

Chapter 10

Self-Regulation of Professional Learning: Towards a New Era of Research



Maaïke D. Endedijk and Katrien Cuyvers

Abstract In the workplace, employees are increasingly expected to take responsibility for their own professional learning. However, there is high variability in the capability of professionals to self-regulate their own learning. Previous descriptive and explanatory studies on self-regulation of professional learning (SRpL) have explored the operationalization of SRpL and provided insights in what personal and contextual factors benefit engagement in this self-regulated learning process. However, in-depth research on the process of how professionals regulate their learning intertwined with their daily work in various social constellations is scarce. Also, insights in how we can support professionals' self-regulation of their learning at work are limited, but highly needed. In this chapter we give an overview of the state-of-the-art of current research on SRpL. Moreover, we identified and explored three avenues to forward research on SRpL based on recent developments in the field of self-regulated learning in educational settings: inclusion of a temporal approach to study the process of SRpL, exploration of social regulation of professional learning, and the use of adaptive tools to support SRpL. This way, we identified crucial building blocks for a new era of research on SRpL.

Keywords Self-regulation of professional learning · Self-regulated learning · Self-directed learning · Professional learning · Workplace learning

M. D. Endedijk (✉)

Faculty of Behavioural, Management and Social Sciences, University of Twente,
Enschede, the Netherlands

e-mail: m.d.endedijk@utwente.nl

K. Cuyvers

Antwerp School of Education, University of Antwerp, Antwerp, Belgium

Spaarne Gasthuis, Hoofddorp, the Netherlands

e-mail: Katrien.cuyvers@uantwerpen.be

© Springer Nature Switzerland AG 2022

C. Harteis et al. (eds.), *Research Approaches on Workplace Learning*,

Professional and Practice-based Learning 31,

https://doi.org/10.1007/978-3-030-89582-2_10

10.1 Introduction

In the workplace, employees are increasingly expected to take responsibility for their own professional learning. Technological revolutions, new world power relationships, complex challenges such as climate change and migration, but also increasing (social) diversity at work and new work orders affect continuously how we define and carry out our work (Cairns & Malloch, 2011). To foster lifelong employability in this fast-changing knowledge society, continuous learning is required (Manuti et al., 2015). Traditional training solutions are relatively slow, costly, and often ineffective (Bersin, 2018), as related learning takes place off-the-job, content has to be developed on beforehand, and trainers need to be trained to facilitate the learning process. There is a widespread belief that learning and work should become more integrated in order to support employees to adapt to continuous changes in our knowledge economy (Ellström, 2001). However, to effectively learn in and from practices, employees need self-regulative knowledge and skills (Tynjälä, 2008). They need to be able to recognize their own learning needs, set goals, find appropriate strategies, apply and monitor these, and evaluate their learning (Sitzmann & Ely, 2011). In other words, the ability to self-regulate professional learning has become a key competence for the current workforce. However, we know from previous research that there is high variability in the capability of professionals to self-regulate their learning (Littlejohn et al., 2016).

Together with the growing interest in research on workplace learning, research on self-regulation of professional learning- for which we use the acronym “SRpL” in this chapter- gained attention in the last two decades. This research explored the operationalization of SRpL and provided insights in what personal and contextual factors benefit engagement in this process (e.g., Raemdonck et al., 2012; Straka, 2000). Nevertheless, the process of SRpL is still a black box: how professionals use different self-regulated learning strategies over time, intertwined with their daily work tasks and taking place in various social constellations is still unknown (Sitzmann & Ely, 2011). This leaves both practitioners and researchers empty-handed as these insights are needed to start supporting professionals in regulating their professional learning, especially where learners need it the most: in the daily work context. In this thematic review, we therefore synthesize and discuss previous research on SRpL by bringing together literature from the framework of self-regulated learning and self-directed learning and we identify and explore three interrelated avenues for a new era of research on SRpL: the inclusion of a temporal approach to study the process of SRpL, exploration of social regulation of professional learning, and the use of adaptive tools to support SRpL. For the identification and exploration of these avenues, we rely on recent developments in and best practices of research on self-regulated learning (SRL) in educational settings and highlight some first promising initiatives within the field of professional learning. Before we further explore these avenues for research, we first outline the current conceptualization of SRL, elucidate the concept of SRpL, give a brief overview of the history of SRpL research, and describe the outcomes of previous pivotal studies on SRpL.

