automatically generated performance overviews. Students and teachers can access overviews based on single learning tasks but also overviews with aggregated assessment information demonstrating progress over time. Figure 4.2 shows a performance overview with aggregated assessment information over time.

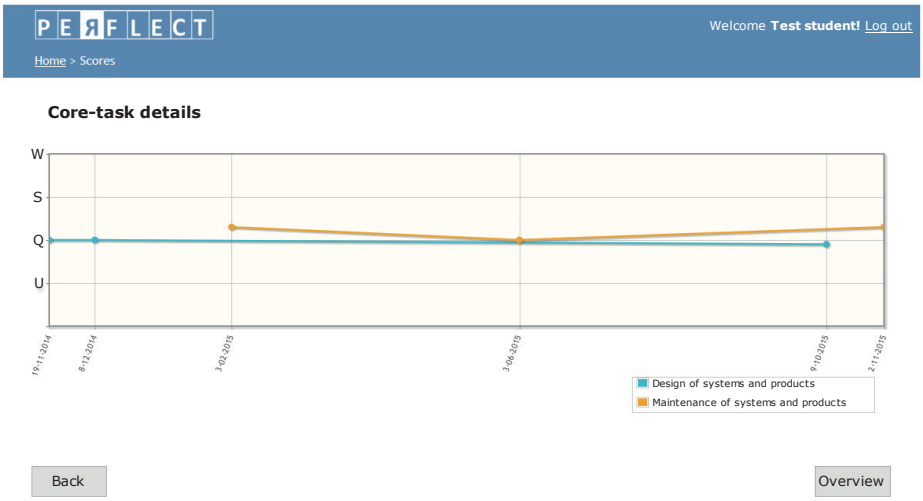

Figure 4.2: Progress over time for one student of middle management engineering on two core-tasks (holistic units of assessment that are comparable to competences). Each line represents one core task. The graph displays various assessment data points that represent an aggregation of self- and teacher assessment scores on a single learning task.

Coaching protocol

For students in the PERFLECT group a coaching protocol was used to ensure that all coaching sessions with the teacher proceeded in a structural fashion. Students in the REGULAR group did not participate in these sessions. The coaching protocol was designed to support self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks. Each of the previous three SDL elements are supported by a number of questions. Self-assessment is supported by three questions (e.g., "Has the student selected the relevant core tasks and working processes?"). Formulation of PfIs is supported by four questions (e.g., "Do the formulated PfIs describe concrete behavior?"). Lastly, selection of future learning tasks is supported by two questions (e.g., "Is the student ready to execute a more difficult learning task?"). Please see the appendix for all questions in the coaching protocol.

4.1.3 Measurement instruments

Motivated Strategies for Learning Questionnaire

To measure students' level of self-directedness and motivation we used four sub-scales of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & Degroot, 1990). Specifically, we employed a version that was translated into Dutch and subsequently validated (van den Boom, Paas, & van Merrienboer, 2007). We used the sub-scale of Meta-cognitive Self-Regulation (11 items, $\alpha = .71$) to measure level of self-directedness. We used the sub-scales of Intrinsic Goal Orientation (three items, $\alpha = .47$), Extrinsic Goal Orientation (four items, $\alpha = .65$) and Self-efficacy for Learning and Performance (eight items, $\alpha = .88$) to measure level of motivation. Two items in the Meta-cognitive Self-Regulation sub-scale and one item in the Intrinsic Goal Orientation scale were removed from the analysis because they displayed a very low (i.e., $<.200$) or a negative item-total correlation. Students were asked to indicate their level of agreement with the presented items in the sub-scales All answers were recorded on a 7-point Likert scale, ranging from *Not at all true of me, to Very true of me.*

Self-assessments and teacher assessments

All students' self-assessments and teachers' student assessments were logged. We measured the quality of the self-assessments by comparing them with teacher assessments. This comparison entailed determining to what extent students and teachers selected the same performance criteria to score the learning tasks and to what extent students and teachers scored these criteria similarly. To see if there was improvement over time (i.e., a greater level of agreement between students and teachers) we compared the level of student-teacher agreement for the first half of the assessments with that of the second half of the assessments.

Formulated PfIs

During the self-assessment process, students' formulated PfIs were also logged. The content of these PfIs was analyzed to see if formulated PfIs included an improvement goal, a method of improvement, and a condition under which improvement should occur. For example, the following PfI contains all three elements: "I need to build electric circuits faster (goal) under time pressure (condition) by making a plan upfront (method)." The presence of each of these elements adds one point to the total PFI quality score, as such this score ranges from 0-3. Each PfI was independently coded by two members of the research

team (interrater-reliability $\kappa = .85$). To see if there was improvement in quality of formulated PfIs a linear regression analysis was conducted.

Evaluation questionnaire

We used an evaluation questionnaire to investigate students' perceptions about both PERFLECT's ability (including the student self-coaching protocol) and teachers' ability to support self-assessment of performance on learning tasks (3 items, e.g., "PERFLECT makes me think more about what aspects of the learning task I performed well") and formulation of PfIs (1 item, "Coaching sessions make me think more about what I need to improve about my performance on learning tasks"). Notice that ability to support future task selection was not measured. This was because students had little to no actual freedom in selecting learning tasks (i.e., a pre-defined lesson plan describing a homogeneous learning path for all students was in place). Students were asked to indicate their level of agreement with the presented items. All answers were recorded on a 5-point Likert scale, ranging from *I fully disagree (1)*, to *I fully agree (5)*.

4.1.4 Procedure

Preceding the intervention, participating students and teachers attended an introductory workshop about working with PERFLECT. For the students, the first part of the workshop was aimed at illustrating the benefits of working with PERFLECT and the second part of the workshop was aimed at instructing students how to use the portfolio. It was at this time that the pre-test (consisting of the MSLQ) was administered. The teachers attended a similar workshop with the addition of an explanation of what was expected from them during the coaching sessions.

The intervention consisted of a 12-week period in which students were asked to assess themselves weekly by filling out the self-assessment with the student self-coaching protocol in PERFLECT. Teachers were asked to assess students' performance on learning tasks once every two weeks; these were preferably learning tasks which students had already self-assessed. The information from both the teacher assessment and the student self-assessment was recorded in PERFLECT and discussed in the complementary teacher coaching sessions using the teacher coaching protocol. After each teacher-coaching session teachers were asked to send their students feedback using PERFLECT. At the end of the 12-week period the post-test (consisting of the evaluation questionnaire and the MSLQ) was administered.

4.2 Results

In the following sections we present student scores on the MSLQ, self- and teacher assessments, formulated PfIs, and the evaluation questionnaire. First, we use MSLQ results to reveal any differences in students' level of SDL and motivation on the post-test, between the REGULAR group and the PERFLECT group. Next, we present results pertaining to the evaluation questionnaire. Finally, we focus on self- and teacher assessment scores, and formulated PfIs to analyze changes over time in the development of SDL.

4.2.1 MSLQ

Table 4.1 presents means and standard deviations for the MSLQ subscales of Meta-cognitive Self-regulation and Self-efficacy for Learning and Performance, for the pre-test and the post-test of both the PERFLECT group and the REGULAR group. Mean scores on the Meta-cognitive Self-regulation sub-scale ($\alpha = .62$) range between 42.21 and 46.41, with a scale maximum of 63 (sum of 9 items, scale 1-7). Mean scores on the Self-efficacy for Learning and Performance sub-scale ($\alpha = .85$) range between 41.12 and 45.20, with a scale maximum of 56 (sum of 8 items, scale 1-7).

ANCOVA demonstrates that there was a significant effect of condition on post-test scores, after controlling for pre-test scores on the MSLQ sub-scale of Meta-cognitive Self-Regulation, $F(1, 42) = 6.78$, $p = .013$, $\eta_p^2 = .145$. The adjusted means of the PERFLECT group ($M = 46.41$, $SE = 1.05$) and the REGULAR group ($M = 42.83$, $SE = 0.98$) reveal that the PERFLECT group scored significantly higher on the post-test than the REGULAR group. There was also a significant effect of condition on post-test scores, after controlling for pre-test scores on the MSLQ sub-scale of Intrinsic Goal Orientation, $F(1, 46) = 4.68$, $p = .036$, $\eta_p^2 = .096$. The adjusted means of the PERFLECT group ($M = 12.40$, $SE = 0.29$) and the REGULAR group ($M = 11.50$, $SE = 0.29$) reveal that the PERFLECT group scored significantly higher on the post-test than the REGULAR group. There was no significant effect of condition on post-test scores, after controlling for pre-test scores on the MSLQ sub-scale of Extrinsic Goal Orientation, $F(1, 43) = 2.46$, $p = .125$. Finally, ANCOVA also demonstrates that there was a significant effect of condition on post-test scores, after controlling for pre-test scores on the MSLQ sub-scale of Self-Efficacy for Learning and Performance, $F(1, 42) = 4.55$, $p = .039$, $\eta_p^2 = .102$. The adjusted means of the PERFLECT group ($M = 45.20$, $SE = 1.00$) and the REGULAR group ($M = 41.12$, SE = 1.03) reveal that the PERFLECT group scored significantly higher on the post-test than the REGULAR group.

Table 4.1: Means and Standard Deviations for the MSLQ subscales of Metacognitive Self-regulation, Intrinsic Goal Orientation, Extrinsic Goal Orientation, and Self-efficacy for Learning and Performance.

	Pre-test				Post-test			
Sub-scale	CON		EXP		CON		EXP	
	M	*SD*	*M*	*SD*	*M*	*SE*	*M*	*SE*
SREG	42.21	10.35	42.45	5.80	42.83	0.98	46.41	1.05
INT	11.30	2.02	11.96	1.71	11.50	0.29	12.40	0.29
EXT	21.50	3.80	20.80	4.88	20.24	0.58	21.53	0.58
SEFF	43.66	6.41	42.91	5.25	41.12	1.03	45.20	1.00

Note. SREG = Metacognitive Self-Regulation, scale maximum = 63, INT = Intrinsic Goal Orientation, scale maximum= 14, EXT = Extrinsic Goal Orientation, scale maximum = 28, SEFF = Self-Efficacy for Performance and Learning, scale maximum = 56, scale 1-7, SREG 9 items, INT 2 items, EXT 4 items, SEFF 8 items.

4.2.2 Self-assessments and teacher assessments

On average students self-assessed between three and four learning tasks ($M = 3.2$, $SD = 1.6$). Their teachers assessed a little less than two learning tasks per student ($M = 1.7$, $SD = 1.7$). In total there were 29 learning tasks that were assessed by both teachers as well as students (please note that some learning tasks were assessed by teachers but not by students and vice versa). When divided over two halves, the first half of assessments includes 14 assessments in which students were assessed by their teacher for the first time. The second half includes 15 assessments in which students were assessed a second or a third time by their teacher.

Table 4.2 displays agreement percentages between students' self-assessments and those of their teachers on scored performance criteria for both time periods. Please note that percentages were rounded, not every row and column will add up to their respective row and column totals.

In period 1, students and teachers gave criteria the same score in only 6% of the cases (i.e., the bold-only diagonal in Table 4.2). In period 2, they gave criteria the same score in 16% of the cases. This is a significant increase of 10 percentage points, $\chi^2(1, 482) = 13.301$, $p = .000$. In period 1, both students and teachers scored criteria as Not Applicable or did not score them at all in 18% of the cases (i.e., the bold italic number in Table 4.2). In period 2, they selected Not Applicable or did not score them at all in only 7% of the cases. This is a significant decrease of 11 percentage points, $\chi^2(1, 482) = 12.403$, $p = .000$. In period 1, students and teachers selected different criteria for the

majority of the cases (69%, i.e., all non-bold italic numbers in Table 4.2). In period 2, they selected different criteria for 67% of the cases. The difference of 2 percentage points between period 1 and period 2 is not significant, $\chi^2(1, 482) = .259$, $p = .611$. In period 1, students overestimate their performance in 4% of the cases (i.e., the sum of the underlined numbers *below* the bold italic diagonal in Table 4.2). In period 2, this is 5%; there is no significant difference between the two periods for overestimation percentage, $\chi^2(1, 482) = 0.363$, $p = .547$. Finally, students underestimate their performance in 5% of the cases in the first period (i.e., the sum of the underlined numbers *above* the bold italic diagonal in Table 4.2). This was 5% in the second period; there is also no significant difference between the two periods for underestimation, $\chi^2(1, 482) = 0.001$, $p = .981$.

Table 4.2: Students' self-assessment scores versus teacher assessment scores in period 1 and period 2 (as percentage of total).

		Teacher score %					Total
		NS	U	Q	S	W	
				Period 1			
	NS	***18***	*2*	*12*	*11*	*3*	45
	U	*0*	***0***	0	0	0	0
Student Score %	Q	*6*	0	***0***	2	0	8
	S	*30*	0	1	***3***	3	37
	W	*5*	0	0	3	***3***	10
Total		58	2	13	19	8	100[a]
				Period 2			
	NS	***7***	*0*	*5*	*16*	*10*	37
	U	*0*	***0***	0	0	0	0
Student Score %	Q	*4*	0	***0***	0	0	4
	S	*23*	0	1	***8***	5	37
	W	*9*	0	1	3	***8***	22
Total		43	0	8	27	23	100[b]

Note. Not scored, U = Unsatisfactory, Q = Questionable, S = Satisfactory, W = Well. Please note that percentile scores are rounded.
[a] 100% = 271 criteria
[b] 100% = 211 criteria

4.2.3 Formulated PfIs

On average, students formulated a little over three PfIs ($M = 3.3$, $SD = 1.6$). After subtracting meaningless PfIs such as "N/A" and "Nothing", students have formulated a little less than three meaningful PfIs ($M = 2.7$, $SD = 1.5$), which is about one PfI for every assessed learning task. The quality of formulated PfIs varied considerably, ranging from very broad keywords such as "Planning" to rather specific descriptions such as "I have to practice more with the software program 'Solidworks' to gain better control over it".

In Table 4.3 we present repeated measures of the quality and composition of the meaningfully formulated PfIs. For every trial (i.e., each time a PfI is formulated) we report the number of formulated PfIs, three composition scores (i.e., percentage of PfIs that include goals, methods and conditions), and the average quality score of the formulated PfIs. Over time there is a substantial decline in the number of formulated PfIs. Whereas 20 PfIs were formulated in the first trial, this number drops to 3 in the last trial. Looking at the composition of formulated PfIs across trials, it is evident that most of these points include a method (a weighted average of 81%), much less include a goal (a weighted average of 34%), and even less include a condition (a weighted average of 15%).

Table 4.3: The quality of students' formulated PfIs over time/trials.

