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# Design and Evaluation of a Development Portfolio: How to Improve Students' Self-Directed Learning Skills

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Abstract

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

# Design and Evaluation of a Development Portfolio: How to Improve Students' Self-Directed Learning Skills

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

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

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

Knowles (1998) recognizes these problems and asserts that on-demand education can only be successful if learners are familiar with the concept of SDL and possess the skills required to implement it. At least in the early stages of an educational program, it is thus critical that students are informed on what is expected of them and are supported in the development and use of SDL skills. To support the development of these SDL skills tools such as reflection reports and (digital) portfolios are indispensable. They help students and teachers to pay not only attention to the transmission of domain knowledge, but also to the learning processes responsible for the purposeful and, ultimately, independent acquisition of such knowledge (Langenbach, 1993). Compared to portfolios with a focus on learning products (e.g., showcase portfolios), especially portfolios with a focus on the learning process, such as development portfolios, learning portfolios, and process-folios have been advocated by many theorists as promising tools to help students become reflective and self-directed learners (e.g., Driessen, van Tartwijk, Overeem, Vermunt, & van der Vleuten, 2005; Järvinen & Kohonen, 1995; Klenowski, 2002;

Seidel et al., 1997). In this article, we will use the term ‘development portfolio’ to refer to portfolios that (a) contain students’ progress reports and reflections and (b) are used for formative assessment purposes. A development portfolio, either digital or paper-based, is thus a tool that helps students to document information about their development of a skill. It documents a student’s skill development and its information can be used for promoting further development of the skill, hence the term ‘development portfolio’. A development portfolio may contain formative self/assessments of performance, reflections on task performance, artefacts like pictures, documents, photographs and video fragments, which indicate the failures and successes the student experienced during his or her skill development, and may also contain a plan to work on skill improvement based on performance assessments and reflections. Unfortunately, research on the design of development portfolios for secondary vocational education and, especially, evidence documenting positive effects of such portfolios on the development of students’ SDL skills is sparse (Herman & Winters, 1994).

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

and select future learning tasks). Finally, the results of the case study are discussed, guidelines for the design of development portfolios are given, and suggestions for future research are presented.

## SDL in On-demand Education

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

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

A first approach to counteract inaccurate assessment of performance is to better inform students on relevant performance standards, including criteria (requirements in terms of speed, accuracy etc.), values (application of particular rules, conventions etc.), and attitudes (Black & Wiliam, 1998; Stiggins, 2001; Wiggins, 1998). Students should be stimulated to base their self-assessments on the presented standards. Hanrahan and Isaac (2001), for instance, report that students who were given the same marking sheets as their teacher to assess their own work, indicated that they "…gained better understanding of marking" (p. 58). Their results extended previous research (e.g., Stefani 1992, 1994) and were also replicated in a study by Andrade and Du (2007), in which students reported they felt to be able to self-assess effectively only when they knew beforehand what the teacher expected. In this study, students also reported that they endorsed self-assessment only after extended practice.

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

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

comparing own assessments with assessments made by others (Mansvelder, Beijaard, & Verloop, 2007).

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

With regard to the design of the development portfolio, it is important to give students the opportunity to document both their strengths and weaknesses (i.e., learning needs) concerning a particular skill, without any consequences for their final grading. After self-assessing their task performance on the given standards students should thus be prompted to think about their learning needs. They should be stimulated to make the learning needs that become apparent from the self-assessments explicit, for instance, by writing them down in their own words. In addition, teachers should clearly communicate the goals of using a development portfolio and its relation with formative, learning-oriented assessments and self-assessments (Knowles, 1998). Teachers must also explain and show how to formulate learning needs in terms of standards, required improvements or changes to behaviors, and conditions. For instance, the learning need "I need

to talk more to my client", does not provide students with sufficiently concrete directions for improvement, whereas "I need to initiate a conversation about common topics, like the weather or the news, to break the ice" is formulated more specifically in terms of required improvements and behaviour.