10.2 The Concept of Self-Regulated Learning

SRL refers to the active personal modification of affective, cognitive, metacognitive, and behavioural processes throughout a learning experience (Panadero, 2017; Schunk & Greene, 2017; Sitzmann & Ely, 2011). The concept of SRL has been extensively investigated in a broad range of contexts over the past decades, leading to the development of different SRL models and theories (Panadero, 2017; Puustinen & Pulkkinen, 2001; Sitzmann & Ely, 2011). Although the different theories are not entirely uniform, all of the models from the field of educational psychology discern important key characteristics. In each model, a core premise is that self-regulated learners strategically and pro-actively orient their thoughts, motivations and actions to respond adaptively to environmental demands and challenges. SRL is initiated by *setting learning goals*, leading to subsequent engagement in *self-regulatory strategies* (Järvelä & Hadwin, 2013; Puustinen & Pulkkinen, 2001; Sitzmann & Ely, 2011). SRL is a cyclical process with interrelations between these self-regulatory strategies initiating, setting forward, and evaluating the progression towards the achievement of the learning goals (Panadero, 2017; Sitzmann & Ely, 2011). Based on self-observation, self-regulated learners compare the current state of functioning with the desired state, which is related to the goals set, referred to as *metacognitive monitoring* (Hadwin et al., 2011; Järvelä & Hadwin, 2013; Pintrich, 2000; Zimmerman, 2002). Then, self-regulated learners adapt the process and strategies used, referred to as *metacognitive control*. Learning and performance are reflected upon and judged, and attributions are made whenever necessary (Hadwin et al., 2011; Pintrich, 2000; Winne, 2011; Zimmerman, 2002). The two most extensively investigated models within the field of SRL, developed by Pintrich and Zimmerman, define SRL as a time-ordered sequential process delimiting different phases with consecutive or hierarchical strategy-use (Panadero, 2017). In comparison, authors of alternative models (e.g., models of Boekaerts, Efklides, Winne and Hadwin, Hadwin, Järvelä and Miller, as in Panadero 2017) do not underscore this delimited nature of the process (Panadero, 2017). Contrary, these authors argue that the process is open and includes recursive phases allowing evaluation and adaptation during each phase, directing loops back to a former phase (Hadwin et al., 2011; Sitzmann & Ely, 2011; Winne & Hadwin, 2008). They conceptualise SRL as a dynamic process that progresses in time and is formed by interrelations between SRL strategies. However, insights on these interrelations, both between different SRL strategies and also with the social context are still very scarce (Hardy III, Day, & Steele, 2018; Sitzmann & Ely, 2011).

10.3 Defining Self-Regulation of Professional Learning

Various concepts are used to describe learning of people during their professional life: lifelong learning, work-related learning, professional learning, and workplace learning (e.g., Eraut, 2004; Kyndt & Baert, 2013; Tynjälä, 2008). Lifelong learning

can be seen as an umbrella term as it includes all learning after graduation, both learning in relation to work as learning beyond the professional life, for example in relation to hobbies or personal interests (Illeris, 2007). Workplace learning and work-related learning are concepts that both used describe employees' learning during working life. However, these concepts are also used to describe learning of future employees (students) in authentic settings, for example during internships (Guile & Griffiths, 2001; Solomon et al., 2006). As we focus in this chapter on self-regulation of learning of employees *after* initial education and in relation to the profession, we use the term self-regulation of *professional learning*. We define professional learning as all learning that employees undertake in relation to their current or future work, including both more formal and more informal learning, and either taking place on or off the job (cf., Jacobs & Park, 2009). Nevertheless, the need for regulating one's own learning and development is highest in more informal learning situations where there is no support of an educational curriculum, trainers and coaches to create learning opportunities, and to co-regulate or scaffold employees' learning processes in relation to their goals (Sitzmann & Ely, 2011). This means that *self-regulation of professional learning* includes employees' dynamic process of setting learning goals, selecting learning activities (either more formal or informal), and monitoring and evaluating the achievements towards these goals. Professionals need to be agents of their own learning process, in the midst of all the challenges and responsibilities related to work and performance. Even though SRpL is often in the first place described as a deliberate process in which time is set aside to intentionally self-regulate professional learning, SRpL can also be more reactive, taking place in response to and in the midst of work-related challenges, driven by performance that is required at the same time (Cuyvers, 2019). Challenges experienced by professionals and demands related to performance can trigger SRpL in the workplace. Professionals recognise the affordance for learning herein, relate this to their self-knowledge regarding needs for learning, and engage in strategy-use which dynamically shapes an ongoing process of SRpL as time evolves (Cuyvers, 2019).