Trial	Meaningful PfIs formulated	PfI includes goal	PfI includes method	PfI includes condition	PfI quality score	
No.	N	%	%	%	*M* (1-3)	*SD*
1	20	25	85	10	1.20	0.41
2	18	33	78	0	1.11	0.32
3	12	33	75	8	1.17	0.39
4	12	42	75	25	1.33	0.49
5	3	33	100	66	2.00	1.00
6	3	66	100	0	1.67	0.58

4.2.4 Evaluation questionnaire

In Table 4.4 we present student evaluation scores of both PERFLECT's and teachers' ability to facilitate the development of SDL skills. Only students in the PERFLECT group completed this questionnaire, because the REGULAR group did not work with PERFLECT nor did they participate in the intervention coaching sessions with their teacher.

We present evaluation scores for self-assessment of performance (measured with 3 items) and formulation of PfIs (measured with 1 item). Individual item means range from 3.5 to 3.9, with a maximum of 5. Results show that students appreciated both PERFLECT's ability to facilitate self-assessment of performance (M = 11.0, SD = 2.2, α = .87), as well as their teachers' ability to do so (M = 10.8, SD = 2.4, α = .88). The evaluation scores for PERFLECT and the teachers did not differ significantly, $t(23) = 0.266$, $p = .793$. Additionally, students appreciated PERFLECT's ability to facilitate the formulation of PfIs (M = 3.9, SD = 0.7) as well as their teachers' ability to do so (M = 3.8, SD = 0.9). These evaluation scores also did not differ significantly $t(23)$ = -0.723, p = .477.

Table 4.4: Evaluation scores of students' satisfaction with self-coaching and teacher coaching with respect to ability to facilitate development of SDL skills.

SDL component	Item	Score			
		Student self-coaching		Teacher coaching	
		M	*SD*	*M*	*SD*
Self-assessment of performance		11.0[a]	2.2	10.8[a]	2.4
	I am stimulated to think more about what aspects of learning tasks I performed well on by...	3.8	0.7	3.8	0.8
	I am stimulated to think more about my weak points by...	3.7	0.9	3.6	0.9
Formulation of PfIs		-	-	-	-
	I am stimulated to think more about what aspects of learning tasks I need to improve on by...	3.9	0.7	3.8	0.9

Note. Mean item scores range from 1-5, 1= fully disagree, 5= fully agree. The evaluation questionnaire was filled out by 24 participants.
[a]SDL component scores range from 3-15.

4.3 Discussion

The current study investigated the effects of using an electronic development portfolio with limited teacher coaching on the development of SDL skills and motivation. With regard to our first research question, we hypothesized that students who used PERFLECT with limited teacher coaching would demon-

strate increased performance in terms of SDL and motivation compared to their peers who did not use PERFLECT. This hypothesis is confirmed. Students who used PERFLECT including self-coaching and with limited teacher coaching displayed improved SDL as measured by the Meta-cognitive Self-Regulation Scale in the MSLQ, while the other students did not. Furthermore, students who used PERFLECT with limited teacher coaching also displayed a superior intrinsic goal orientation and superior self-efficacy beliefs, compared to their peers who did not use PERFLECT.

Concerning our second hypothesis, we expected that students who used PERFLECT with limited teacher coaching would display improvement of their SDL skills over time. This hypothesis is partly confirmed. Over time, students and teachers more often choose to score identical performance criteria, indicating that they increasingly perceive the same criteria as being important for assessment of the learning task. Moreover, over time, they also agree more often on how these criteria should be scored. This suggests that students and teachers move towards each other in terms of scoring performance criteria when the same criteria are chosen. However, more often than not students and teachers disagree on what criteria should be used to assess performance on learning tasks. While this finding is interesting, it is unsurprising, because previous research already suggests that students need a lot of support with selection of relevant criteria for performance assessment (e.g., Fastré, van der Klink, Amsing-Smit, & van Merriënboer, 2014). Interestingly, occurrences of under- and overestimation of performance constitute a minority in our study. This is remarkable, because it is incongruent with the vast body of literature reporting student overconfidence as a serious problem (e.g., de Bruin & van Gog, 2012). Looking at the composition of the PfIs that students formulate, it is clear that students almost always include how they want to improve their performance. However, more often than not they do not include what they want to improve. Moreover, hardly any PfI includes the conditions under which better performance should be achieved. Thus, while in general students improve their ability to formulate PfIs, they can greatly profit from coaching aimed at including what they want to improve and under which conditions they want to improve it, not so much how they plan to do it.

Lastly, we expected students to be more satisfied about teacher coaching than self-coaching, with regard to facilitation of SDL. This hypothesis is not confirmed. In this study, students were satisfied with both forms of coaching. Moreover, no difference was found in students' satisfaction with both forms of coaching. We expected a difference in satisfaction because student self-coaching was designed to handle routine aspects of coaching, so that teacher coaching could help students find answers to non-routine questions. Possibly, teacher coaching also had to focus on routine aspects of coaching. Effectively developing a self-coaching routine takes time, which was limited in this study.

Likely, teachers spent time supporting students' internalization of the self-coaching routine, limiting the available time to focus on non-routine aspects of coaching.

With regard to limitations of this study, we employed a nonequivalent groups design (i.e., the existing school structure was used and the REGULAR group only participated in pre- and post-tests). While this increases the risk of confounding due to the possibility of unequal groups, we took steps to minimize the risk. Firstly, time-on-task was kept equal for the PERFLECT and the REGULAR group, by organizing the coaching sessions during class time. As such the PERFLECT group did not receive more instruction than the REGULAR group and score differences between both groups cannot be attributed to differences in time spent on task. Secondly, to minimize the influence of pre-existing differences between the PERFLECT group and REGULAR group we used ANCOVA, which adjusts the treatment effect for pre-existing differences.

PERFLECT was designed to be used with a wide variety of learning tasks; students were free to choose the learning tasks they wanted to assess. This implicitly means that not every self-assessed learning task was suitable for teacher assessment, because in some cases the teacher had no way of establishing the student's performance on a specific learning task (e.g., learning tasks that teacher had not supervised). Consequently, coaching sessions sometimes had to be postponed or canceled altogether, because there were no suitable learning tasks available to discuss. In future studies, students should receive more support by pre-selecting a number of learning tasks that are suitable for assessment by both students and teachers.

An interesting line of future research is situated in the field of metacognition and is concerned with judgments of learning (JOLs). These JOLs comprise students' judgments about how much is learned from previously performed learning tasks. Koriat (1997) states that at the heart of these JOLs lay a number of performance cues indirectly related to the strength of the memory trace of the performed learning tasks. Some cues are more reliable than others in predicting actual performance. A-specific cues (e.g., JOLs based on a person's belief about his general ability to execute similar learning tasks) are less effective than specific, performance-related cues (e.g., JOLs based on the use of objective performance standards) in helping predict how much is actually learned. In order to improve students' self-assessment skills, future research could focus on integrating performance related cues into an e-portfolios.

Another valuable line of future inquiry is that of learning analytics. Through learning analytics large amounts of user-produced data can be transformed to provide useful personal learning opportunities. The system can for example analyze commonly made mistakes in the user-provided answers and offer suggestions for improvement based on input from other users. Applied to

electronic development portfolios it would be interesting to investigate whether learning analytics can also be used to scaffold students' SDL skills.

Concluding, the use of an electronic development portfolio with a student self-coaching protocol and limited teacher coaching is a promising approach to facilitate students' development of SDL skills. The use of this approach leads to increased student levels of self-directedness and motivation. Moreover, students' self-assessment accuracy improves as well as the quality of their formulated PfIs. However, students have to be supported with selecting suitable criteria for self-assessment. Through the use of performance related assessment cues and learning analytics the use of electronic development portfolios can likely be made even more effective.

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Appendix

The student self-coaching protocol questions:
Self-assessment:

1. Has the student completed a minimum of 1 self-assessment a week?
   If not: What was the reason the student has not completed 1 self-assessment a week? Please explain that regular self-assessments help the student to improve his performance on learning tasks.

2. Do you agree with the student's self-assessment?
   Please ask the student to motivate his self-assessment. Please motivate why you agree or disagree. Please discuss discrepancies between your assessment and the student's self-assessment.

3. Has the student selected the appropriate criteria for his self-assessment?
   If not: Please ask the student to motivate his choice. Inform the student about the appropriate criteria and explain why this was the case.

Formulation of PfIs:

1. Are the formulated PfIs specific enough?
   If not: Please explain that specific goals are better than general goals.

2. Do the formulated PfIs describe concrete behavior?
   If not: Please explain that goals that describe concrete behavior have a higher chance of being attained than goals that do not.

3. Are the formulated PfIs realistic? (i.e., not too easily attainable nor too hard)
   If the formulated PfIs are too easy: Please explain that unambitious goals will not inspire learning. If the formulated PfIs are too hard: Please explain that goals that are too ambitious will likely lead to frustration and are detrimental to learning.

4. Are the formulated PfIs time bound?
   If not: Please explain that time bound goals have a higher chance of being attained than goals that are not.

Selection of future learning tasks:

1. Does the student want to execute the next learning task with or without support?
   Please discuss your vision with the student.

2. Does the student think he is ready for a more difficult learning task?
   Please discuss your vision with the student.

Chapter 5

Walking the tightrope with an e-portfolio: Imbalance between support and autonomy hampers self-directed learning

Beckers, J., Dolmans, D.H.J.M., & Van Merriënboer, J.J.G. (2016). *Walking the tightrope with an e-portfolio: Imbalance between support and autonomy hampers self-directed learning.* Manuscript submitted for publication.

Abstract

Teacher coaching is essential to support self-directed learning, but requires a lot of time and energy. This mixed-methods study investigated the effects of using an e-portfolio with a student self-coaching protocol and limited teacher coaching on the development of self-directed learning skills and motivation. With regard to self-directed learning, students' overestimation of performance on learning tasks grew over time, while their ability to formulate points for improvement did not change significantly. With regard to motivation, students' controlled (i.e., largely extrinsic) motivation increased while their autonomous (i.e., largely intrinsic) motivation decreased. Thematic analysis of interviews demonstrated students needed more support and feedback from their teacher. The use of suboptimal cues for performance assessment and an imperfect balance between autonomy and support hampered self-directed learning and motivation. We recommend providing just-in-time feedback about performance on learning tasks and giving students some autonomy over the choice of learning tasks, to enhance reflection and motivation.

Over the past few years senior vocational education has adapted to meet the changes of the workplace (e.g., the introduction of competency-based education). These changes require students to assume more control and responsibility over their learning process (Jossberger, Brand-Gruwel, Boshuizen, & Van de Wiel, 2010). Giving students more control over the learning process is thought to be advantageous for them. Among others, it is associated with a heightened degree of learner autonomy, which is an important component of intrinsic motivation for learning (Ryan & Deci, 2000). However, students in senior vocational education typically do not possess well-developed self-directed learning (SDL) skills, which are needed to control the learning process effectively. In order to successfully complete senior vocational education it is thus crucial that students develop these SDL skills.

SDL has been defined in many different ways, but most definitions share common elements that include self-assessment of performance, identification of learning needs and subsequent formulation of points for improvement (PfIs), and selection of learning tasks (e.g., Brockett & Hiemstra, 1991; Candy, 1991). Much like the acquisition of domain-specific skills, students should be supported and guided when they acquire SDL skills. Without training, students tend to utilize sub-optimal cues for performance assessment (i.e., indicators of actual performance, Koriat, 1997), fall prey to self-serving biases in self-evaluations (e.g., Dunning, Meyerowitz, & Holzberg, 1989), and are not proficient at choosing learning tasks that match their learning needs (Corbalan, Kester, & van Merriënboer, 2009). It is thus evident that students should only gradually assume responsibility over their own learning process.

Kicken, Brand-Gruwel, and van Merriënboer (2008) suggest that an electronic development portfolio can facilitate a gradual shift in responsibility for learning with built-in features that support learners' self-directedness. An electronic development portfolio facilitates self-assessment of performance on learning tasks, by offering performance standards and information on the student's current level of performance. It facilitates identification of learning needs and formulation of PfIs by offering advice on how to formulate them realistically. Finally, the portfolio helps students choose suitable learning tasks, for example by restricting the number of learning tasks they can choose from.

Indeed, the use of electronic development portfolios has been associated with positive outcomes for both the development of students' SDL skills as well as their motivation to learn (e.g., Abrami, Venkatesh, Meyer, & Wade, 2013; Ziegler & Moeller, 2012). This is not to say that effective use is easily attained. In fact, various reviews demonstrate that a variety of factors influence the effectiveness of portfolio use (e.g., Buckley et al., 2009; Tochel et al., 2009; Van Tartwijk, Driessen, Van der Vleuten, & Stokking, 2007). Research reviews state that teachers should assume a facilitative role when supporting students' development of SDL skills, which can be difficult when they are

used to a more directive role (Chau & Cheng, 2010). Furthermore, portfolio use should not be casual, there should be a driving force (e.g., an assessment status) that inspires students to take the portfolio seriously (Driessen, Van Tartwijk, Overeem, Vermunt, & Van der Vleuten, 2005). While a certain degree of structure is needed to support the student, over-structuration should be avoided (Van Tartwijk & Driessen, 2009). Perhaps most evident from the literature is the persistent finding that teacher coaching is of paramount importance to effective reflective learning with an e-portfolio (Dekker et al., 2009; McMullan, 2008; Nothnagle, Goldman, Quirk, & Reis, 2010).

While teacher coaching is crucial to effective SDL with an e-portfolio, it is a time-consuming process and therefore not always possible. Beckers, Dolmans, and Merriënboer (2016b) suggest substituting a portion of teacher coaching with student self-coaching, so that teachers' workload is significantly reduced, while students' development of SDL skills continues to be supported adequately. To do so, Beckers et al. (2016b) have incorporated a student self-coaching protocol (i.e., a set of reflective questions that are routinely asked by teachers during coaching sessions) into an e-portfolio (e.g., "How can you improve your performance on this learning task?"). As such, a part of the reflective work is already done before the student goes to the coaching session with his teacher.

Results of the Beckers et al. (2016b) study demonstrated that it was indeed possible to foster positive effects on students' development of SDL skills and motivation for learning, while using an electronic development portfolio with reduced teacher coaching and student self-coaching. Over time, students that used the portfolio in this study more accurately self-assessed their performance on learning tasks and formulated higher quality PfIs. Additionally, students using the portfolio were more intrinsically motivated to learn than their fellow students who did not use the portfolio. It is important to replicate these findings, because empirical studies on the effectiveness of electronic portfolios with limited teacher coaching and student self-coaching are scarce. Moreover, it is crucial to understand why these effects occur.

Therefore, we aim to answer the two research questions:

1. What are the effects of using an electronic development portfolio with a student self-coaching protocol and limited teacher coaching in the context of senior vocational education on the development of SDL skills and motivation for learning?

2. How can these effects be explained by students' perceptions of the portfolio's ability to help them self-direct their learning?

We expect students to show development of their SDL skills (i.e., we expect students' self-assessments to become more accurate and the quality of

their PfIs to increase). Furthermore, we expect students to become more intrinsically motivated over the intervention period.