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

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

Concluding, on-demand education can only be effective if students are -at least in the early stages of the educational program- guided in the development of their SDL skills. A well-

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

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

## STEPP: A Development Portfolio Supporting SDL

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

### *Assessment of Performance*

To develop the assessment functionality of the portfolio, first all skills and sub skills performed in the profession of hairdressing were analyzed (e.g., washing, cutting, permanent waving, communicating with clients, giving advise on hair styles, selling hair products, etc.). These skills are shown in a hierarchical menu on the assessment page of STEPP (see left side of Figure 1). Next, for each of the 10 skills and 48 sub skills, performance standards (i.e., criteria, values, and attitudes) were defined in agreement with two expert hairdressers and two instructors. On STEPP's assessment page, the standards are provided in matrices (see right side of Figure 1). After performing a particular learning task, a student can either fill out the assessment page him/herself (i.e. self-assessment) and/or request other assessors (e.g., teacher, instructor, clients, peer students), who were given access to the student's portfolio beforehand, to

update the portfolio with their assessments of the skills and sub skills performed as part of the learning task.

To fill out the assessment page, by clicking on particular entries, the assessor (i.e., the student or another assessor) selects from the list with all hairdressing skills the sub skills that were practiced as part of the learning task. Then, a list of standards relevant to the assessment of the selected sub skills appears and the assessor indicates on a three-point scale (fail, satisfactory, very good) how well these sub skills were performed according to the presented standards. For dying hair, for instance, the assessor has to indicate whether the hair-dye was distributed evenly, applied fast enough, washed out thoroughly, and so forth. The assessor may also consult a 'dictionary' of standards in which the meaning of each standard is explained and illustrated.

*Formulation of Learning Needs*

The functionality 'formulation of learning needs' is implemented in STEPP using a textbox. It allows multiple inputs from the student and is positioned directly under the list of standards used to assess sub skills (see bottom of Figure 1). Students can use the textbox to describe as many learning needs as they prefer, using their own words. For example, if a student indicates that with respect to her communication skills she failed on the standard 'keep the conversation with the client going', her formulated learning need might be to find out which topics can be interesting to talk about with different groups of clients. Displaying the textbox together with the list of standards with rating scales prevents students from assessing their performance only according to a predefined set of standards by means of rating scales. It prompts students to think about *why* particular standards are not yet met and what could be done to improve their performance according to those standards. Furthermore, displaying the textbox on the same page as the list of standards provides students with some direction for formulating

learning needs. In addition, students may also ask other assessors (teacher, instructor, peer students, clients) to formulate learning needs for them, in the same way as they may ask other assessors to fill out the relevant rating scales.

### *Selection of Learning Tasks*

The task-selection functionality is implemented in STEPP as a structured format students use to indicate which future learning task(s) they want to perform. The format distinguishes four relevant criteria. First, students indicate the required level of difficulty or complexity of the future tasks, for instance, whether they want to practice to apply one color of hair dye, two or more colors, or how to apply highlights. Second, they indicate the level of support and guidance they would like to receive, for instance, do they want to observe an experienced hairdresser who is performing the task, do they want to perform the task under direct guidance of an expert, or do they want to perform the task independently? Third, students indicate the authenticity of the task they perform, for instance, whether they will perform the task on a dummy, a human model, or a real client. Fourth, they indicate which learning needs they want to meet, that is, which sub skills they want to focus on during the performance of future learning tasks. For instance, a student may select the task ‘cutting hair in one length’. For this particular task, she may indicate that she wants to perform the task on the hair of a human model (e.g., her sister), without any help of the instructor, and with a focus on handling the scissors quicker and more fluently to prevent irregularities in the haircut (i.e., meeting this particular learning need).

To provide students with sufficient information to base their task selections on, STEPP provides students with task metadata. All sub skills are listed on the same page as the task selection format, starting with the most simple skills and ending with the most complex skills, thus informing students on their relative level of difficulty (see Figure 2). In addition, while

thinking about new learning tasks to select, students can always refer to previously formulated learning needs and previous task selections. Students can use this information to decide on the difficulty level, available support and guidance, and focus of the next learning task(s).

