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

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e-Portfolios have become increasingly popular among educators as learning tools. Some research even shows that e-portfolios can be utilised 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.

Introduction

Self-directed learning (SDL) is an umbrella term for various learning processes related to goal-directed, self-controlled learning behaviour (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 characterised 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 characterised as a mandated portfolio for learning purposes. These portfolios can be found in many school settings. For example, 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 characterised 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 1 depicts the four different kinds of portfolios. The purpose of the portfolio is placed on the vertical axis. Volition of use is placed on the horizontal axis.

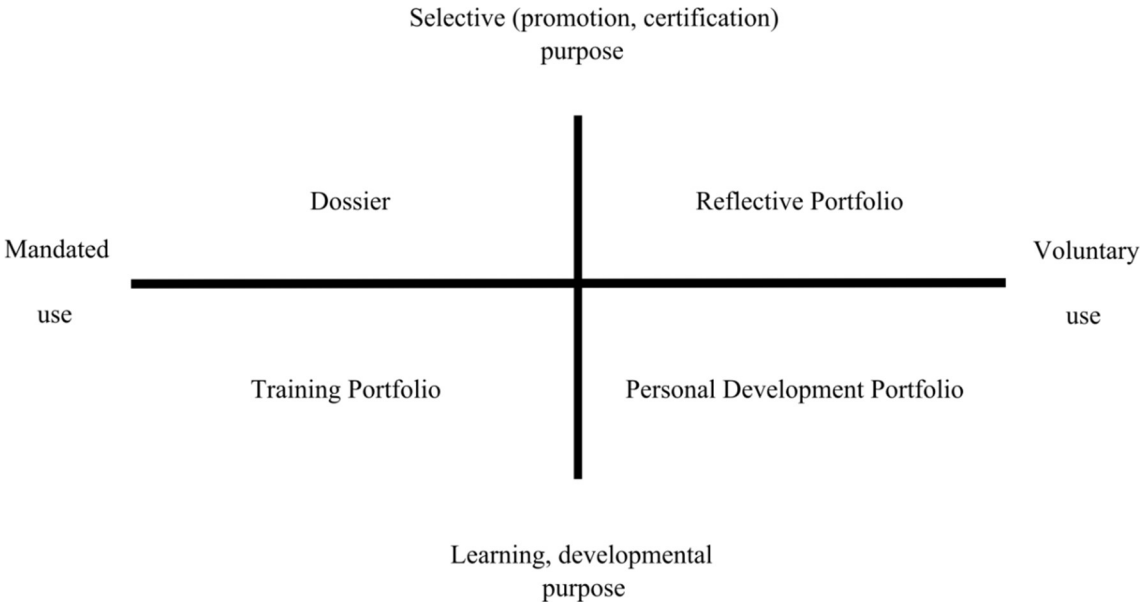

Figure 1. A portfolio classification by purpose and volition of use (adapted from Smith & Tillema, 2003; p. 628).

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, Muijtjens, Van Tartwijk, & Van der Vleuten, 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 optimise 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?

Methodology

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*.

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.

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.

Identifying influencing factors

After we selected articles to review, we started identifying influencing factors. We created a table to summarise the most important information from each paper, such as design, aim, findings, context, and reported influence on SDL. The emerging themes were further analysed 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.

Results

Search results

Figure 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.

Study characteristics

Table 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.