10.4 Self-Regulation of Professional Learning: A Brief History

Explorations on SRpL began around 2002 (e.g., Butler et al., 2004; Tillema & Kremer-Hayon, 2002; van de Wiel et al., 2004; Van Eekelen et al., 2005), but it is only since 2012 that different research groups started to make some systematic efforts (Gijbels et al., 2012; Littlejohn et al., 2016; Margaryan et al., 2013; Raemdonck et al., 2012). When reading through existing research on regulation of learning in the workplace, it becomes immediately clear that there is conceptual tangle regarding self-regulated learning and self-directed learning (SDL). Both concepts have different origins. As SRL stems from social cognitive theory (Zimmerman, 1989), this concept is strongly rooted in research on academic SRL taking place in educational settings. SDL originates from theories on adult learning with an

emphasis on the personal autonomy and responsibility of adults (Ellinger, 2004). One of the most cited definitions of SDL comes from Knowles who describes SDL 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” (Knowles, 1975, p. 18).

Broadly conceived, SRL and SDL share major similarities. Active engagement in setting goals, choice and implementation of appropriate learning strategies, and evaluation of learning are described by both concepts with the primary responsibility lying with the learners (Jossberger et al., 2010; Knowles, 1975). Besides these similarities however, on critical examination, major differences in the conceptual basis can be found. By different authors, different dimensions are described (Candy, 1991; Garrison, 1997) highlighting the versatility of the concept. According to Candy self-directedness entails four dimensions: personal autonomy, self-management or the willingness to commit one’s own education, learner control as a mode of instruction, and independent pursuit of learning whereby individuals pursue learning opportunities in the natural societal setting. Garrison (1997) describes three intimately connected dimensions: self-management, self-monitoring, and motivation. In all, SDL describes the general approach to learning adopted by a learner, representing a process on a more global level and pursuing learning opportunities fitting the continuous professional development of learners (Jossberger et al., 2010). SRL has a specific focus on the learning process in relation to a clearly defined task (Zimmerman, 2008). SRL is highly strategic and a variety of key strategies needs to be used to ensure that the intended learning is achieved: the progress towards the selected goals is self-monitored, adaptive changes and attributions are made if needed, and the process is evaluated (Zimmerman & Schunk, 2011). Further, contrary to SDL, SRL has evolved towards a theory with different granular levels, distinguishing different aspects of learning within SRL models: cognitive, metacognitive, behavioural, motivational, and emotional/affective, and detailed descriptions of micro processes related to these aspects and the different SRL phases. In other words, SRL offers a comprehensive and holistic approach, and allows for a grain-size perspective, with a big concern for the different strategies used by the learner (Loyens et al., 2008). However, models of SRL as developed to describe learning in educational settings do not include crucial workplace learning strategies such as taking learning initiative and identifying learning opportunities, as these models depart from a situation in which the learning goal or task are pre-defined for the learner (Cuyvers et al., 2020).

Taken into account all these definitions, an effective self-directed learner should be an effective self-regulated learner, using a variety of key SRL strategies to achieve the self-identified chosen goals (Brydges et al., 2015). An effective self-regulated learner however is not by definition an effective self-directed learner, as self-directed learners are not only capable of regulating a single task, but also shape and manage their environment and select, design, and self-guide their learning trajectories as a whole (Raemdonck et al., 2017). Nevertheless, both concepts are often used interchangeably, and the conceptual tangle is apparent in the literature. In all,

as the framework of SRL offers more handles for a rich and in-depth investigation of how self-regulation of learning takes place during daily work, we will use this concept throughout this chapter, but also include outcomes of research on SDL.