### *Overviews*

In addition to the functionalities specifically designed to execute one of the three basic SDL skills, STEPP also has a functionality of providing students with overviews and summaries of all entered information. Students can review all assessments of all sub skills, by all assessors, sorted by sub skill or by learning task (see Figure 3). They can also review all formulated learning needs and specific information on all learning tasks performed in a specific period. The assessments and learning needs provided by other assessors are shown next to the student's self-assessment to facilitate comparison between different assessments. Students can use the overviews and summaries to become better informed on, for instance, recurrent learning needs, deviations between different assessors of a specific learning task, weaknesses in performance as indicated by repeatedly failing to meet specific standards of a sub skill, and so forth. In addition, when students have supervision meetings the overviews and summaries can be used as a starting point for the discussion on what has been done in the previous period and what should be done in the coming period.

## Case Study

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

well as factors that influence its use, and (c) STEPP's perceived effectiveness to improve SDL skills.

## *Method*

### *Participants*

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

### *Materials*

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

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

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

*Prior skills questionnaire*. To gain insight in students' prior skills, for eight hairdressing skills (e.g., cutting hair, washing hair) students indicated on a four-point scale (0 = never; 3 = many times) how often they had performed these skills before starting the program. Reliability of the questionnaire was determined by Cronbach's Alpha, $\alpha = .91$. Convergent validity of the questionnaire with the number of days working in a hairdressing salon and/or attending a hairdressing course was high ($r_s = .89$, $p < 0.01$).

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

After the interview students' answers were compared to their log files to determine the truthfulness of their responses.

In the second part of the interview the reasons why students used STEPP were explored by means of an open-ended question asking why they used STEPP (i.e., to reflect, to gather proof of learning).

In the third part, concerning the perceived usability of STEPP, three yes/no questions were asked with respect to (a) the ease of operating the STEPP software, (b) the ease of interpreting the information on the different input screens, and (c) the clarity of the output screens (i.e., overviews). Students were asked to explain their answers and provide any other information pertaining to usability aspects.

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

All student interviews were taped and typed out transcripts were analysed. Answers concerning the reasons to use STEPP were assigned to six categories: (a) daily/weekly routine

(e.g., “every Thursday I fill out STEPP with all the skills I practiced”, or “sometimes the teacher reminds us to use STEPP, but otherwise I forget”); (b) personal approach to direct own learning (e.g., “I do not need STEPP to know what I do right or wrong or to think about what I will be doing, I always used my agenda or know it by heart”, or “STEPP is like a guide who helps me to think about what I did and will be doing”); (c) affinity with computers (e.g., “I use my computer a lot, especially for MSN or to check my email, then I usually fill out STEPP too”, or “I do not use my computer a lot so it costs me extra effort to switch it on to use STEPP”); (d) use of STEPP to reflect on own learning (e.g., “I use it so I can see my weaknesses and can work on those”); (e) use of STEPP as a checklist for examinations (e.g., “I use it to see what skills I need to practice for my exam and what standards they have to meet”), and (f) use of STEPP as a file or diary (e.g., “I use it so my teacher can see what I did last week”, or “I think it is nice to look back in STEPP after one year or so to see how I was doing, what I did and how it went”).

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

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

which a learning need was formulated, and the number of actually submitted task selections over the whole period of 10 weeks.

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

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

*Procedure*

Students first filled out the prior skills questionnaire. Then, they participated in an instruction lesson in which the use of STEPP and its functionalities were explained and explored. During 10 weeks students worked in the on-demand educational setting and used STEPP to self-assess their learning, formulate learning needs, and select learning tasks. Students were free to

sign up for the weekly supervision meetings. The use of STEPP was logged. After the 10 weeks all students and their supervisor were interviewed.

## *Results*

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

### *Actual Use of STEPP*

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

*Perceived Usability of STEPP*

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

Students were grouped for each of the six factors that, according to the interview data, affected the use of STEPP. Two groups were composed per factor; one group with students to which the particular factor did apply and one to which it did not. Table 1 presents per factor and per composed group an overview of the median and range of the three variables indicating the actual use of STEPP: Number of tasks assessed per week, number of skills assessed per task, and number of submitted task selections for the whole period of 10 weeks. The percentage of assessed skills per learning task for which a learning need was formulated was not used as a variable, because it did not provide an appropriate indication of quantitative STEPP use. For example, a student who assessed only two skills and formulated also two learning needs, would receive a 100%-score on this variable. On the contrary, a student who assessed 15 skills and formulated 13 learning needs would only receive a 80%-score, whereas the latter used STEPP more frequently and effectively.