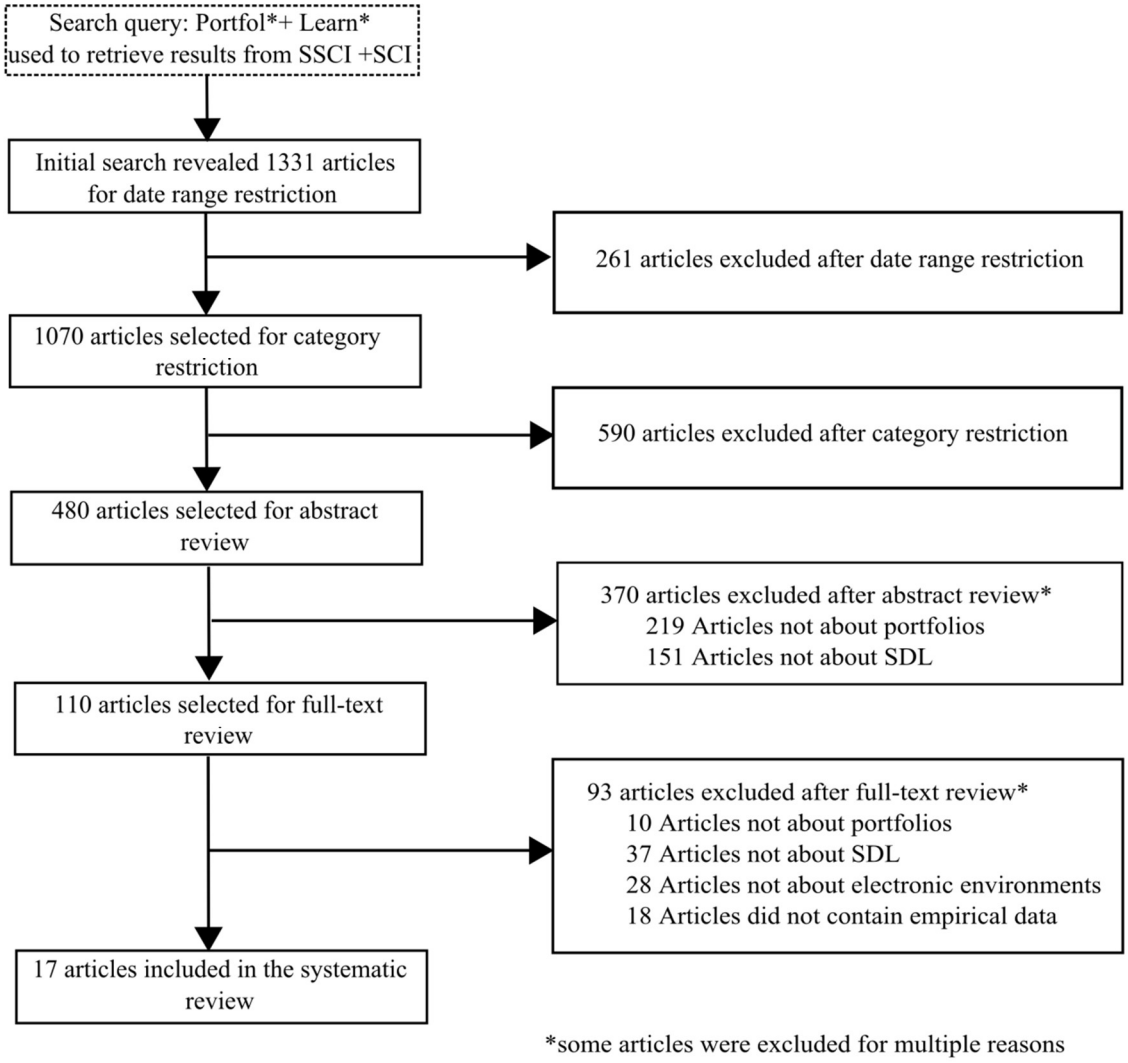

Figure 2. The article selection process.

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 explorative 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 explorative studies, they employed qualitative designs for the

larger part. With the exception of the Hadwin, Wozney, and Pontin (2005) study, all qualitative studies measured perceptions of teachers and students about the effectiveness of e-portfolio mediated learning. The Hadwin et al. study (2005) 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.

Table 1
Description of portfolio characteristics, SDL outcome variables, and study context.

Study	Portfolio name	Portfolio type	Relevant SDL outcome variables	Context
Abrami, Venkatesh, Meyer, and Wade (2013)	ePEARL	Personal development portfolio	SDL related questionnaire (SLSQ)	Primary education (Grades 4-6, Canada)
Altahawi, Sisk, Poloskey, Hicks, and Dannefer (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, Tseng, Liang, and Liao (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, Rientis, Corrin, and Olmos (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, Brand-Gruwel, and van Merriënboer (2009b)	STEPP	Personal development portfolio	Perceived effectiveness for improving SDL skills	Tertiary education (Hairdressing students)
Kjaer, Maagaard, and Wied (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, Abrami, Wade, Aslan, and Deault (2010)	ePEARL	Personal development portfolio	SDL related questionnaire (SLSQ)	Primary education (Grade 4-6, Canada)
Van Schaik, Plant, and O'Sullivan (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)

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 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 3 also denotes whether or not factors were associated with a positive or negative influence on the facilitation of SDL skills development.