10.5 Self-Regulation of Professional Learning: Outcomes of Empirical Studies

As the field has been in full development only recently, most of the studies have focused on theory-building and developing instruments to employ in research. This is analogous to the research situated in the “period of development” according to Schunk and Greene (2017). In this developmental process, different types of empirical studies have been described, distinguishing broadly two main sets of studies- the process-oriented SRL-type of studies, and the professional learning-type of studies that builds on the SDL-framework- and a third more recent line of research in which a pedagogical framework for improving and supporting SRL at the workplace has been developed (see also Cuyvers et al. (2020) for a systematic review of empirical studies on SRpL). In line with our definition of SRpL, we included outcomes of empirical studies that studied self-regulated learning or self-directed learning of professionals, leaving out studies on future professionals (e.g., interns, college students, etc).

In the *first* set of studies (Fontana et al., 2015; Littlejohn et al., 2016; Milligan et al., 2015; van de Wiel et al., 2004; Van Eekelen et al., 2005) the process-oriented focus from an SRL perspective is mainly in the forefront. The underlying premise of these studies is that professional learning requires active engagement in everyday work experiences, and that social practices and interactions play an important role (Bauer & Gruber, 2007; Billett, 2004; Harteis & Billett, 2008). However, professional learning does not merely take place by engaging in these social practices and interactions. The workplace offers learning affordances and constraints (Billett, 2001, 2004), but self-regulation strategies are needed to recognize such affordances and deal with the constraints (Cuyvers, 2019). This first set of studies often used the Self-Regulated Learning at Work Questionnaire (SRLWQ) (Fontana et al., 2015) and/or logs and semi-structured interviews to measure SRpL. These studies showed that viewing learning as a long-term, personalised self-improvement is a key characteristic of SRpL but also that for SRpL it is hard to clearly delineate discrete phases of planning, implementation, and reflections. In particular when tasks and goals are less bounded or well-defined as is the case in many workplaces, the phases suggested may not be meaningful. Rather, SRL in the workplace is suggested to be iterative, fluid and continuous. Further, distinguishing between respondents’ reflections on learning and working was found to be difficult due to the predominantly outcome-oriented focus on learning in the workplace, as well as the workers lacking knowledge of reflection strategies and techniques (Margaryan et al., 2013). Finally, SRL in the workplace is suggested to be deeply integrated with work, and highly social.

A *second* set of studies explicitly identified self-regulated aspects of professional learning by using the framework of the SDL theory. In this set of studies, different, but all quantitative self-report instruments were used to explore SDL as a predictor of workplace learning (Gijbels et al., 2012; Raemdonck et al., 2014), employability of low-qualified employees (Raemdonck et al., 2008), and career satisfaction (Joo et al., 2013). Different from the first set of studies in which a process-oriented view is dominant, these studies aimed to integrate a process-orientation with SDL as a personal characteristic. In these studies, the work-related self-directed learning scale (Raemdonck, 2006) was used to measure regulation of learning in the workplace, but also the self-directed learning readiness scale (Guglielmino et al., 1987). Using this latter scale, the study of Hashim (2008) indicated that eight SDL attributes could be distinguished: determination, independence, confidence, initiative, clarity, openness, reflection, and readiness. Self-education and working in teams were found as the prevalent methods used to acquire competences by self-directed learners (Hashim, 2008). Further, in this set of studies, also predictors of SDL have been examined. For example, cross-sectional studies using self-report measures have found effects of rather stable personal characteristics (e.g. age, gender, and personality) on the tendency to self-regulate professional learning (Gijbels et al., 2012; Raemdonck et al., 2012, 2014). In addition, studies have shown that contexts in which employees experience autonomy, competence and social relatedness (Straka, 2000) positively influence employees' self-regulated learning (SRL). Next to that, job characteristics such as task variety and growth potential, and on the organizational level also participatory staff policy (Raemdonck et al., 2012) have the same positive influence.