5.1 Method

Forty-seven students participated in this study. The sample included 32 males and 15 females with a mean age of 17.3 years ($SD = 1.5$). These were all students from a school for senior vocational education in the Western part of the Netherlands. There were 17 first-year "Retail entrepreneur" students, 13 first-year "Retail manager" students, 10 second-year "Retail entrepreneur" students, and 7 second-year "Retail manager" students. Four of the students own teachers participated in this study.

5.1.1 Materials

PERFLECT

An electronic development portfolio (PERFLECT; Beckers, Dolmans, & Merriënboer, 2016a) was used to help students self-assess their performance on learning tasks, formulate (PfIs), and select future learning tasks.

Self-assessment of performance is a four-step process in PERFLECT. First, students are asked to fill out details about the learning task. Second, students select assessment criteria for the learning task that they deem relevant. Third, students score these assessment criteria with either *U* (unsatisfactory), *Q* (questionable), *S* (satisfactory), *W* (well), or *N/A* (not applicable). Finally, students are asked to answer questions prompting reflection (e.g., "What parts of the learning task still need improvement?").

Formulation of PfIs is an integrated part of the self-assessment as one of the questions that prompt reflection ("Can you formulate a learning goal to improve your performance on this learning task?"). PERFLECT automatically saves the answer to this question for review later on.

Support of selection for future learning tasks is also an integrated part of the self-assessment. Two reflective questions help students determine the difficulty and level of support that is appropriate for future learning tasks (i.e., "Can you now complete a more difficult learning task?" and "Would you like to complete the next learning task with our without support?").

Teacher coaching protocol

A teacher coaching protocol was used to ensure that all coaching sessions with the teacher adhered to the same basic structure. Like PERFLECT, the coaching protocol was designed to support self-assessment, formulation of

PfIs, and selection of future learning tasks. Three questions in the protocol are aimed at supporting self-assessment of performance on learning tasks (e.g., "Do you agree with the student's self-assessment scores?"). Four questions in the teacher coaching protocol are aimed at supporting formulation of PfIs (e.g., "Are the formulated PfIs realistic?"). Finally, two questions in the teacher coaching protocol are aimed at supporting selection of future learning tasks (e.g., "Is the student ready to complete a more difficult learning task?").

Learning tasks

In cooperation with the teachers in the study we developed 11 learning tasks to help students master the topic of sales activities and to provide them with the opportunity to self-assess their performance. These learning tasks all consisted of dilemmas (e.g., providing feedback to aggressive sales employees) that students may encounter in practice. They were asked to provide solutions for the practical dilemmas. To help the students with the learning tasks, support in the form of prompts was offered (e.g., "It is important to provide feedback based on observed behavior, not based on personal characteristics"). To help students develop their self-assessment skills, support was also offered in the form of a pre-selection of relevant assessment criteria. Over the learning tasks this support gradually faded.

5.1.2 Measurement instruments

SRQ-A

To measure students' level of motivation for learning we used an adapted version of the Academic Self-Regulation Questionnaire (SRQ-A; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009). The questionnaire consists of four sub-scales The first sub-scale measures intrinsic motivation (four items, $\alpha = .89$), a type of motivation that is fully autonomous. The second sub-scale measures identified regulation ($\alpha = .79$) an autonomous form of motivation in which external values have been largely internalized. The third sub-scale measures introjected regulation ($\alpha = .69$), which is a largely controlled type of motivation with some aspects of internalization. Finally, the fourth sub-scale measures external regulation ($\alpha = .77$), the most controlled type of motivation. One item was removed from the introjected regulation sub-scale because it displayed a negative item-total correlation. Students were asked to indicate their level of agreement with the presented items in the sub-scales All answers were recorded on a 5-point Likert scale, ranging from *Not at all important (1)* to *Very important (5).*

Evaluation questionnaire

Students' perceptions about various aspects of working with PERFLECT were measured with an evaluation questionnaire. Students' perceptions about PERFLECT's and their teacher's ability to help them improve self-assessment of performance were measured with six items (e.g., "Answering questions by myself in PERFLECT has taught me how to self-assess myself"). Students' perceptions about PERFLECT's and the teacher's ability to help students formulate PfIs were measured with two items (e.g., "The coaching session with my teacher stimulated me to formulate PfIs'). Two items were also used, with regard to measuring students' perceptions about PERFLECT and the teacher's ability to help students select future learning tasks (e.g., "Answering questions by myself in PERFLECT has stimulated me to think about what I should work on with new learning tasks"). Motivation for learning with PERFLECT and during the coaching sessions with the teacher was measured with two items as well (e.g., "The coaching sessions with my teacher improve my effort and motivation to learn"). Perceptions about PERFLECT's and the teacher's ability to help students gain domain-specific knowledge and skills were measured by four items (e.g., "Answering questions by myself in PERFLECT has helped me prepare for the domain-specific test of sales activities"). Finally, three items measured students' perceptions about PERFLECT's usability and utility (e.g., "I thought PERFLECT was user-friendly"). All answers were recorded on a 5-point Likert scale, ranging from *I fully disagree (1)*, to *I fully agree (5)*.

Domain-specific test

A domain-specific test was used to measure the level of knowledge on the topic of sales activities. The test consisted of 8 multiple choice questions and 22 open-ended questions. Students could obtain a score between 1-10, where a score of 1 is considered to be very poor, a score of 10 is considered to be excellent (i.e., a test with absolutely no errors) and a 5.5 is the minimum passing grade.

Self-assessments and teacher assessments

All self-assessments and teacher's assessments were saved in PERFLECT. To measure quality of students' self-assessments we compared them with teachers' assessments on the same learning tasks. On these joint assessments we measured how often students and teachers selected the same criteria for performance assessment and how often students and teachers scored criteria similarly. To see if there was improvement over time (i.e., more agreement on what criteria to select and how to score them) we compared the first half of the assessments with the second half of the assessments.

Formulated PfIs

All PfIs were analyzed to see to what degree they contained an improvement goal, a method of improvement, and a condition under which the improvement should take place. The presence of a quality element (i.e., a goal, a method, or a condition) yielded one quality point per element. As such the total quality score ranges from 0 (no elements present in the PfI) to 3 (all elements present in the PfI). For example, the PFI: "I need to help more customers (goal) during busy hours (condition)", yields two quality points, because it contains a goal and a condition, but not a method. Each PfI was independently coded by two members of the research team (inter-rater-reliability $\kappa = .85$). To see if there was improvement in the quality of formulated PfIs we compared the first half of formulated PfIs with the second half of PfIs.

Student interviews

Focus group participants were randomly selected from all students that partook in the study. Four focus groups were conducted with a total of 19 students. Research assistants with interviewing experience facilitated the focus group discussion while JB took notes. Students were asked open-ended questions about how they perceived PERFLECT to help them with SDL (e.g.., "How did answering questions by yourself in PERFLECT help you to learn from the learning task?"). Data from the evaluation questionnaire were already available at the time of the interview and used as input (e.g., "Many of you think that the self-reflection in PERFLECT could be improved. How would you suggest that it should be improved?")

All interviews were recorded and transcribed verbatim. The transcripts were entered into and analyzed with qualitative data analysis software (QDA miner 1.5 lite). To analyze the data from focus groups we used thematic analysis with elements of grounded theory (i.e., open coding and axial coding, Strauss, Corbin, et al., 1990). We started the analysis with open coding (i.e., primary coding that describes raw phenomena). Both JB and MK coded the first interview in full. Subsequently, discrepancies in coding were discussed and consensus was reached. MK coded the remaining three interviews. Ensuing, JB used axial coding (i.e., secondary coding aimed at creating connections between open codes) in an iterative process to create initial categories from all open codes. The axial codes were discussed with DD and adapted were needed until both researchers agreed on content. JB combined the final version of the axial codes into themes and a thematic map. The thematic map and themes were discussed among JB, DD, and JvM and adapted until consensus was reached.

5.1.3 Design

We employed a mixed-method sequential explanatory design (Ivankova, Creswell, & Stick, 2006). This kind of design involves collection and analysis of data over consecutive phases, (i.e., quantitative and a qualitative phases). Data that are collected and analyzed in initial phases are subsequently enriched with data collected in later phases. Our study consisted of two phases. In the first phase we gathered quantitative data during the intervention (i.e., data in the portfolio) and shortly after (i.e., the SRQ-A and the evaluation questionnaire) which we used to establish preliminary conclusions. In the second phase these preliminary conclusions were explained with qualitative data (i.e., the student interviews) that were gathered shortly after the intervention.

5.1.4 Procedure

Three of the four teachers in this study had previously worked with PERFLECT. The other teacher was trained informally by the experienced teachers. To promote ownership among the participating teachers, they instructed students about how to work with PERFLECT themselves (instead of the researchers) and they also administered the pre-test (consisting of the SRQ-A) in the first week of the intervention. The intervention consisted of an 11-week period in which students received theoretical instruction about sales activities, completed learning tasks about sales activities under supervision, self-assessed their performance on these learning tasks, and received additional teacher coaching.

The intervention followed a weekly routine. Two hours were reserved for theoretical instruction that was aimed at supporting successful completion of learning tasks. Two more hours were reserved for self-assessment of their performance on learning tasks with PERFLECT. These two hours were supervised by a teacher. It was during these two hours that students were called from their class for a 15-minute additional coaching session once every two weeks (i.e., on a turn-by-turn basis). In these sessions, teachers used the teacher coaching protocol to discuss students' skills with regard to self-assessment, formulation of PfIs, and learning task selection. In this session, discrepancies and similarities between the student's self-assessment and the teacher assessment were also discussed. After the coaching session the teachers provided feedback to the students. At the end of the 11-week period students were asked to fill-out the post-test (consisting of the SRQ-A and the evaluation questionnaire).

5.2 Results

In the following sections we present students' scores on the SRQ-A, the evaluation questionnaire, and the domain-specific test. Furthermore, we analyze students' development of SDL skills over time by comparing students' self-assessment scores with teacher assessment scores and assessing quality of formulated PfIs. Lastly, using thematic analysis on student interviews, we will further explore how PERFLECT with limited teacher coaching and a student self-coaching protocol influences the development of skills for SDL.

5.2.1 SRQ-A

Table 5.1 presents means and standard deviations for the SRQ-A sub-scales of Intrinsic Motivation, Identified Regulation, Introjected Regulation, and External Regulation for the pre-test and the post-test. Mean scores on the Intrinsic Motivation sub-scale (α = .89) are 13.55 for the pre-test and 14.84 for the post-test, with a scale maximum of 20 (sum of 4 items, scale 1-5). Mean scores on the Identified Regulation sub-scale (α = .79) are 13.41 for the pre-test and 14.94 for the post-test, with a scale maximum of 20 (sum of 4 items, scale 1-5). Mean scores on the Introjected Regulation sub-scale (α = .85) are 5.64 for the pre-test and 8.35 for the post-test, with a scale maximum of 15 (sum of 3 items, scale 1-5). Finally, mean scores on the External Regulation sub-scale (α = .90) are 5.81 for the pre-test and 9.55 for the post-test, with a scale maximum of 20 (sum of 4 items, scale 1-5).

Paired-samples t-tests demonstrate that, between pre-test and post-test, there was a significant increase in scores on External Regulation (M = -3.74, SD = 3.78), $t(30)$ = -5.52, p = .000, a significant increase in scores on Introjected Regulation (M = -2.71, SD = 2.82), $t(30)$ = -5.35, p = .000, and a significant decrease of scores on Identified Regulation (M = 1.52, SD = 3.43), $t(30)$ = 2.46, p = .020. There was no significant difference between scores on pre-test and post-test on Intrinsic Motivation (M = 1.29, SD = 3.71), $t(30)$ = 1.94, p = .062.

5.2.2 Evaluation questionnaire

In Table 5.2 we present students' mean evaluation scores of various aspects of working with PERFLECT. We present scores pertaining to PERFLECT's and teachers' ability to help improve self-assessment of performance (M = 2.6, SD = 0.8, α = .90), formulation of PfIs (M = 2.5, SD = 0.8, α = .77), learning-task selection (M = 2.6, SD = 0.8, α = .77), motivation for learning (M = 2.4, SD = 1.0, α = .90), and domain-specific skills (M = 2.5, SD = 0.7, α = .78). We also present scores pertaining to PERFLECT's usability and

utility ($M = 2.4$, $SD = 0.8$, $\alpha = .74$). The evaluation scores reflect a slight dissatisfaction with all aspects.

Table 5.1: Means, standard deviations, and mean differences between pre-test and post-test for the SRQ-A subscales of Intrinsic Motivation, Identified Regulation, Introjected Regulation, and External Regulation on the pre-test and post-test.

Sub-scale	Pre-test (A)		Post-test (B)		Mean difference (A-B)
	M	*SD*	*M*	*SD*	
Intrinsic motivation	14.84	2.88	13.55	2.79	1.29
Identified regulation	14.94	2.69	13.41	2.64	1.53*
Introjected regulation	5.64	2.20	8.35	2.89	-2.71**
External regulation	5.81	2.85	9.55	3.80	-3.74**

Note. Intrinsic Motivation scale maximum = 20, scale 1-5, Identified Regulation scale maximum = 20, scale 1-5, Introjected Regulation scale maximum = 15, scale 1-5, External Regulation, scale maximum = 20, scale 1-5.
* Significant at the $p < .05$ level
** Significant at the $p < .005$ level

Table 5.2: Students' mean evaluation scores and standard deviations on various aspects of working with PERFLECT including: SDL, motivation, domain-specific skills, and usability and utility.

Evaluation aspect	Score (items)	
	M (1-5)	*SD*
Self-assessment of performance	2.6	0.8
Formulation of PfIs	2.5	0.8
Learning-task selection	2.6	0.8
Motivation for learning	2.4	1.0
Domain-specific skills	2.5	0.7
Usability and utility	2.4	0.8

Note. The evaluation questionnaire was filled out by 37 participants.

5.2.3 Domain-specific test

A total of 35 students out of 47 completed the domain-specific test and obtained an average score of 3.9 ($SD = 1.0$) out of 10. Only 2 students passed the test (i.e., obtained a score higher than or equal to 5.5), while 33 students failed (i.e., obtained a score lower than 5.5).

5.2.4 Self-assessments and teacher assessments

On average, students self-assessed about six learning tasks ($M = 5.9$, $SD = 3.0$). Their teachers assessed between three and four learning tasks per student ($M = 3.6$, $SD = 1.7$). In total 109 learning tasks were assessed by both teachers and students (please note that some learning tasks were assessed by teachers but not by students and vice versa). When divided over two periods, the first period contains 52 joint assessments, whereas the second period contains 57 joint assessments.

Table 5.3: Students' self-assessment scores versus teacher assessment scores in period 1 and period 2 (as percentage of total).