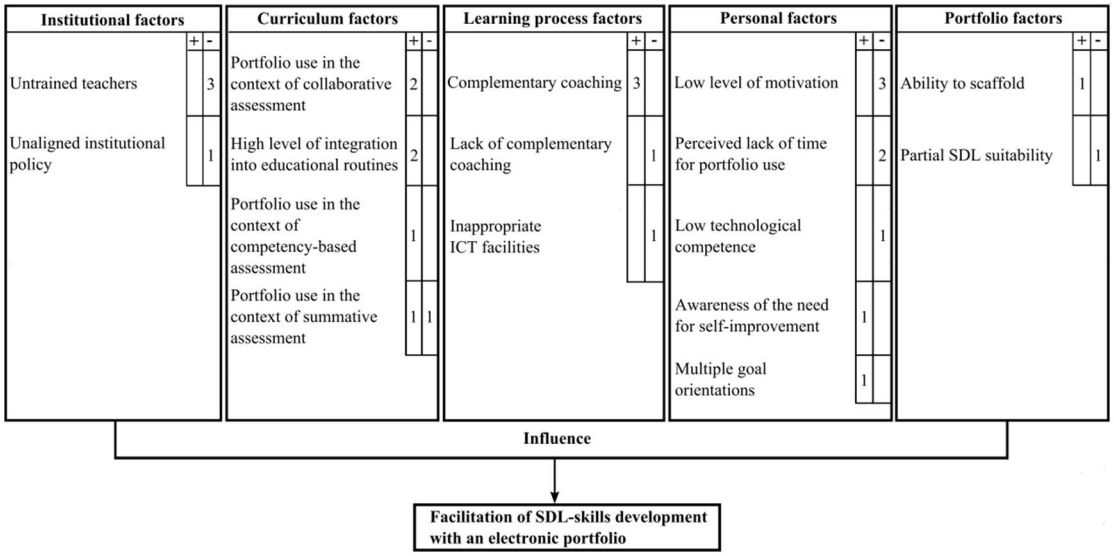

Figure 3. Overview of factors influencing facilitation of SDL with an e-portfolio. A positive influence on SDL as reported in the study is represented by a plus sign in the figure. A negative influence is represented by a minus sign. Factors are ordered by the number of articles they appear in.

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. study (2013) mentors teaching SDL all had different conceptions of the SDL concept and of 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) have already 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 prioritised 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 unfavourable 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) analysed the messages that students sent to each other on a dedicated online message board. It was found that students' messages to each other contained 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 workflow.

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 scepticism 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 explorative studies on the subject report contradictive results. First, Hudson, Rienits, Corrin, and Olmos (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 trainee's 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 reception of 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 who 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 pre-set 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. study (2006) 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. study (2012). 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 smartphones. 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 wilfully 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 characterised as the different motivations students have to engage in study behaviour. Generally, two goal orientations are distinguished: Mastery goals and performance goals. Whereas mastery goals can be characterised 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 analysed teacher-student dialogue about the contents of portfolios. The analysis of the student-teacher dialogues demonstrated that teacher-directed dialogue decreased over time, whereas student-directed dialogue increased. Furthermore, discourse targeting cognition (i.e., discourse targeting task-solving strategies) decreased, whereas discourse targeting metacognition 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 fulfil. 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 metacognition.

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.

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 organisational 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, van Tartwijk, van der Vleuten, & Wass, 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.

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 favour 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.

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 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.

Table 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 behaviour
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	

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 recognised as being portfolios when in fact they were, and vice versa. Because a portfolio can have many different forms, the generalisability 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 generalisable 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 recognising 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 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.

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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