Finally, a new evolving line of research is the work of Siadaty and her colleagues (Siadaty et al., 2012b, 2016b, c), who suggested a pedagogical framework distinguishing micro-level (e.g., task analysis, making personal plans, etc.) and macro-level processes (planning, enactment, and evaluation & reflection) to design technological scaffolds to support self-regulated workplace learning. The micro-level approach helped to reveal what technological interventions impact which SRL processes. The studies combined trace data to measure actual behaviours with self-perception data of the effect of the interventions, which turned out to be non-related. These studies thus revealed an important mechanism of how it comes that some interventions are not perceived to support learning: when participants do not experience the intervention as a learning intervention as they associate learning with formal training and not with informal learning (Siadaty et al., 2016c). Also, this research-line pinpoints the context-specificity of SRpL and draws attention to the need for customization of approaches.

In conclusion, despite the importance of SRpL, research on SRpL is scattered and still in its infancies. More empirical research is needed to advance the field's understanding of how workers regulate their learning before, during, and after their daily work in complex and changing work environments. Below, we identify three avenues for research on SRpL that we see as important building blocks to bring our field forward.

10.6 Next Steps: Three Avenues for Research on SRpL

In the following paragraphs we identify and explore three main avenues for the next decades of SRpL research: the inclusion of a temporal approach to study the process of SRpL, exploration of social regulation of professionals learning to better describe regulation of learning taking place in various social constellations, and the use of adaptive tools to support SRpL. For each research avenue, we subsequently describe the research avenue as we envision it, followed by best practices from research on SRL in educational settings, after which we describe existing promising initiatives from the field of professional learning and directions for future research for this field.

10.6.1 *Research Avenue 1: Towards a Temporal Approach to Study the Process Self-Regulation of Professional Learning*

Regulation of learning has consistently been defined as a *cyclical* process that unfolds over *time*. Even though the majority of scholars agree on these core characteristics, measurements are not always aligned (Cuyvers et al., 2020). Traditionally, SRL has been measured in two different ways: (1) as a relatively static aptitude using off-line self-report measures (e.g., questionnaires, interviews), and (2) as contextualized behaviour that may differ from event to event, measured *in situ* by using online (real-time) measurement tools (e.g., observation, thinking aloud, trace data) (Endedijk et al., 2016; Panadero et al., 2016; Schunk & Greene, 2017). Already a decade ago, Dinsmore et al. (2008) concluded that the far majority of research on self-regulation and self-regulated learning in educational settings consisted of decontextualized self-report measures, which often do not correspond well to actual strategy use (Veenman, 2011). A recent review (Cuyvers et al., 2020) also showed that even though many studies nowadays use process-oriented conceptualizations of SRL, only a far minority also operationalises and measures SRL as a dynamic process in their empirical studies. Moreover, as at the workplace, learning and work are often intertwined, this has even more implications for study designs and measurement of the SRpL processes. First, it is difficult for the learner to see differences between regulation of learning and of performance (working) and to self-report on these behaviours. As the work of Siadaty et al. (2016c) suggested, employees might easily not recognize certain activities as part of learning when they are highly informal in nature. Second, when working and learning are intertwined, learning – and also regulation of learning – can take place at any moment on the day, instead of on a planned moment on a set location. Indeed, we need continuous and unobtrusive measurements in order to capture the crucial moments of SRpL.

This leaves the field with many remaining questions on how SRpL evolves at the workplace. Indeed, only by including time (Roe, 2008) in our research questions, designs and measures, we will be able to measure the dynamics within the

SRpL-process and answer questions such as how skilful self-regulated learners intertwine their SRL strategy-use with their work activities. Under what circumstances is a certain person capable of self-regulating learning and when not? On what moments in the process do self-regulated learners experience barriers? Thus, designs taking into account temporal features, as well as temporal analysis techniques are needed to for example show patterns in series of events of skilful self-regulators. Consequently, intensive longitudinal methods and within-person analyses are needed to find crucial moments, and the right interplay of contextual factors for SRpL to evolve (Hardy III et al., 2018). Although this may seem to intensify our research, it actually lowers the burden on the need for huge numbers of participants, as within-subject designs have greater statistical power and thus need much fewer participants to achieve the same power than between-subject designs (Bellemare et al., 2014). Moreover, only if we measure SRL dynamically in response to temporal and contextual characteristics, we will be able to know when and how to provide support and to measure the immediate and longer-term effects of it (Siadaty et al., 2016a).