		Teacher score %					Total
		NS	U	Q	S	W	
				Period 1			
	NS	***22***	*1*	*2*	*3*	*0*	29
	U	*1*	***0***	0	0	0	2
Student Score %	Q	*18*	0	***1***	3	0	22
	S	*21*	1	4	***7***	0	32
	W	*11*	1	2	2	***0***	15
Total		73	4	9	15	0	100[a]
				Period 2			
	NS	***9***	*3*	*6*	*5*	*0*	22
	U	*2*	***0***	1	0	0	2
Student Score %	Q	*17*	1	***4***	3	0	24
	S	*20*	4	9	***6***	0	38
	W	*6*	1	4	2	***0***	13
Total		54	9	23	15	0	100[b]

Note. Not scored, U = Unsatisfactory, Q = Questionable, S = Satisfactory, W = Well. Please note that percentile scores are rounded.
[a] 100% = 449 criteria
[b] 100% = 532 criteria

Table 5.3 displays agreement percentages between students' self-assessments and those of their teachers on scored performance criteria for both time periods. Please note that percentages were rounded, not every row and column will add up to their respective row and column totals.

In Period 1, overestimation (i.e., the sum of the underlined numbers *below* the bold italic diagonal in Table 5.3) constituted 10% of the scored criteria, this was 21% for Period 2. This implies a significant increase of 11 percentage points in performance overestimation occurrences, $\chi^2(1, 981) = 22.527$, $p = .000$. In Period 1, both students and teachers scored criteria as *Not Applicable* or did not score them at all in 22% of the cases (i.e., the bold italic number in Table 5.3). In Period 2, they selected *Not Applicable* or did not score criteria at all in only 9% of the cases. This is a significant decrease of 13 percentage points, $\chi^2(1, 981) = 31.154$, $p = .000$. In Period 1, students and teachers agreed on criteria scores in only 8% of the cases (i.e., the bold-only diagonal in Table 5.3). In Period 2, they agreed on criteria scores in 10% of the cases. The difference of 2 percentage points between Period 1 and Period 2 is not significant, $\chi^2(1, 981) = .920$, $p = .337$. Students and teachers selected different criteria to assess the same learning tasks (i.e., all non-bold italic numbers in Table 5.3) in 57% of the cases in Period 1. This was 59% for Period 2, a non-significant change, $\chi^2(1, 981) = .002$, $p = .968$. Finally, underestimation of performance (i.e., the sum of the underlined numbers *above* the bold italic diagonal in Table 5.3) occurs in 3% of the cases in Period 1. This was 4% in period 2, a non-significant change, $\chi^2(1, 981) = .001$, $p = .975$.

5.2.5 Formulated PfIs

Students formulated an average of six PfIs during the intervention ($M = 6.0$, $SD = 3.0$), however not all of these were meaningful (i.e., some of these PfIs neither contained goals, nor methods, nor conditions). Examples of such PfIs are: "No", "I cannot", and "Not applicable". After subtracting all meaningless PfIs, students formulated a little less than four PfIs on average ($M = 3.8$, $SD = 2.5$). This amounts to about one meaningful PFI for every two learning tasks. Most of these were formulated rather succinctly (e.g., "handle complaints better" or "check up on procedure").

Table 5.4 presents repeated measures of the quality and composition of the meaningful PfIs. For each trial (i.e., for each subsequent point in time) we report the number of formulated PfIs, the percentage of PfIs that contain goals, methods, and conditions, and the average quality score of PfIs. Trials had to contain more than one PfI to be considered as such. Most PfIs include a method (59%) or a goal (40%), however only a small number of PfIs includes a condition (10%).

Table 5.4: The quality of students' formulated PfIs over time/trials.

Trial	Meaningful PfIs formulated	PfI includes goal	PfI includes method	PfI includes condition	PfI quality score	
No.	N	%	%	%	*M* (1-3)	*SD*
1	33	42	58	0	1.00	0.00
2	25	40	56	16	1.12	0.33
3	26	42	58	12	1.08	0.27
4	23	30	65	9	1.04	0.21
5	15	33	67	7	1.07	0.26
6	13	38	62	8	1.00	0.00
7	10	40	60	10	1.10	0.32
8	10	50	60	20	1.30	0.48
9	6	33	50	33	1.17	0.41
10	6	50	50	0	1.00	0.00

A paired samples t-test demonstrates that the quality of PfIs does not differ significantly between trials 1-5 and trials 6-10, $t(24) = -0.44$, $p = .664$.

5.2.6 Student interviews

Thematic analysis of student interviews revealed four main themes in student discourse about working with PERFLECT. These themes include: SDL conceptions, need for support and feedback, usability and utility, and motivation for learning. Forthcoming, we will describe the identified themes in more detail.

Theme 1. SDL conceptions

Central to this theme are students' conceptions of what SDL entails and whether or not it is useful to self-direct learning altogether. There is strong focus on self-assessment of performance on learning tasks but the theme also touches upon formulation of PfIs. Students find it hard to self-assess their performance and think it is not very useful to do so, they feel information from these assessments is inherently positively biased. They are not inclined to say anything that reflects poorly on them. Students' inclination towards positive judgments of their own performance is captured in the following excerpt:

> What went well? I think that everything I do, I do well. (S19)
> * Laughter**
> Right? Ultimately, I do... otherwise I would not write it down.

(S19)
And how would you like a learning task to be... different then? (INT)
Well, that you just complete the learning task and hand it in. That somebody else just corrects it for you. Because, well, if you correct it yourself... well yeah... you will always do that ehm... in your own positivity. (S39)
To your own advantage. (S19)
Yes, that. (S39)

When students engage in self-assessment of performance on learning tasks they tend to use suboptimal performance cues to do so, for example: "Everyone was done in time, so it must be fine. (S27)"

The concept of formulating PfIs is seen as inherently strange. Students do not think it is useful to formulate PfIs because they feel that they have already performed learning tasks to the best of their knowledge and ability. This is not to say that students believe that their performance is always flawless. They just think they are not able to identify what needs to be improved by themselves. This is seen as something only the teacher can do: "You write down how you think you have done and afterwards you talk with [...] or [...] and only then will it be corrected. Only then you see what you have done wrong" (S33).

Theme 2. Need for support and feedback

Another prevailing topic of conversation was students' need for support and feedback. Students think it is essential to receive feedback from their teachers to *really* know whether or not they are on the right path. A certain insecurity about learning is displayed, which it seems can only be ameliorated by validation of a teacher. Some students even go as far as claiming that without feedback from their teachers it would be impossible to learn at all. The following quote quintessentially captures students' dependency on feedback from their teacher: "In fact we are just like "Henk" [a person from the learning task], if we... he also got to hear when he did something wrong. If he did not hear what he did wrong... he would keep on doing the same thing every time right? (S39)"

In a broader sense, students feel they need to be supported more extensively while they develop SDL skills. The following excerpt illustrates students' need for (more) support: "I was just thrown into the deep end immediately. (S13) And... and... how would you like to see that differently? (INT) Well just eh... feedback about what I am doing. (S13)"

Theme 3. Doubts about usefulness

Discourse in this theme was focused on students' perceptions of PERFLECT's usefulness and usability. As a whole, students do not see much added value in using PERFLECT in their curriculum. They miss certain features in the functional design of the portfolio: "It is better if the learning tasks would be included in PERFLECT (S19)". Furthermore, the student self-coaching questions are perceived to be too general to be useful: "It's just really easy and not about the learning task at all (S28)". Students' doubts about PERFLECT's usefulness are likely aggravated by their occasional misuse of the portfolio: "I just put 'Well', 'Well', 'Well', there, when in fact I did not even complete the learning task at all" (S19). Conversely, students feel that if PERFLECT was aligned better to the other parts of the curriculum it might be more useful: "Well I think in any case... in any case start with PERFLECT a month later. Because then your place of apprenticeship has like a clue of what... what you are like. (S23)"

Theme 4. Motivation for learning

The final theme is concerned with students' motivation for learning. Throughout the interviews students assert that they were only ever really motivated extrinsically for learning by working with PERFLECT. Several obstacles to motivation for learning when working with PERFLECT are identified. Firstly, students perceive some aspects of working with PERFLECT as unchallenging, especially the learning tasks are thought to provoke little thought:

> Ehm... yeah I thought it was pretty boring. Haha. (S17)
> And what makes it boring? (INT)
> Well yeah eh...just the difficulty. In a way it is also quite easy and stuff and as such yeah... then I am not motivated to do it. (S17)

Secondly, working with PERFLECT is perceived to be tedious and monotonous. They perceive the process of self-assessment to be very static, it is always the same: "I thought that eh... there could be a little more variation. Every time you assess yourself it is the same question over and over. And that gets to be monotonous. (S33)". Finally, students state that they are highly motivated to learn from tasks that have practical relevance, which in their eyes, PERFLECT does not have: "I can complete that learning task, but then I do not know whether I can really do it. (S21) ... There is nothing practical in there, so you can never know. (S40)"

All themes and sub-themes are displayed in Figure 5.1. Theme 1, SDL conceptions is represented by the sub-themes within the continuous oval-shaped

line. Theme 2, need for support and feedback is comprised by all sub-themes within the double-lined oval shape. Theme 3, usability and utility, contains all sub-themes within the dashed oval-shaped line. Finally, theme 4, motivation for learning is built up from all sub-themes within the double-lined dashed oval shape. Please note that sub-themes are all represented by gray circles. The size of these circles communicates the relative dominance of the sub-themes within student discourse.

5.3 Discussion

Working with portfolios is a delicate process that only works under certain terms and conditions (Driessen, 2016). The delicacy of this process is reinforced in this sequential mixed-methods explanatory study, where we investigated the effects of using an electronic development portfolio with limited teacher coaching and a student self-coaching protocol on the development of SDL skills and motivation in senior vocational education.

We hypothesized that over the study period students' self-assessments would become more accurate and the quality of students' formulated PfIs would increase. Contrary to what we expected students' self-assessments became *less* accurate; rise in overconfidence was observed. This overconfidence was most apparent in the discrepancy between students' ideas about their performance and their actual performance. Whereas students attested en masse to the lack of challenge offered by the learning tasks in PERFLECT, the vast majority of them did not pass the related domain-specific test. Overconfidence in own abilities is a well-known phenomenon, especially among low-achieving students (e.g., Kruger & Dunning, 1999). However, this does not explain why overconfidence levels *increased* over the intervention period. Qualitative findings suggest that students' repeated exposure to learning tasks that were perceived by them as being too easy, gradually induced a state of overefficaciousness (i.e., an inflated belief in one's own ability to complete tasks and reach goals). Furthermore, students' misguided sense of proficiency was likely exacerbated by their use of suboptimal cues for assessment (e.g., I was done quickly with the learning task, so I performed well), because assessments based on these cues do not necessarily offer information about *actual* performance.

Notably, only 2 students passed the domain-specific test. This may be a product of aforementioned overconfidence. Nowell and Alston (2007) demonstrated that students spend less time on studying if they already feel confident about the test outcome. This seems to provide a plausible explanation for the low grades among the students in our study. Likely they stopped studying prematurely, because they were instilled with a false sense of security about

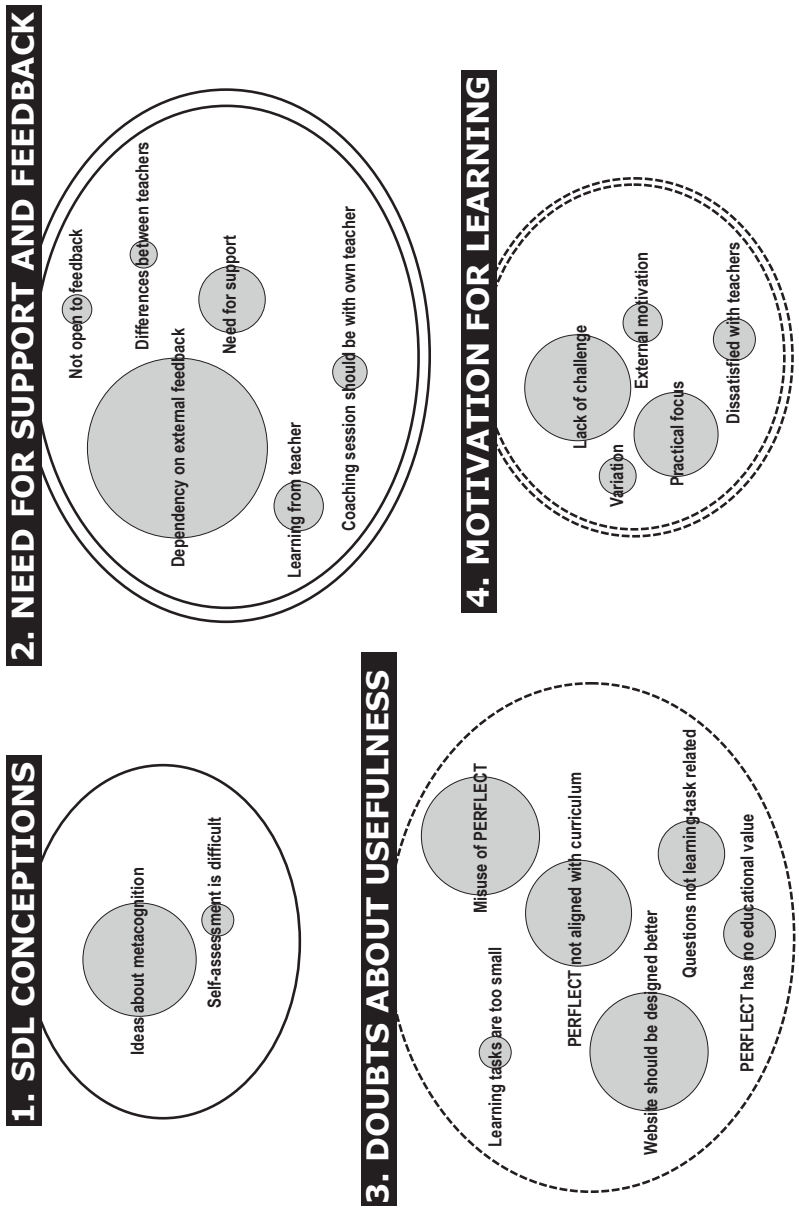

Figure 5.1: A pictorial representation of identified themes and sub-themes within student discourse about PERFLECT's ability to facilitate the development of SDL.

the test outcome. However, it has to be considered that there may have been a problem with either the learning tasks, or the domain-specific test, or both. Students' performance on the domain-specific test may have suffered from ill-alignment between the learning tasks and the domain-specific test (i.e., when the learning objectives addressed by the learning tasks do not match the learning outcomes measured in the domain specific test).

With regard to formulation of PfIs, no change in quality was observed over the study period. Possibly, learning tasks were too small to induce deep reflection of performance on learning tasks, as was suggested by students in the interviews. Learning tasks grounded in practice (e.g., during an apprenticeship) likely would have offered more opportunities to reflect and generate meaningful, high quality PfIs.