Kolmogorov-Smirnov *Z* tests were used to compare the groups of students to which a particular factor did or did not apply (i.e., whether the groups have the same continuous

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

The influence of students' prior hairdressing skills on the actual use of STEPP was also investigated. Table 1 presents for students with high ($n = 5$, *Mdn* = 1.25, *Range* = 1.00 – 3.00) and low prior hairdressing skills ($n = 5$ , *Mdn* = .50, *Range* = .13 - .88) an overview of the median and range of the variables that indicate portfolio use. Mann-Whitney *U* tests show that students with high prior skills assess less tasks per week than students with low prior skills, $z = -2.15$, $p < .05$. In line with this, students also differ in the number of visits they pay to their supervisor (high prior skills: *Mdn* = 2, *Range* = 2-5; low prior skills: *Mdn* = 6, *Range* = 3-10). Students with high prior skills pay less visits to their supervisor than students with low prior skills, $z = -2.23$, $p < .05$. Thus, students with lower prior skills make more extensive use of STEPP and pay more visits to their supervisor to discuss the overviews created by STEPP.

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

of skills assessed per task, $r_s = .66$, $p < .05$, and to the percentage of actual task selections, $r_s = .68$, $p < .05$.

*Perceived Effectiveness of STEPP*

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

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

Table 2 presents for the infrequent and frequent users the median and range of the quality of self-assessments, formulated learning needs, and task selections – split between student self

ratings (top of Table) and supervisor ratings (bottom of Table). A Spearman's rank correlation test showed a significant correlation between the supervisor's rating of the quality of students' task selections and the number of assessed tasks ($r_s = .86$, $p < 0.01$). The supervisor's rating of the students' learning needs also correlated with the number of assessed tasks ($r_s = .64$, $p < 0.05$). To investigate this correlation in more detail, Kolmogorov-Smirnov *Z* tests were used to compare the supervisor's ratings for infrequent and frequent users of STEPP. Frequent STEPP users are rated somewhat higher on the quality of their task selections than infrequent users ($z = 1.27$, $p < .10$), and frequent users are rated slightly higher on the quality of their formulated learning needs than infrequent users ($z = 1.27$, $p < .10$). When asked to explain the higher rating for the quality of task selections of frequent users the supervisor explains that "…these student have a better understanding of all the standards they have to meet and the skills they need to develop, and they use this information to base their choices on". With respect to the quality of formulated learning needs she explains that "…the quality of learning needs of the infrequent users is lower, because they formulate their needs in less detail than the frequent users. The latter have a better understanding of what is expected from them and use this information to indicate their learning needs. This makes their learning needs useful because they are formulated specifically".

As indicated above, some infrequent users stated that they did not perceive STEPP to contribute to their SDL skills because they were already well able to direct their own learning. We investigated if this was a legitimate reason for not using STEPP. A Wilcoxon signed ranks test was used to compare the supervisor's rating to the students' rating of SDL skills. The analysis shows that their scores differ slightly. Infrequent users appear to rate themselves higher than their supervisor: They especially overestimate the quality of their task selections ($z = -2.032$,

$p < .05$). In addition, they tend to slightly overestimate the quality of their self-assessments ($z = -1.86$, $p < .10$). For frequent users, no differences between their own ratings and the supervisor ratings of SDL skills were observed.

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

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

## General Discussion

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

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

provides tools supporting a systematic selection of future tasks. In addition to these three functionalities, a fourth functionality pertains to the generation of summaries and overviews that give an impression of overall progress and provide a basis for supervision meetings.