Moreover, the leading questions that were designed to structure the reflection were perceived by the students as being too general, they did not apply to learning tasks specifically. Furthermore, students' beliefs about SDL inhibit development of their ability to formulate PfIs. Without external feedback, students think it is pointless to formulate PfIs. They think that self-assessment of performance does not provide a solid basis for formulating PfIs, because the information is inherently positively biased. Students believe you can never *really* assess your own performance. Consequently, they perceive formulation of PfIs to be of little use and do not take it seriously.

We also hypothesized an increase in students' intrinsic motivation for learning after the intervention. This increase in motivational levels was not observed. Conversely, a decrease in identified regulation was observed as well as an increase in introjected regulation and external regulation. Previous research (e.g., Pelletier, Fortier, Vallerand, & Briere, 2001; Vansteenkiste, Lens, DeWitte, De Witte, & Deci, 2004) has made a distinction between *autonomous motivation* (a combination of identified regulation and intrinsic motivation) and *controlled motivation* (a combination of external regulation and introjected regulation). For the purpose of understanding the differential effects of our intervention on students' different types of motivation for learning, we will also use this distinction. The observed increase of controlled motivation versus the observed decrease of autonomous motivation in our study is likely due to a decrease in students' perceived autonomy in the learning process. This loss of perceived autonomy is supported by qualitative results in our study: Students reported to only have worked with PERFLECT because they were required to by their teachers, and that working with PERFLECT had no educational value to them whatsoever.

5.3.1 Theoretical implications

Our study reinforces the importance of constructive SDL beliefs to the development of SDL skills, as suggested by previous studies (e.g., Nothnagle, Anandarajah, Goldman, & Reis, 2011; Van Schaik, Plant, & O'Sullivan, 2013). This study adds to generalizability of these findings by reporting similar findings in the context of senior vocational education. Future research is needed to determine how to best instill constructive SDL beliefs among students of senior vocational education.

The reported findings in this study with respect to motivation may differ across educational contexts. Senior vocational education typically aims to deliver practically-oriented professionals (e.g., car mechanics), while higher education typically aims to educate students broadly. What motivates students to learn in senior vocational education may not motivate students in higher education and vice versa. Further research is needed to ascertain what differences exist between both educational contexts with respect to motivation for learning. Further research is also needed to determine the implications for the design of electronic portfolios aimed at motivating students in these contexts for learning.

Students' repeated exposure to learning tasks that were perceived to be too easy likely led to an increase in overconfidence. Possibly, students would have reflected less on these learning tasks if PERFLECT did not require them to. This begs the question if the use of e-portfolios can be responsible for an increase in overconfidence among students. If so, how would e-portfolios be responsible for such an increase? Further research is needed to answer the two previous questions.

Findings in this study indicate that students did not use optimal cues for performance assessment. It is important to know how portfolios should be designed so that students are encouraged to use optimal cues for performance assessment. Furthermore, this design should account for differences between various types of education. For example, between differences in focus between senior vocational education (i.e., a focus on practical skills) and higher education (i.e., a focus on deep understanding). As such, future research should investigate how portfolios should be designed to evoke the use of optimal cues for performance assessment and on how this design can be adapted to different educational contexts.

5.3.2 Practical implications

To ensure that students engage in deep reflection of performance on learning tasks they need to be aware of the need for self-improvement (Chau & Cheng, 2010). In order to raise such awareness, we propose to offer students

just-in-time feedback about their proficiencies and their deficiencies in their performance on learning tasks. It has to be noted that offering just-in-time feedback is most effective when mastering procedural aspects of a learning task (i.e., aspects of a learning task that are recurrent, like greeting a customer). As such a teacher needs to be present while students are executing learning tasks.

Intrinsic motivation for learning among students needs to be promoted by fostering their autonomy in the learning process. Students should be able to assess performance on learning tasks of their own choice. This allows them to assess performance on learning tasks that they feel are relevant to their own learning. However, to ensure that students choose learning tasks that fit with their learning needs and allow them to come to an accurate self-assessment they should receive feedback on their selection and tips about selecting appropriate learning tasks. To further enhance relevancy to their learning, students should also be able to select learning tasks for assessment situated in their clerkships.

To promote PERFLECT's integration into the daily educational routine it should be able to communicate with other software that students use. We suggest using an application programming interface (API), which is a set of protocols that describe rules for communication between source software and external software. The use of an API would allow other software to communicate with PERFLECT and integrate its data and services into their own environment. As such students can use one program to access all of their relevant data.

5.3.3 Limitations

This study lacked a control group. As such it is hard to attribute the described effects on SDL and motivation to the intervention. However, the sequential mixed-methods explanatory design of the study ensured that additional data were collected. These data give credence to the fact that the reported effects are attributable to our intervention and are not a product of chance.

Due to logistical constraints it was not possible to have the coaches present during execution of the learning tasks. Thus, the coaches could not assess the actual performance of the students. However, the learning tasks also prompted students to describe their learning process. This way the coaches could assess the product of the learning task and the process. Nevertheless, it would be preferable to have coaches present during the actual execution of the learning tasks to rule out any self-reporting biases.

Our approach to SDL entails a cyclical process of self-assessment of performance, formulation of PfIs, and selection of future learning tasks. Whereas students in our study were able to self-assess their performance and formu-

late PfIs, they could not select future learning tasks. Not having control over selection of learning tasks may have led to reduced feelings of autonomy and reduced personal relevancy. Students should be supported in the whole SDL cycle to ensure that they learn to self-direct their learning process effectively.

5.3.4 Conclusion

Using an electronic development portfolio with a student self-coaching protocol and limited teacher coaching to facilitate students' development of SDL skills is a delicate process to which many conditions apply. To ensure that the development of SDL skills is facilitated optimally, students should be assisted in seeing the need for deep reflection of performance on learning tasks. To do so it is important that they are instilled with constructive conceptions about SDL and that they receive feedback on their performance on learning tasks just-in-time. Furthermore, intrinsic motivation for learning needs to be fostered by giving students a certain degree of autonomy over the learning tasks they want to assess, while supporting them in choosing learning tasks that are appropriate for self-assessment.

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Chapter 6

General Discussion

In senior vocational education students are increasingly being expected to take responsibility over their own learning. To do so it is crucial that they develop skills for self-directed learning (SDL). These skills include self-assessment of performance, formulation of points for improvement (PfIs), and selection of future learning tasks (Knowles, 1975). The development of SDL skills requires support and guidance which can possibly be offered by an electronic development portfolio with teacher coaching. Research shows that the use of an electronic development portfolio in combination with teacher coaching can help students develop SDL skills (e.g., Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009) and enhance intrinsic motivation (e.g., Abrami, Venkatesh, Meyer, & Wade, 2013). Yet, teacher coaching is very time-consuming. The main goal of this dissertation was to examine if routine parts of teacher coaching could be substituted with student self-coaching while the positive effects of portfolio use on the development of students' SDL skills and motivation were retained.

Three research questions were formulated to accomplish the main goal. Figure 6.1, which was presented before in the Chapter 1, depicts the three research questions, how they were addressed in the different Chapters, and what type of studies were carried out to investigate them.

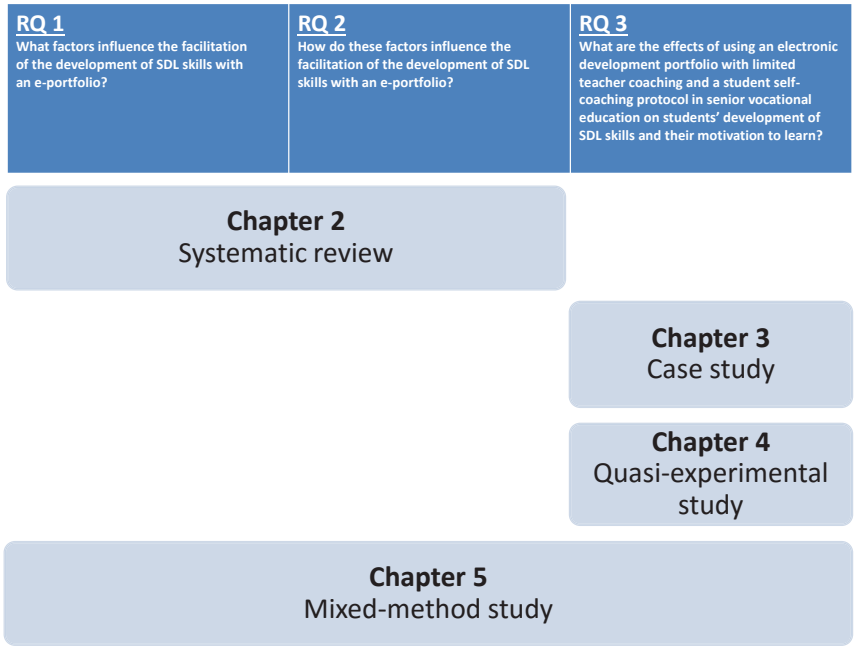

Figure 6.1: An overview of investigated research questions and their relation to dissertation Chapters and carried out studies.

In this General Discussion we will first discuss the main findings from the studies, organized by the three research questions. Next, theoretical implications from these findings are presented as well as directions for future research. Ensuing, practical implications are discussed. Subsequently, limitations of the studies are discussed. Finally, a general conclusion is presented.

6.1 Main Findings

In this section we will discuss the main findings organized by the three main research questions.

6.1.1 RQ 1: What factors influence the facilitation of the development of SDL skills with an e-portfolio?

In Chapter 2 a systematic review was conducted to investigate *what* factors influence effective e-portfolio use, with regard to facilitating the development of SDL skills. This review revealed that the development of SDL skills with an e-portfolio is influenced at five different levels: The institutional level, the curriculum level, the learning process level, the personal level, and the portfolio level. At the institutional level, effective portfolio use is influenced by macro factors such as educational policy (e.g., the presence of a faculty development program aimed at educating teachers about their role in supporting SDL). At the curriculum level, educational choices (e.g., the level of integration of portfolio use with other educational activities) are of influence. At the level of the learning process, micro factors such as the availability of teacher coaching influence the development of SDL skills with an e-portfolio. At the personal level, student characteristics influence effective portfolio use. These factors include motivating them to learn with teacher coaching and scheduling protected time influence effective portfolio use. Finally, at the portfolio level, characteristics of the portfolio (e.g., opportunity to describe points of improvement) influence effective development of SDL skills.

In Chapter 5 students' perceptions of the ability of an electronic development portfolio (PERFLECT) to support the development of their SDL skills were captured in focus-group interviews. Four main influences were identified: (1) Students' SDL conceptions, (2) their need for support and feedback, (3) their doubts about PERFLECT's usefulness, and (4) their motivation for learning. Firstly, effective portfolio use is influenced by students' conceptions of SDL. It is essential that students believe that well-developed SDL skills can yield valuable insights about what to do to improve their learning. Secondly, students assert that they need regular feedback to help them ascertain whether they are moving in the right direction. Thirdly, students' doubts about PERFLECT's usefulness mostly stem from friction between portfolio

use and other activities in the curriculum (e.g., students doubt PERFLECT's usefulness because they could not use it during their apprenticeships). Finally, students experienced trouble being intrinsically motivated for learning, because working with PERFLECT was perceived to be externally mandated and unchallenging.

Looking at the factors that were identified in Chapter 2 and Chapter 5, it is clear that both students and teachers struggle to understand what their role entails exactly in SDL. Teachers display trouble with letting go of their directive role, while students display trouble with taking a more directive role. Students' doubts about PERFLECT's usefulness reinforce the importance of seamless integration of portfolio use into daily educational routines, because these doubts seem to arise from suboptimal alignment of PERFLECT with those routines. Interestingly, results from Chapter 2 and Chapter 5 suggest that motivation to learn is both a prerequisite for effective portfolio learning as well as a desired outcome. Furthermore, results from Chapter 5 reinforce the importance of perceived autonomy among students, because their experience of portfolio use as being externally mandated was associated with decreased intrinsic motivation. Possibly, the use of a static student self-coaching protocol (i.e., a protocol aimed at substituting routine parts of coaching sessions) does not challenge students enough to support their intrinsic motivation.

6.1.2 RQ 2: How do the identified factors influence the facilitation of the development of SDL skills with an e-portfolio?

In Chapter 2, it was also investigated *how* factors influence the development of SDL skills with an e-portfolio. Based on results from the systematic review it can be concluded that several conditions must be satisfied at the institutional level, the curriculum level, the learning process level, the personal level, and the portfolio level. At the institutional level, teacher professionalization aimed at educating teachers about their role in supporting students' development of SDL skills should be present. At the curriculum level it is essential that the portfolio is seamlessly integrated into existing daily routines (i.e., portfolio use should relieve the overall workload instead of add to it). At the learning process level, it is essential that students receive additional teacher coaching in which the responsibility for learning gradually moves from teacher to student. This scaffolding process is also important to increase motivation to learn at the personal level. At the portfolio level, the portfolio must be designed so that it supports basic elements of SDL (i.e., self-assessment of performance, formulation of PfIs, and selection of future learning tasks).

In Chapter 5, students' perceptions of effective portfolio use pointed towards the importance of constructive SDL beliefs among students, provision of

feedback and support, students' doubts about PERFLECT's usefulness, and students' perceived obstacles for intrinsic motivation. In addition to providing teacher professionalization to help teachers understand their role in SDL, it also important to reserve enough time for educating students about their role in SDL. Additionally, it appears that suboptimal integration of portfolio use into daily educational routines may lead to doubts about the usefulness of portfolios. Finally, students' perceptions of limited challenge and autonomy in selection and assessment of learning tasks seem to be related to external forms of motivation.

Chapter 2 and Chapter 5 report similar influences on the development of SDL skills. Specifically, the integration of portfolio use into daily educational routines comes up in both Chapters, as well as the importance of intrinsic motivation in portfolio learning. Interestingly, findings from Chapter 2 were already incorporated into the design of PERFLECT and its implementation in intervention studies (described in Chapters 3 through 5). We have attempted to integrate PERFLECT into daily educational routines and we have focused on gradually transitioning responsibility for learning from teachers to students. Nevertheless, students claim to be externally motivated and have doubts about PERFLECT's usefulness. It thus seems that practical implementation of theoretical insights is not easily attained and that especially the transfer from these insights to practice needs further attention.

6.1.3 RQ 3: What are the effects of using an electronic development portfolio with limited teacher coaching and a student self-coaching protocol in senior vocational education on students' development of SDL skills and their motivation to learn?

The effect of portfolio use on students' development of SDL skills was investigated in Chapters 3 through 5. In Chapter 3 the design and a small-scale evaluation of PERFLECT were described. Students were satisfied with PERFLECT's ability to help them self-direct their learning. They particularly appreciate the fact that PERFLECT offered them good overviews of their performance on a series of learning tasks, that it stimulated them to think about what they could improve, and that it helped them think about what they should pay attention to in future learning tasks.