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

Not surprisingly, another factor with a positive effect on the frequent use of STEPP is making its use part of a weekly routine. Right from the start of the educational program, its use should therefore be clearly embedded in the educational process and be monitored (e.g., with fixed times for updating it, consulting it in supervision meetings, etc.). Embedding the use of the

portfolio in the educational process will help students build routines of which the use of the portfolio is an essential part, enhancing the chance that it will still be used if monitoring decreases. The study also shows that the number of visits paid to the supervisor is positively related to the number of tasks assessed, number of skills assessed per task, and the percentage of actual task selections. It could be concluded from this that it is important for students to act according to a routine, in which both the use of STEPP and the weekly meetings with the supervisor are incorporated.

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

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

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

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

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

With regard to the duration of the case study, the period of 10 weeks is relatively short to expect substantial progress on -the highly complex- SDL skills. Longitudinal research is needed to give students better opportunities to become acquainted with a new learning environment (i.e., SDL in on-demand education supported by the use of a portfolio), and to reach a better understanding of the developmental processes of SDL skills. Furthermore, using longitudinal research, the critical process of scaffolding SDL could be further investigated. This should provide practical guidelines for gradually handing over more and more responsibilities over the learning process to students.

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

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## Figure Captions

*Figure 1*. Self-assessment and formulation of learning needs functionality in STEPP: Overview of skills (left column), standards (table) for performance assessment, and possibility to formulate learning needs (textbox).

*Figure 2*. Task selection functionality in STEPP: Overview of skills (left column), table to indicate the selected task(s) in terms of skill, level of support, authenticity and learning needs, and options to view all formulated learning needs and the previous task selection (right).

*Figure 3*. An overview page in STEPP: All assessments by all assessors (right) of the performance on one particular task (left). F= fail, S=satisfactory, V=very good.

Table 1

*Overview of Actual Use of STEPP for Students Grouped per Indicated Factor and Prior Skills*