In Chapter 4 a quasi-experimental study was conducted to establish the effects of using PERFLECT with a student self-coaching protocol and limited teacher coaching on students' development of SDL skills and their motivation. From this study, it could be concluded that students who used PERFLECT reported higher levels of SDL skills than students who did not use PERFLECT. Furthermore, students that used PERFLECT improved at self-assessment of

their performance and formulation of PfIs. For the larger part students and teachers disagree on what criteria are relevant for performance assessment. However, over time students and teachers do agree increasingly on relevancy of criteria for performance assessment, as well as on how these criteria should be scored. Additionally, over time students' formulated PfIs included more quality elements (i.e., an improvement goal, an improvement method, and conditions under which improvement should be attained).

The study in Chapter 5 had a similar aim as the study in Chapter 4, however conflicting effects of using PERFLECT on SDL skills are reported. A negative influence on students' development of SDL skills was found. Over time students' self-assessments actually became *less* accurate. Most notably, students became *more* overconfident over time (i.e., they self-assessed their performance higher than their teachers did).

Whereas the use of PERFLECT yielded positive effects on the development of students' SDL skills in one study (Chapter 4), it yielded negative effects in another study (Chapter 5). While the setup in these studies was very similar, there was one crucial difference: The amount of student autonomy. In the Chapter 4 study, students were allowed to choose the learning tasks they wanted to perform and self-assess, as well as *when* they wanted to self-assess these tasks. In an effort to have more learning tasks assessed by teachers and students, students in the Chapter 5 study could only assess pre-selected learning tasks and were required to assess them under supervision. While more learning tasks were indeed assessed by teachers and students in the Chapter 5 study, student autonomy was inadvertently lost because students could not select which learning tasks they wanted to assess. Perhaps the assessment was overly structured and blocked the transition of responsibility for learning from teacher to student.

The effect of portfolio use on students' motivation was investigated in Chapter 4 and Chapter 5. In the Chapter 4 quasi-experimental study the use of PERFLECT was related to an increase in intrinsic motivation. However, in the Chapter 5 study the use of PERFLECT was related to a rise in controlled motivation (i.e., extrinsic forms of motivation) and to a decline in autonomous motivation (i.e., intrinsic forms of motivation).

The use of PERFLECT also had conflicting effects on students' motivation to learn, much like on their development of SDL skills. The observed decline in students' autonomous motivation provides strong support for the notion that the loss of autonomy had negative effects on students' development of SDL skills in Chapter 5.

6.2 Theoretical Implications

In the following section we will describe three theoretical implications resulting from our research. First, we will describe the delicate balance between support and autonomy that exists when e-portfolios are being used to support the development of students' SDL skills and motivation. Second, we will discuss students' difficulties with selecting relevant criteria for performance assessment. Third, we will discuss the plausibility of substituting teacher coaching with student self-coaching.

6.2.1 The delicate balance between support and autonomy

Our findings are in line with Driessen (2016), who states that: "... without mentoring, portfolios have no future and are nothing short of bureaucratic hurdles in our competency-based education programs." (p. 6). While we agree with the fact that portfolio use should be supported and guided, our results from Chapter 5 indicate that maintaining the delicate balance between student autonomy and support is crucial. While too much autonomy may lead to unfavorable learning outcomes because students might find it difficult to set goals, too much support (e.g., over structuration of the portfolio, or no freedom to select new learning tasks) may lead to frustration among portfolio users and negatively impact their motivation to learn and their development of SDL skills. This begs the question: How much autonomy is too much autonomy? And: How much support is too much support? These are not easy questions to answer. For one, a gradual transition of responsibility for learning from teacher to student implies that the amount of autonomy and support needed are in constant state of flux. Thus, the amount of support and autonomy offered should be dynamic as well. Furthermore, the amount of support and autonomy offered may also vary between individual students, because of individual differences in, for example, cognitive abilities and situational interest.

To account for individual differences between students, differentiated instruction in the classroom is a promising approach (Tomlinson, 2014). E-portfolios are likely very useful tools to help differentiate in the instruction process, because they contain a lot of information about students' learning statuses. However, it is not yet clear how portfolios should be designed so that they accurately reflect the students' current need for autonomy and support. Future research should focus on investigating how portfolios should be designed so they can help teachers decide how to adapt their instruction according to students' current needs for autonomy and support.

6.2.2 Using apprenticeships to help students select relevant performance assessment criteria

In Chapter 4 and Chapter 5 students *consistently* have trouble with selecting relevant criteria for self-assessing their performance. Moreover, the use of PERFLECT does not seem to significantly influence this process (i.e., the percentage of selected criteria that were relevant for performance assessment did not change significantly over time). This is interesting because PERFLECT did have features embedded to help students select relevant criteria for performance assessment (e.g., a pre-selection of relevant criteria in some learning tasks). Furthermore, teachers also discussed the choice of criteria in the coaching sessions.

In order to learn to select relevant criteria for performance assessment, Fastré (2011) states that it is important to identify criteria "... (a) explicitly provided by others, (b) implicitly used by others who assess their performance, and (c) implicitly used by others who demonstrate intended performance" (p. 112). Perhaps, students in our studies demonstrated consistent trouble with selecting relevant criteria for performance assessment, because relevant criteria were largely provided to them explicitly by others (i.e., by PERFLECT and teachers). Likely, students would have experienced more opportunities to identify and experience what criteria are relevant for performance assessment if PERFLECT had also been used during apprenticeships, because then students could learn from others who demonstrate the intended performance.

Future research should focus on investigating whether the use of an electronic development portfolio during apprenticeships provides students with more opportunities to identify criteria that are explicitly provided by others, implicitly used by others who assess their performance, and implicitly used by others who demonstrate intended performance. Additionally, it would be interesting to know whether differences in educational context (i.e., a school setting vs. an apprenticeship) lead to differences in the development of self-assessment skills and the best way to support this development.

6.2.3 Balancing teacher and student self-coaching

An important aim of the studies reported on in this dissertation was to investigate whether routine parts of teacher coaching could be substituted with student self-coaching, while retaining positive effects on students' development of SDL skills and motivation. There is an indication that this is indeed the case; positive effects on students' development of SDL skills and their motivation are reported in Chapter 4. While Chapter 5 reports negative effects, this is likely due to the aforementioned imbalance between support and autonomy,

since the student self-coaching was not perceived negatively by the students in the focus groups of the study in Chapter 5.

In our view, self-coaching is mostly valuable when it supports teacher coaching. Ideally, a basic student self-reflection is already present at the time of a teacher coaching session (i.e., the student has preliminary answers to "Where am I going?", "How am I going?", and "Where to next?"). This way, teachers can have an in-depth discussion with students focused on personal growth. Student self-coaching should be aimed at laying the foundation for a fruitful discussion between student and teacher.

To improve self-coaching, individual learning needs should be taken into account. At this point in time student self-coaching consists of a static set of reflective questions. Likely, these questions will be more motivating and yield more relevant reflections if they are tailored to specific learning tasks and students. We should be moving towards "smart" portfolios that offer students immediate feedback on their learning progress. We join Hadwin, Wozney, and Pontin (2005) in proposing to develop smart portfolios that can tailor their support to the amount of support that students need and the type of support they need (e.g., support for self-assessment of performance).

6.3 Limitations

Throughout this thesis we have defined SDL skills as self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks. While we have had the opportunity to investigate the former two, selection of future learning tasks was only marginally investigated. The studies were planned to be carried out in an educational environment that allowed students to select their own learning tasks, however this was not the case. Students all had to follow a predetermined lesson program. This meant that students' self-directed learning cycle could not be completed and was thus somewhat artificial. Likely, this has impacted students' motivation to learn sub optimally, because students carried out preparatory steps to select learning tasks that fitted their learning needs, only to find out that they could not actually select those learning tasks.

The use of PERFLECT always occurred within a school setting. PERFLECT was never used during apprenticeships. Conversely, students massively attested to the fact that they learn most from actual practice at the workplace. As such, the use of PERFLECT in a school setting likely has less educational value than the use of PERFLECT during apprenticeships. It is reasonable to assume that the use of PERFLECT has a different influence on students' development of SDL skills and their motivation if it is used dur-

ing apprenticeships, because students regard these periods to be of highest educational value.

6.4 Practical Implications

When an e-portfolio is used to support the development of students' SDL skills and their motivation, some important considerations regarding its design and implementation need to be taken into account. The portfolio has to be designed so that it supports self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks. Furthermore, it is essential that portfolio use is implemented in a context where it is part of the daily educational routine (i.e., it is aligned with other educational activities) and supported by regular coaching. It should also be aligned to the aims of the curriculum (e.g., the curriculum offers students the possibility to follow individual learning paths), and fit within the institutional vision on learning (e.g., the institute utilizes forms of learning that foster SDL such as problem-based learning). Furthermore, it must motivate students by offering autonomy to them and increasing the amount of autonomy when students are ready for it (e.g., by gradually increasing the number of learning tasks students can choose from).

Careful consideration has to be given to what learning tasks will be used for self-assessment of performance. Findings in Chapter 5 indicate that students prefer to use real-life learning tasks for self-assessment of performance. However, students need to be able to get feedback, so a coach needs to be present when the learning task is completed to offer students immediate feedback. It is also important that a coach is present during the completion of the learning task so that students' performance can be assessed. It requires careful planning to make sure that students get high-quality feedback about the learning tasks they have completed.

6.5 General Conclusion

The studies conducted as part of this dissertation together provide insight into the factors that influence the development of students' SDL skills with an e-portfolio as well as how these factors influence this development. This dissertation adds to the available literature by focusing on e-portfolios. There is an indication that it is possible to substitute routine parts of teacher coaching with student self-coaching in electronic development portfolios, while retaining positive effects on students' development of SDL skills and their motivation. When students develop SDL skills with an electronic development portfolio it is imperative that the balance between autonomy and support is guarded

– when students do not experience enough autonomy the positive effects of using an e-portfolio disappear. The future of developing SDL skills with an e-portfolio resides with smart portfolios that can enhance SDL skills and students' motivation to learn more effectively by taking individual needs into account.

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Summary

Chapter 1: General introduction

Students in senior vocational education are increasingly being expected to self-direct their learning. However, students do not naturally possess skills for self-directed learning, these skills need to be developed. Portfolios can be used to support the development of skills for self-directed learning (SDL). Research shows that there are several factors (e.g., the availability of teacher coaching and of a structured approach to reflection) that influence the effectiveness of portfolio learning. However, research aimed specifically at developing self-directed learning skills with an electronic portfolio (which offers advantages over regular paper-and-pencil portfolios) is scarce. To gain more insight into developing SDL skills with electronic portfolios, the first two research questions are introduced. The first research question is: *What factors influence the facilitation of the development of SDL skills with an e-portfolio?* The second research question is: *How do these factors influence the facilitation of the development of SDL skills with an e-portfolio?* Both research questions are investigated in Chapters 2 and 5. The available research shows that it is possible to support students' development of SDL skills with an e-portfolio and to positively impact students' motivation. However, teacher coaching is essential to attain these effects; such coaching is very time-consuming. Student self-coaching aimed at substituting routine parts of teacher coaching may alleviate teachers' workload. The possibility to substitute routine parts of teacher coaching with student self-coaching is investigated with the third research question: *What are the effects of using an electronic development portfolio with limited teacher coaching and a student self-coaching protocol in senior vocational education on students' development of SDL skills and their motivation to learn?* This research question is investigated in Chapters 3 through 5.

Chapter 2: e-Portfolios enhancing students' self-directed learning: A systematic review of influencing factors

Electronic portfolios are increasingly being used to help students develop skills for self-directed learning including self-assessment of performance on learning tasks, formulation of points for improvement (PfIs), and selection of future learning tasks. Yet, it is not clear what factors influence effective support of the development of SDL skills, nor is it clear *how* these factors influence this development. Chapter 2 describes a systematic review aimed at identifying these factors and ascertaining their influence on the development of self-directed learning. The review yielded 17 articles which were used to es-

tablish factors that were of influence. Effective self-directed learning with an electronic portfolio is influenced by factors at five levels, including (1) the institutional level, (2) the curriculum level, (3) the learning process level, (4) the personal level, and (5) the portfolio level. To ensure that the development of self-directed learning is fostered it is important that portfolio use is supported at all levels. At the institutional level, faculty development aimed at educating teachers about their role in supporting students' development of SDL skills should be present. At the curriculum level, portfolio use should be integrated into existing educational routines. At the learning process level, teacher coaching should help students answer the following reflective questions: "Where am I going?", "How am I going?", and "Where to next?". At the personal level, students should be motivated by gradually receiving more responsibility over their own learning process. Finally, portfolios should possess features that support students' development of SDL skills (i.e., students' self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks).

Chapter 3: PERFLECT: Design and Evaluation of an Electronic Development Portfolio

Chapter 3 describes the design of PERFLECT, an electronic development portfolio aimed at supporting students' development of skills for self-directed learning. A small-scale evaluation was also carried out. PERFLECT is theoretically rooted in the four-component instructional design model (4C-ID). The model suggests a system of shared responsibility for learning. PERFECT assumes part of this responsibility by facilitating self-assessment of performance on learning tasks, formulation of PfIs, and selection of future learning tasks. In PERFLECT, self-assessment of performance is a four-step process. In the first step, students fill out learning-task details. This is followed by selecting criteria for performance assessment. In the third step students score their performance on the selected criteria. Finally, in the fourth step students answer reflective questions designed to help them determine what they should improve about their performance on the learning task (this is how formulation of PfIs is facilitated in PERFLECT) and what learning tasks fit their learning needs (i.e., this is how selection of future learning tasks is facilitated in PERFLECT). The development of students' SDL skills is further supported by automatically generated performance overviews and additional teacher coaching.

The small-scale evaluation indicates that students generally perceive PERFLECT to be able to help them develop self-directed learning skills, to be useful, and to be user-friendly. Students particularly appreciate that PERFLECT

offers them overviews of their performance on learning tasks and helps them reflect on what skills they have not yet mastered. Suggestions for improvement are also identified, including simplification of language use, increasing the interval between self-assessments, and changing the aesthetics of PERFLECT.

Chapter 4: Students, direct thyself! Developing self-directed learning skills with an electronic development portfolio

In Chapter 4 a quasi-experimental study is described that was aimed at investigating the effects of using PERFLECT with limited teacher coaching and a student self-coaching protocol on students' development of self-directed learning skills and their motivation. Over the course of 12 weeks two groups of 24 and 28 students either followed the regular lesson program in which a small part of that program was substituted with the use of PERFLECT (the PERFLECT group), or they only followed the regular lesson program without the use of PERFLECT (the REGULAR group). A pre-test post-test non-equivalent groups design was employed. The Motivated Strategies for Learning Questionnaire (MSLQ) was used to measure students' level self-direction and their motivation to learn before and after the intervention. Students' development of SDL skills was measured by analyzing the accuracy of their self-assessments (i.e., by comparing self-assessments with teacher assessments) and the quality of PfIs they formulated over time. Finally, an evaluation questionnaire was used to investigate students' perceptions about teachers' and PERFLECT's ability to help them develop SDL skills.

Students in the PERFLECT group reported higher levels of self-direction and intrinsic motivation than students in the REGULAR group. Furthermore, students became more accurate at self-assessing their performance on learning tasks over time, but they did demonstrate problems with selecting relevant criteria for performance assessment. Over time, students formulated higher quality PfIs. Students did not report a difference in satisfaction between teacher coaching and student self-coaching. The use of an electronic development portfolio with limited teacher coaching is a promising approach to support students' development of SDL skills. However, it seems that students need more support with the selection of relevant criteria for performance assessment.

Chapter 5: Walking the tightrope with an e-portfolio: Imbalance between support and autonomy hampers self-directed learning

In Chapter 5 a mixed-method study investigated the effects of using PERFLECT with limited teacher coaching and a student self-coaching protocol on students' development of SDL skills and their motivation. The study was similar to the study reported in Chapter 4 but, additionally, focus groups were conducted to collect students' perceptions about PERFLECT's ability to help them develop SDL skills. We employed a mixed-method sequential explanatory design with a quantitative phase and a qualitative phase. The quantitative phase entailed a 10-week period in which 47 students used PERFLECT to self-assess their performance on learning tasks and formulate PfIs. Like the study reported on in Chapter 4, students' development of SDL skills was measured by analyzing the accuracy of students' self-assessments (i.e., by comparing self-assessments with teacher assessments) and the quality of PfIs they formulated over time. Students level of motivation to learn was measured before and after the intervention using an adapted version of the Academic Self-Regulation Questionnaire (SRQ-A). Results from this quantitative phase are explained with qualitative data from focus groups conducted shortly after the intervention.

Results from the quantitative phase demonstrate that students' self-assessments became less accurate and that the quality of their formulated PfIs did not change significantly. Furthermore, a rise in controlled motivation (i.e., extrinsic forms of motivation) was observed, while simultaneously a drop in autonomous motivation (i.e., intrinsic forms of motivation) was observed. Results from the qualitative phase show that students did not have constructive conceptions of SDL, they wanted to have more feedback and support, they had doubts about PERFLECT's usefulness, and had trouble with being motivated for learning, because they experienced the use of PERFLECT to be externally mandated.

In this study the use of an electronic development portfolio with limited teacher coaching did not contribute to students' development of SDL skills. Likely, an imbalance between support and autonomy hampered self-directed learning. On the one hand, students' nonconstructive SDL beliefs and their need for more support and feedback formed an obstacle to effective development of their SDL skills. On the other hand, students' experience of mandated portfolio use was related to a drop in their autonomous motivation. It is thus important to guard the delicate balance that exists between support and autonomy, so that the development of SDL and intrinsic motivation are fostered.

Chapter 6: General discussion

The general discussion discusses main findings, theoretical implications, limitations, and practical implications. Both Chapter 2 and Chapter 5 point towards the fact that it is important to educate teachers about their role in SDL, to integrate portfolios seamlessly into daily educational routines, and to foster intrinsic motivation for learning among students. However, practical implementation of these findings is not an easy task. Furthermore, PERFLECT's positive effects on students' development of SDL skills and intrinsic motivation for learning in Chapter 4, versus the negative effects on students' development of SDL skills and intrinsic motivation for learning in Chapter 5, are likely caused by differences in students' perceived autonomy. In the Chapter 4 study, students were allowed to select their own learning for performance assessment, while in the Chapter 5 study, these learning tasks were preselected, which decreased students' autonomy. In both Chapter 4 and Chapter 5 students demonstrated difficulties selecting relevant criteria for performance assessment. Students might be better able to select relevant criteria for performance assessment if they could use PERFLECT in their apprenticeships. As it stands there is an indication that routine parts of teacher coaching sessions can be substituted with student self-coaching. The research was limited by the fact that the educational context did not allow students to select their future learning tasks. To effectively support students' development of SDL skills and intrinsic motivation it is very important that the balance between autonomy and support is guarded. To improve effectiveness of portfolio use, "smart" portfolios should be developed that can also help students with non-routine parts of coaching and take their individual needs into account.

Nederlandse samenvatting

Hoofdstuk 1: Algemene Introductie

Van MBO studenten wordt tegenwoordig steeds meer verwacht dat zij hun eigen leren sturen. Zelfsturing van het eigen leerproces is echter niet makkelijk. Om effectief zelf het leren te sturen moeten studenten geholpen worden bij het ontwikkelen van de benodigde vaardigheden hiervoor. Een middel dat goed kan helpen bij het ontwikkelen van vaardigheden voor zelfgestuurd leren (ZL) is een portfolio. Onderzoek laat zien dat verscheidene factoren de effectiviteit van ZL met een portfolio beïnvloeden (zoals de aanwezigheid van docent-coaching en een gestructureerde aanpak voor reflectief leren). Onderzoek op het gebied van ondersteuning van verwerven van vaardigheden voor ZL met een *elektronisch* portfolio (welke voordelen biedt ten opzichte van een regulier portfolio, zoals versimpelde opslag) is echter schaars. Om beter te begrijpen hoe vaardigheden voor ZL het best verworven kunnen worden met een elektronisch portfolio, worden de eerste twee onderzoeksvragen geïntroduceerd. De eerste onderzoeksvraag is: *Welke factoren beïnvloeden het faciliteren van verwerven van vaardigheden voor ZL met een elektronisch portfolio?* De tweede onderzoeksvraag is: *Hoe beïnvloeden deze factoren het faciliteren van het verwerven van vaardigheden voor ZL met een elektronisch portfolio?* Beide onderzoeksvragen worden onderzocht in Hoofdstuk 2 en 5. Het beschikbare onderzoek laat zien dat het mogelijk is om het verwerven van vaardigheden voor ZL en de leermotivatie van studenten positief te beïnvloeden door het gebruik van een elektronisch portfolio. Om deze positieve effecten te bereiken is het echter essentieel dat er docent-coaching aanwezig is. Deze ondersteuning vraagt echter een behoorlijke tijdsinvestering van docenten. Zelf-coaching door studenten kan mogelijk een deel van de werkdruk bij docenten ontlasten. De mogelijkheid om routine onderdelen van docent-coaching te vervangen door zelf-coaching door studenten wordt onderzocht met de derde onderzoeksvraag: *Wat zijn de effecten van de inzet van een elektronisch ontwikkelingsportfolio in een programma met gelimiteerde docent-coaching en zelf-coaching door studenten, op de ontwikkeling van vaardigheden voor ZL en de leermotivatie van studenten?* Deze onderzoeksvraag wordt onderzocht in Hoofdstukken 3 tot en met 5.

Hoofdstuk 2: e-Portfolio's die zelfgestuurd leren van studenten verbeteren: Een systematisch review naar beïnvloedende factoren

Elektronische portfolio's worden steeds meer gebruikt om studenten te helpen bij het ontwikkelen van vaardigheden voor ZL. Deze vaardigheden omvatten het zelf beoordelen van eigen prestaties op leertaken, het formuleren van ver-

beterpunten en het selecteren van nieuwe leertaken die bij de leerbehoefte passen. Ondanks het veelvuldig gebruik van elektronische portfolio's is het nog niet duidelijke welke factoren effectieve inzet beïnvloeden en *hoe* deze factoren van invloed zijn. Hoofstuk 2 beschrijft een systematische review van de literatuur die erop gericht is om deze factoren te identificeren en vast te stellen hoe deze factoren het aanleren van vaardigheden voor ZL met een elektronisch portfolio beïnvloeden. Uit de review zijn 17 artikelen geselecteerd die gebruikt zijn om de factoren te identificeren en hun invloed vast te stellen. Effectieve zelfsturing met een elektronisch portfolio wordt beïnvloed door factoren op vijf verschillende niveaus, waaronder (1) het institutionele niveau, (2) het curriculum niveau, (3) het onderwijsleerproces niveau, (4) het persoonlijke niveau en (5) het portfolio niveau. Om er zeker van te zijn dat de ontwikkeling van vaardigheden voor ZL effectief verloopt, is het van belang dat gebruik van een elektronisch portfolio wordt ondersteund op alle voorgenoemde niveaus. Op het institutionele niveau is het van belang dat er docentprofessionalisering aanwezig is die docenten helpt studenten te ondersteunen bij het aanleren van vaardigheden voor ZL. Op het curriculum niveau is het van belang dat het portfolio zo veel mogelijk wordt geïntegreerd in de dagelijkse onderwijsroutines. Op het onderwijsleerprocesniveau moet docent-coaching aanwezig zijn gericht op het helpen van studenten met beantwoorden van de volgende reflectieve vragen: "Wat is mijn doel?", "Hoe presteer ik op dit moment?" en "Wat is de volgende stap?". Op het persoonlijke niveau moeten studenten gemotiveerd worden door hen geleidelijk meer verantwoordelijkheid te geven over hun leerproces. Tenslotte moeten portfolio's tenminste basale capaciteiten hebben om de ontwikkeling van vaardigheden voor ZL te bevorderen (d.w.z. functionaliteiten gericht op het ondersteunen van zelf beoordelen van eigen prestaties op leertaken, formuleren van verbeterpunten en selecteren van nieuwe leertaken die passen bij de leerbehoefte).

Hoofdstuk 3: PERFLECT: Ontwikkeling en evaluatie van een elektronisch ontwikkelingsportfolio

Hoofstuk 3 beschrijft het ontwerp en een kleinschalige evaluatie van PERFLECT, een elektronisch ontwikkelingsportfolio gericht op het ondersteunen van studenten die vaardigheden voor ZL aanleren. PERFLECT is gebaseerd op theorie uit het four-component instructional design model (4C/ID). Dit model raad een werkwijze aan waarbij docent en leerling gezamenlijk de verantwoordelijkheid delen voor het leerproces. PERFLECT helpt hierbij door zelfbeoordeling van eigen prestaties op leertaken, formulering van verbeterpunten en selectie van geschikte nieuwe leertaken te faciliteren. In PERFLECT bestaat het zelf beoordelen van leertaken uit vier stappen. In de eerste stap

vullen leerlingen details in over de uitgevoerde leertaak. In de tweede stap kiezen zij zelf criteria uit waarmee zijn hun prestatie op de leertaak willen beoordelen. In de derde stap scoren zijn hun prestatie met de door hen uitgekozen criteria. Ten slotte beantwoorden zij reflectieve vragen die hen helpen te bepalen hoe zij hun prestaties op de leertaak kunnen verbeteren (dit is hoe het formuleren van verbeterpunten wordt ondersteund in PERFLECT) en welke leertaak bij hun leerbehoefte past (dit is hoe het selecteren van nieuwe leertaken die passen bij de leerbehoefte wordt ondersteund in PERFLECT). De ontwikkeling van vaardigheden voor ZL wordt verder ondersteund door automatisch gegenereerde prestatieoverzichten en aanvullende docent-coaching.

De kleinschalige evaluatie laat zien dat studenten over het algemeen ervaren dat PERFLECT hen kan helpen bij het ontwikkelen van vaardigheden voor ZL, dat zij PERFLECT als nuttig ervaren en ook als gebruiksvriendelijk. Studenten waarderen vooral dat PERFLECT hen automatisch gegenereerde prestatieoverzichten aanbiedt en hen helpt te reflecteren over vaardigheden die zij nog moeten verbeteren. Er waren ook suggesties ter verbetering, waaronder versimpeling van het taalgebruik in PERFLECT, het vergroten van het tijdsinterval tussen zelfbeoordelingen en veranderingen aan esthetische aspecten van PERFLECT.

Hoofdstuk 4: Studenten, stuur jezelf! Het ontwikkelen van vaardigheden voor zelfgestuurd leren met een elektronisch ontwikkelingsportfolio

In Hoofdstuk 4 wordt een quasi-experimentele studie beschreven die gericht is op het onderzoeken van de effecten van het gebruik van PERFLECT met gelimiteerde docent-coaching en zelf-coaching door studenten, op hun ontwikkeling van de vaardigheden voor ZL en hun leermotivatie. Gedurende 12 weken volgden 2 groepen van respectievelijk 24 en 28 studenten het reguliere lesprogramma waarbij een klein onderdeel van dat programma was verwisseld door het gebruik van PERFLECT (de PERFLECT-groep) of alleen het reguliere lesprogramma (de REGULIERE-groep). Een pre-test post-test design met non equivalente controle groep is gebruikt. The Motivated Strategies for Learning Questionnaire (MSLQ) is gebruikt om het niveau van zelfsturing en leermotivatie te bepalen onder de studenten voor en na de interventie. De ontwikkeling van vaardigheden voor ZL is gemeten door te kijken naar de accuratesse van de zelf beoordeling (d.w.z. kijken naar mate van overeenstemming tussen zelf beoordelingen en docent beoordelingen) en de kwaliteit van geformuleerde verbeterpunten over tijd. Ten slotte is er een evaluatie vragenlijst afgenomen om te kijken in hoeverre studenten vonden dat docenten en PERFLECT hen konden helpen vaardigheden voor ZL te ontwikkelen.

Studenten in de PERFLECT-groep rapporteerden hogere zelfsturingniveaus en intrinsieke leermotivatie dan studenten in de REGULIERE-groep. Bovendien werden over tijd de zelfbeoordelingen van studenten accurater, desondanks hadden ze problemen met het selecteren van relevante criteria voor het beoordelen van hun prestaties op leertaken. Daarnaast werd de kwaliteit van de geformuleerde verbeterpunten ook beter over tijd. Studenten rapporteerden geen verschil in tevredenheid tussen docent-coaching en zelf coaching. Het gebruik van een elektronisch ontwikkelingsportfolio met gelimiteerde docent-coaching en zelf coaching door studenten is een veelbelovende aanpak om studenten te ondersteunen in hun ontwikkeling van vaardigheden voor ZL. Studenten moeten echter aanvullend ondersteund worden bij het selecteren van de juiste criteria voor zelf beoordeling van prestaties op leertaken.

Hoofdstuk 5: Koorddansen met een e-portfolio: Een disbalans tussen ondersteuning en autonomie staat zelfsturing in de weg

In Hoofdstuk 5 wordt een mixed-method studie beschreven die gericht is op het onderzoeken van de effecten van het gebruik van PERFLECT met gelimiteerde docent-coaching en zelf-coaching door studenten, op hun ontwikkeling van de vaardigheden voor ZL en hun leermotivatie. De studie was vergelijkbaar van opzet als de studie die beschreven wordt in Hoofdstuk 4. In deze studie zijn echter ook focusgroepinterviews gehouden om te onderzoeken in welke mate studenten PERFLECT ervoeren als ondersteunend bij het leren van vaardigheden voor ZL. We hebben gebruik gemaakt van een mixed-method sequential explanatory design met een kwantitatieve fase en een kwalitatieve fase. The kwalitatieve fase bestond uit een periode van 10 weken waarin 47 studenten PERFLECT gebruikten om hun prestaties op leertaken te beoordelen en verbeterpunten te formuleren. Zoals de studie in Hoofdstuk 4 is de ontwikkeling van vaardigheden voor ZL is gemeten door te kijken naar de accuratesse van de zelf beoordeling (d.w.z. kijken naar mate van overeenstemming tussen zelf beoordelingen en docent beoordelingen) en de kwaliteit van geformuleerde verbeterpunten over tijd. De leermotivatie van studenten is voor en na de interventie gemeten met een aangepaste versie van de Academic Self-Regulation Questionnaire (SRQ-A). Resultaten uit de kwantitatieve fase worden verklaard met data uit focus groepen die zijn georganiseerd kort na de interventie.