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

* = $p < .05$

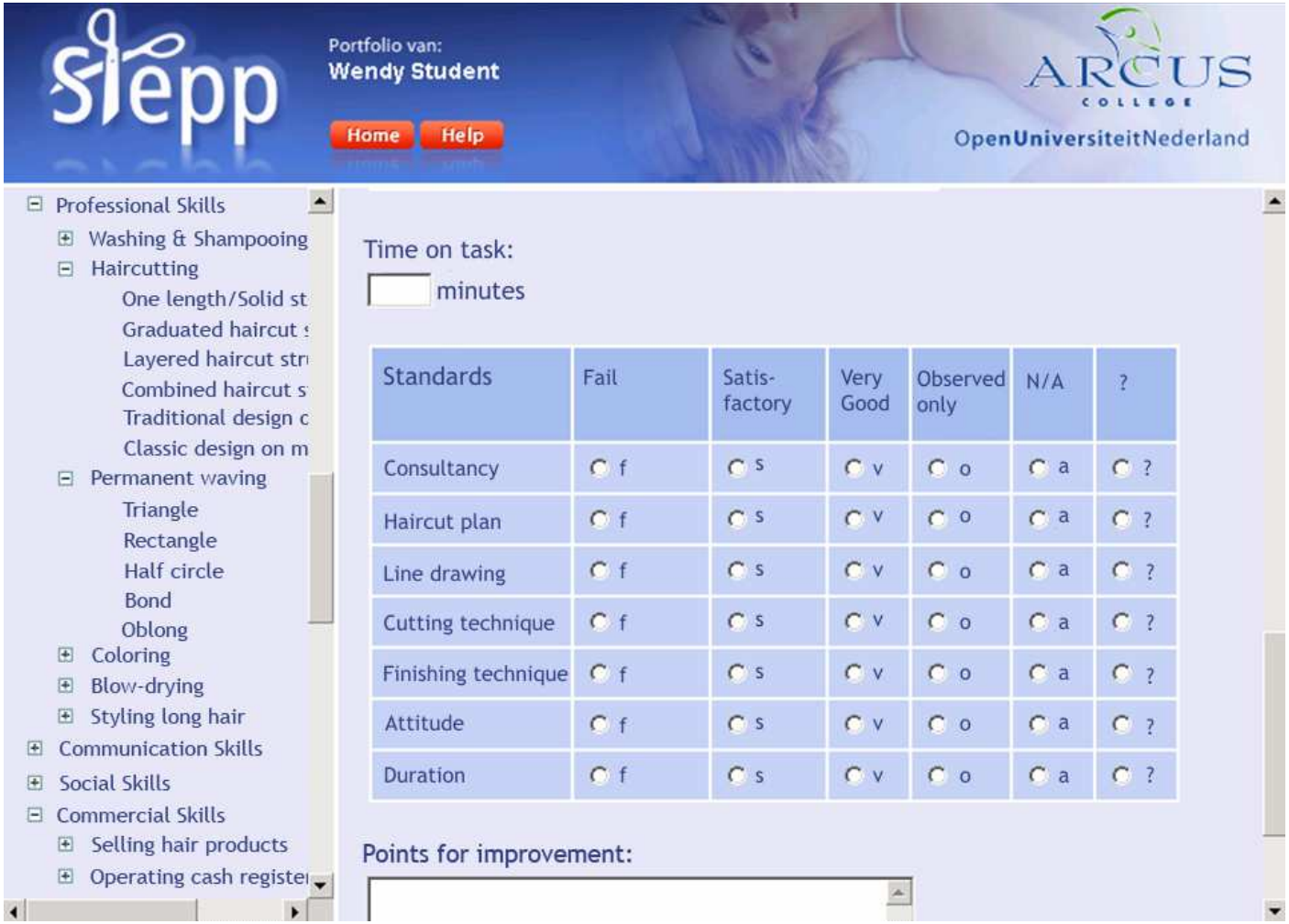
** = $p < .10$

Table 2

*Perceived Effectiveness of STEPP*

| | *Infrequent Users* *(n = 5)* | | *Frequent Users* *(n = 5)* | | *Total Group* *(N = 10)* | |
|---|---|---|---|---|---|---|
| | Student Interview – 5-Point Self-Rating Scales (1 = Very bad, 2 = bad 3= good/bad, 4= good, 5 = very good) | | | | | |
| | *Mdn* | *Range* | *Mdn* | *Range* | *Mdn* | *Range* |
| Quality of Self-assessments | 5 | 3-5 | 4 | 4-4 | 4 | 3-5 |
| Quality of Formulated Learning Needs | 5 | 3-5 | 4 | 4-4 | 4 | 3-5 |
| Quality of Task Selections | 4 | 4-5 | 4 | 3-4 | 4 | 3-5 |
| | Supervisor Interview - 5-Point Rating Scales | | | | | |
| | *Mdn* | *Range* | *Mdn* | *Range* | *Mdn* | *Range* |
| Quality of Self-assessments | 2 | 2-4 | 4 | 4-4 | 4 | 2-4 |
| Quality of Formulated Learning Needs | 3 | 2-4 | 4 | 4-4 | 4 | 2-4 |
| Quality of Task Selections | 2 | 2-3 | 4 | 3-4 | 3 | 2-4 |

Figure 1


Slepp
Portfolio van:
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Home
Help
ARCUS COLLEGE
OpenUniversiteitNederland
Professional Skills
Washing & Shampooing
Haircutting
One length/Solid st
Graduated haircut
Layered haircut str
Combined haircut s
Traditional design c
Classic design on m
Permanent waving
Triangle
Rectangle
Half circle
Bond
Oblong
Coloring
Blow-drying
Styling long hair
Communication Skills
Social Skills
Commercial Skills
Selling hair products
Operating cash registe
Time on task:
minutes
Standards
Fail
Satis-factory
Very Good
Observed only
N/A
?
Consultancy
Haircut plan
Line drawing
Cutting technique
Finishing technique
Attitude
Duration
Points for improvement:

Figure 2

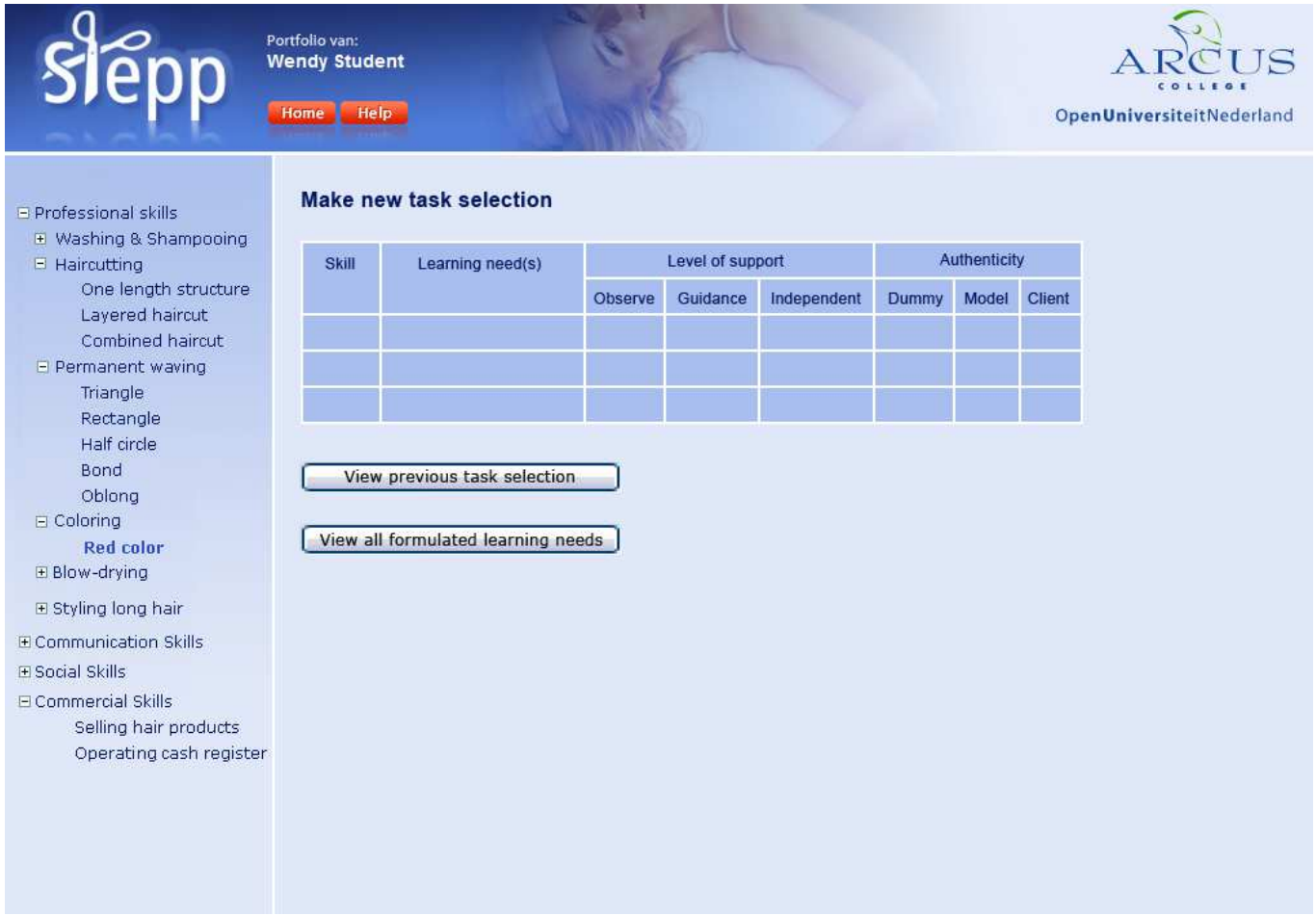
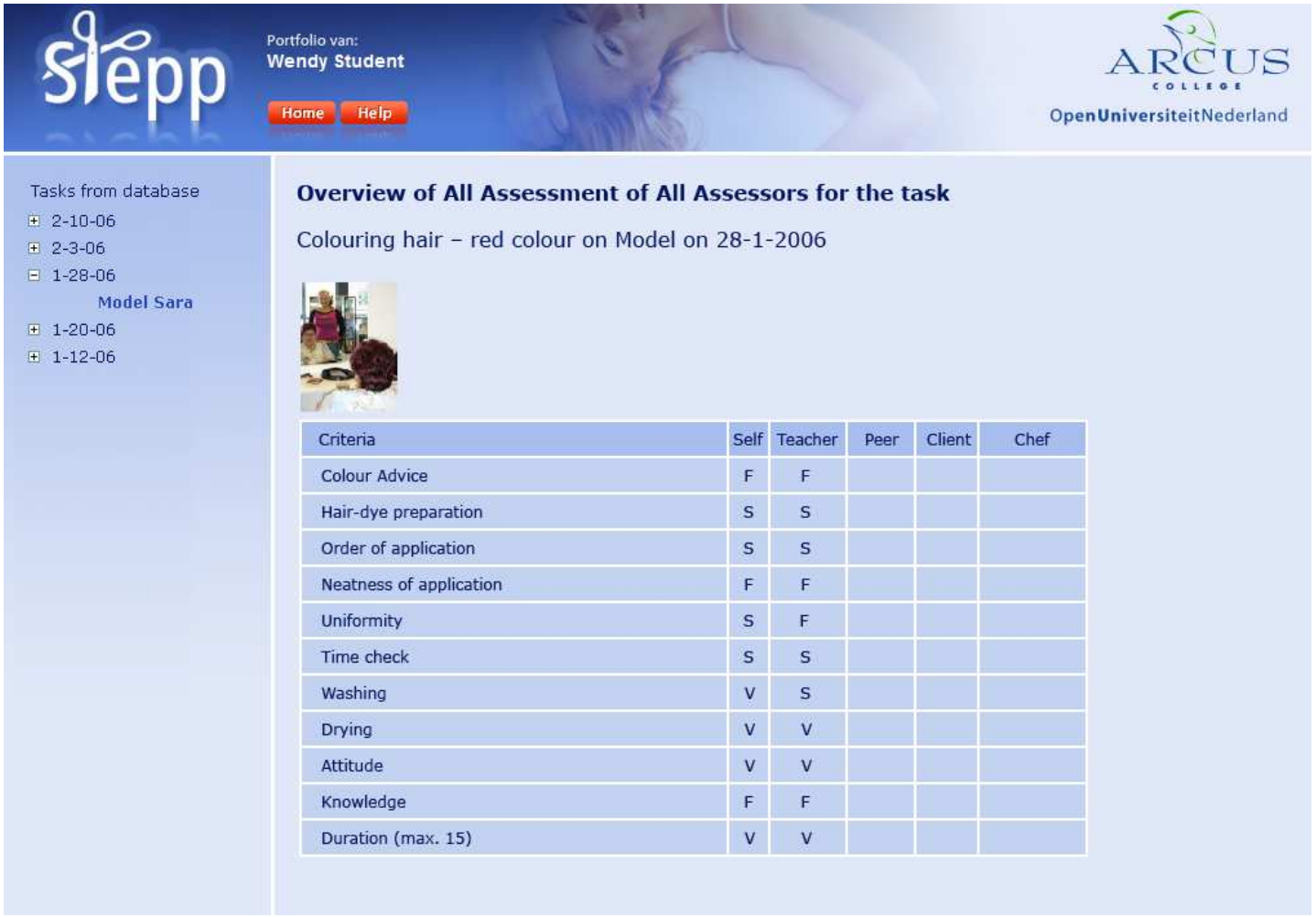

Slepp
Portfolio van:
Wendy Student
Home
Help
ARCUS COLLEGE
OpenUniversiteitNederland
Professional skills
Washing & Shampooing
Haircutting
One length structure
Layered haircut
Combined haircut
Permanent waving
Triangle
Rectangle
Half circle
Bond
Oblong
Coloring
Red color
Blow-drying
Styling long hair
Communication Skills
Social Skills
Commercial Skills
Selling hair products
Operating cash register
Make new task selection
Skill
Learning need(s)
Level of support
Observe
Guidance
Independent
Authenticity
Dummy
Model
Client
View previous task selection
View all formulated learning needs

Figure 3




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