Resultaten van de kwantitatieve fase laten zien dat de accuratesse van de zelf beoordelingen van studenten over tijd verslechterde en dat de kwaliteit van hun geformuleerde verbeterpunten niet significant veranderde. Daarnaast werd een stijging in gecontroleerde motivatie (extrinsieke vormen van moti-

vatie) en een daling in autonome motivatie (intrinsieke vormen van motivatie) waargenomen. Resultaten uit de kwalitatieve fase laten zien dat studenten geen constructieve concepties hadden van ZL, zij behoefte hadden aan meer ondersteuning en feedback, zij twijfels hadden over het nut van PERFLECT en dat zij motivatieproblemen hadden, omdat ze het werken met PERFLECT als opgelegd ervoeren.

In deze studie heeft het gebruik van een elektronisch ontwikkelingsportfolio met gelimiteerde docent-coaching en zelf coaching door studenten niet bijgedragen aan de ontwikkeling van vaardigheden voor ZL. Waarschijnlijk heeft een disbalans tussen ondersteuning en autonomie effectief ZL in de weg gestaan. Aan de ene kant vormden niet constructieve ZL-concepties en de behoefte aan meer ondersteuning en feedback een obstakel voor de effectieve ontwikkeling van vaardigheden voor ZL. Aan de andere kant vormde het gevoel dat werken met PERFLECT studenten werd opgelegd een obstakel voor hun intrinsieke leermotivatie. Het is dus belangrijk om de delicate balans die bestaat tussen ondersteuning en autonomie te bewaken zodat de ontwikkeling van vaardigheden voor ZL en intrinsieke leermotivatie optimaal worden gefaciliteerd.

Hoofdstuk 6: Algemene Discussie

De algemene discussie bespreekt hoofdbevindingen, theoretische implicaties, limitaties en praktische implicaties. Zowel Hoofdstuk 2 als Hoofdstuk 5 laten het belang zien van docentprofessionalisering gericht op het helpen van docenten bij het begeleiden van studenten met het verwerven van vaardigheden voor ZL. Daarnaast wijzen deze beide studies op het belang van integratie van portfolio's in de dagelijkse onderwijsroutine en het bevorderen van intrinsieke leermotivatie, hoewel dit geen makkelijke taak is. De studies in Hoofdstuk 4 en Hoofdstuk 5 laten hele andere resultaten zien op het gebied van verwerven van vaardigheden voor ZL en het bevorderen van intrinsieke motivatie voor leren. Waarschijnlijk bestaat hier een verschil in waargenomen autonomie. In de studie in Hoofdstuk 4 mochten studenten zelf kiezen welke leertaken zij beoordeelden, terwijl deze leertaken in Hoofdstuk 5 voorgeselecteerd waren, wat waarschijnlijk van invloed was op waargenomen autonomie. In deze beide studies lieten studenten problemen zien met het selecteren van relevante criteria voor het zelf beoordelen van leertaken. Mogelijk zijn studenten beter in staat de juiste criteria te selecteren als zij PERFLECT zouden kunnen gebruiken tijdens hun stages. Er bestaat een indicatie dat routine onderdelen van coaching sessies vervangen kunnen worden door zelf-coaching. Het onderzoek werd gelimiteerd door het feit dat studenten niet in staat waren leertaken te selecteren die bij hun leerbehoefte pasten (omdat de omgeving dit niet toestond). Om de ontwikkeling van vaardigheden voor ZL en de intrinsieke leermotivatie

van studenten effectief te ondersteunen is het van belang dat de balans tussen autonomie en ondersteuning wordt bewaakt. Om de effectiviteit van portfoliogebruik te verbeteren zouden er slimme portfolio's ontwikkeld moeten worden die studenten kunnen helpen met niet-routinematige onderdelen van coaching, waarbij rekening wordt gehouden met hun individuele behoeftes.

Valorisatie addendum

Het aanleren van vaardigheden voor zelfgestuurd leren is essentieel voor een leven lang leren. Het belang van het onderwijzen van deze vaardigheden is voor het mbo waarschijnlijk nog evidenter, omdat mbo-studenten vaak komen te werken in competentiegerichte leeromgevingen die een beroep doen op zelfsturingsvaardigheden. Het onderzoek dat is beschreven in dit proefschrift heeft praktische resultaten en inzichten opgeleverd op het gebied van zelfsturing met elektronische ontwikkelportfolio's in het mbo.

Dit valorisatieaddendum beschrijft voor wie de resultaten met name relevant zijn en hoe de resultaten van waarde zijn, daarnaast wordt beschreven welke producten er zijn opgeleverd en hoe deze producten van praktische waarde kunnen zijn.

Voor wie heeft dit onderzoek praktische waarde?

De resultaten uit dit onderzoek zijn voor verschillende doelgroepen in de praktijk interessant, maar vooral voor mbo-docenten, teamleiders, beleidmakers/directie en ontwikkelaars van elektronische portfolio's.

Docenten

Docenten hebben met een elektronisch ontwikkelportfolio een waardevol hulpmiddel in handen. Onderzoek in dit proefschrift laat zien dat onder de juiste omstandigheden het gebruik van een elektronisch ontwikkelportfolio er toe leidt dat studenten vaardigheden voor zelfgestuurd leren effectiever ontwikkelen en bovendien een hogere intrinsieke motivatie om te leren hebben dan studenten die geen gebruik maken van een dergelijk portfolio. Deze bevinding is niet nieuw. Het is al langer bekend dat het werken met een elektronisch ontwikkelportfolio deze effecten kan hebben. In voorgaand onderzoek was echter sprake van uitgebreide docentcoaching. Het onderzoek in dit proefschrift laat zien dat de positieve effecten ook haalbaar zijn wanneer een deel van het reflectieproces wordt doorlopen door studenten. Zij doen dit door het zelfstandig beantwoorden van reflectieve vragen in het elektronisch portfolio. Dit heeft een belangrijke implicatie voor docenten. De coaching kan efficiënter plaatsvinden. Enerzijds hoeven docenten minder tijd te besteden aan coaching om dezelfde kwaliteit te behouden. Een deel van het werk wordt immers al overgenomen door de studenten zelf. Anderzijds is het bij gelijkblijvende tijdsinvestering mogelijk om dieper in te gaan op vragen omdat de student zelf al nagedacht heeft over de vragen, waardoor knelpunten eerder naar boven zullen komen.

Het onderzoek in dit proefschrift heeft ook inzichten opgeleverd voor docenten met betrekking tot de condities waaronder een elektronisch portfolio het best ingezet kan worden. Als docenten een elektronisch ontwikkelportfolio inzetten om studenten te begeleiden bij het ontwikkelen van vaardigheden

voor zelfgestuurd leren, is het belangrijk dat zij daarbij de delicate balans tussen studentautonomie en docentbegeleiding bewaken. Studenten hebben een bepaalde mate van autonomie nodig om intrinsiek gemotiveerd te zijn voor het leerproces. Studenten hebben echter ook begeleiding nodig als zij nieuwe vaardigheden leren. De docent moet genoeg begeleiding bieden zodat studenten nieuwe vaardigheden efficiënt leren, maar hen ook genoeg vrijheid bieden zodat ze intrinsiek gemotiveerd blijven. In de praktijk vereist dit dat de docent alert is op signalen van studenten dat zij behoefte hebben aan verandering in de mate van begeleiding. Het vereist ook dat docenten hun begeleiding aanpassen op de veranderde behoefte.

Teamleiders

De teamleiders op mbo's hebben de belangrijke rol om docenten zo goed mogelijk te ondersteunen. Het is cruciaal dat portfolio's aansluiten op de dagelijkse onderwijsroutine. Hierbij moet onder andere worden gedacht aan de aansluiting op bestaande toetsing, de aansluiting op stageperiodes en de aansluiting op andere onderwijsactiviteiten. Als belangrijke schakel tussen de werkvloer en de directie, hebben teamleiders een belangrijke signaleerfunctie. Sluit de manier van toetsing aan op het portfoliogebruik? Wordt het portfolio ingezet in periodes dat er praktijkstages zijn? Hebben docenten genoeg tijd om samen met studenten te werken met het portfolio? Samengevat, past het werken met het portfolio in het leerproces of valt het erbuiten? Het is belangrijk dat de teamleiders docenten zoveel mogelijk faciliteren bij hun werkzaamheden. Waar dit niet mogelijk is, is het belangrijk dat ze knelpunten aankaarten bij de directie.

Beleidmakers/directie

Aan de beleidmakers/directie de belangrijke taak om de voorwaarden te creëren voor teamleiders en docenten waarbinnen zij efficiënte ondersteuning kunnen bieden aan studenten die vaardigheden voor zelfgestuurd leren verwerven. Praktisch gezien betekent dit vooral dat zij moeten zorgen voor een docentprofessionaliseringprogramma waar docenten leren coachen in een onderwijssysteem gericht op het bevorderen van het vermogen tot zelfsturing. Daarnaast is het van belang dat beleidmakers/directie signalen oppikken van de verscheidene teamleiders wanneer er problemen worden aangekaart die een beleidsverandering vereisen (zoals een verandering in toets beleid of het aanpassen van een stageperiode).

Ontwikkelaars elektronische portfolio's

De ontwikkelaar van elektronische portfolio's moeten ervoor zorgen dat deze portfolio's tenminste het zelf beoordelen van leertaken, het formuleren van verbeterpunten en het selecteren van nieuwe leertaken ondersteunen. Bij voorkeur worden er 'slimme' functionaliteiten in het portfolio geïntegreerd die ervoor zorgen dat de ondersteuning adaptief is. De student heeft namelijk niet altijd de behoefte aan dezelfde ondersteuning. Daarnaast zijn er ook verschillen tussen studenten wat betreft behoefte aan ondersteuning. Idealiter leert het portfolio van individuele studenten en past het portfolio de ondersteuning aan naar individuele behoefte.

Om een elektronisch ontwikkelportfolio efficiënt in te zetten om studenten te helpen met het verwerven van vaardigheden voor zelfgestuurd leren is het essentieel dat alle bovengenoemde doelgroepen de inzichten succesvol toepassen.

Opgeleverde producten

PERFLECT

In het onderzoek in dit proefschrift is een elektronisch ontwikkelportfolio voortgebracht dat studenten ondersteunt bij het zelf beoordelen van leertaken, het formuleren van verbeterpunten en het selecteren van nieuwe geschikte leertaken. Bij de ontwikkeling is nadrukkelijk rekening gehouden met brede inzetbaarheid. Het portfolio kan in principe worden ingezet binnen elke mbo-opleiding waarin gewerkt wordt met landelijke kwalificatiedossiers.

Publicaties

In dit proefschrift is een artikel opgenomen dat vrij toegankelijk is voor alle geïnteresseerden. Dit artikel kan worden gebruikt bij het ontwerp en de implementatie van lesprogramma's waarbij elektronische ontwikkelportfolio's worden ingezet om studenten te ondersteunen bij het leren van vaardigheden voor zelfgestuurd leren. Dit artikel is vrij toegankelijk via de volgende hyperlink: `https://ajet.org.au/index.php/AJET/article/view/2528`

Trainingen

Bepaalde onderdelen van dit proefschrift zijn ook gepresenteerd op nationale en internationale congressen. Een aantal van deze congressen waren nadrukkelijk gericht op onderwijsprofessionals. Tijdens deze congressen zijn de inzichten van de uitgevoerde onderzoeken op een zo praktisch mogelijke manier verspreid. Bovendien zijn er van de Kennisnet Onderzoek Conferentie 2015

videobeelden beschikbaar die onderwijsprofessionals kunnen gebruiken om hun lessenseries vorm te geven. De presentatie kan via de volgende hyperlink bereikt worden: `https://www.youtube.com/watch?v=PSjO8lVSMFA`

Presentaties

De trainingen die gebruikt zijn om docenten te leren werken met PERFLECT zijn op aanvraag beschikbaar. Deze kunnen gebruikt worden bij het ontwerp en de implementatie van lesprogramma's waarbij elektronische ontwikkelportfolio's worden ingezet om studenten te ondersteunen bij het aanleren van vaardigheden voor zelfgestuurd leren.

Dankwoord

Hoewel promoveren veel momenten kent waarin je alleen aan de slag bent, heb ik het proces zeker niet als een solo-expeditie ervaren. Ik heb hierbij van veel mensen hulp gehad. Daarvoor wil ik graag mijn dankbaarheid uitdrukken.

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Curriculum Vitae

Jorrick Beckers was born in Helmond on May 20, 1985. He has received a Bachelor's degree in Cognitive Psychology at Maastricht University in 2008. He has received a Master's degree in Work & Organizational Psychology at Maastricht University in 2011. He has started a PhD-project in September 2011. This PhD project was conducted at the School of Health Professions Education. During his PhD project he obtained a University Teaching Qualification. During a part of this period he was the PhD-representative of the "Research in Education" board of the School of Health Professions Education (2013-2014). In addition to working on his PhD project, he assumed various teaching roles including tutor in a Health Sciences course, teacher of communication & reflection education in Medicine, and instructor in a course about Curriculum & Course design in Educational Sciences.

After his PhD-Research he has worked for the task-force of Quality Assurance where he was responsible for the quality assurance of various master programs in Health Sciences and Biomedical Sciences with a focus on digital evaluation. Furthermore, he has conducted additional research at high schools on the topic of effective differentiated instruction in the classroom.

Currently, he is about to start a teaching position at Fontys Sporthogeschool.

List of publications

Beckers, J., Dolmans, D. H. J. M., & Merriënboer, J. J. G. (2016). e-Portfolios enhancing students' self-directed learning: A systematic review of influencing factors. *Australasian Journal of Educational Technology, 32(2)*, 32-46. doi:10.14742/ajet.2528

Van Loon, M. H., Kok, E. M., Kamp, R., Carbonell, K. B., Beckers, J., Frambach, J. M., & De Bruin, A. (2013). AM Last Page: Avoiding Five Common Pitfalls of Experimental Research in Medical Education. *Academic medicine: journal of the Association of American Medical Colleges, 88*, 1588-1588. doi:10.1097/ACM.0b013e3182a36cc6

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