In response to the call for including temporality in SRL research, a recent special issue of *Learning and Instruction* showed how the use of various process analysis techniques to analyse multimodal data (e.g., combination of video data, log data, eye-tracking, but also physiological measurements such as cardiovascular data and electrodermal activity) can reveal temporal characteristics of SRL in relation to performance (Järvelä et al., 2019). For example, process mining was used to unravel that a certain element of SRL (i.e. monitoring) was weakly connected to other SRL processes (Engelmann & Bannert, 2019). In this way, the weakest link in the SRL process could be indicated, which can inform the design of targeted interventions. Another study analysed trace data to show how not merely the *use* of SRL strategies, but in particular *when* and under what *conditions* they were used was predictive for performance (Greene et al., 2019). In addition, the study of Lajoie et al. (2019) showed how sequential analysis revealed both similarities and differences between low and high performing medical students in the order of applying SRL strategies: although all students followed the same cyclical pattern, low performers got stuck in the initial orientation phase for a longer period of time in comparison to high performers who were able to design concrete plans and select the right strategies.

If trace data and process mining techniques can be used to unravel students' SRL in digital learning environments, this must also be possible in digital environments where employees work and learn together. Existing studies show that tracing processes of self-regulation of employees is possible in highly specialized domains where knowledge is stored in online environments, but that in broader domains where knowledge is shared via face-to-face communication, this is much more difficult (Lindstaedt et al., 2010). The main challenge will thus be to translate these methods and techniques to learning at the workplace – where learning paths are more individualized and work and learning activities are not automatically traced. How can, for example, crucial self-regulation events be caught from an avalanche of professional activities? The field of professional learning analytics is still in its

infancies (Littlejohn, 2017), but due to the rapid growth of use of online work and learning platforms in many different sectors, possibilities to apply these methods to professional work settings increase. Therefore, we foresee great possibilities to use trace and log data and analysis techniques such as process mining and machine learning to better understand the process of SRpL.

10.6.2 Research Avenue 2: Exploration of Social Regulation of Professional Learning

Social and contextual aspects influence SRL (Hadwin et al., 2011, 2017; Järvelä & Hadwin, 2013; Järvenoja et al., 2015; Schunk & Zimmerman, 1997; Zimmerman, 2008). Also, in the context of work learning does not take place in a social vacuum. Organizational work takes more and more place in various collaborative settings: (self-managing) teams, project groups, inter-organizational networks, communities of practice, etc. (Vangrieken et al., 2017), and therefore also learning often takes place in interaction (Tynjälä, 2008). Given the collaborative nature of workplace learning, it is remarkable that thus far SRpL research predominantly focused on intra-individual processes of SRL without taking into account the inter-personal or social regulation processes that occur in these various social constellations. Not that studies have neglected the social context: already for decades the social context has been included in studies as a factor that influences the engagement in self-regulation of learning (Confessore & Kops, 1998). Nevertheless, these studies still focused on SRL as an individual process, while in teams, people have a shared responsibility for setting their goals, monitoring their team development, etc.

In the past two decades a strong line of research has developed from the field of computer supported collaborative learning (CSCL) on social regulation as taking place in students' collaborative learning settings (Hadwin & Oshige, 2011). Social regulation captures how individuals reciprocally regulate each other's cognitive and metacognitive processes – including goal setting, monitoring and evaluation -, and engage in shared modes of cognitive and metacognitive regulation (Volet et al., 2009). Different modes of social regulation have been identified with socially shared regulation as the dominant one: group or team members collectively regulate in a balanced way their cognition, metacognition, emotion, motivation, and behaviour for which they use various joint regulatory strategies, such as joint co-constructing of their goals (Panadero & Järvelä, 2015). These studies indicate that teams that show high levels of socially shared regulation also show better performance in educational settings (Panadero & Järvelä, 2015). A second mode of social regulation is co-regulation that has been operationalised in various ways: either as a transitional process in which a more experienced person (e.g., teacher or parent) scaffolds the regulative actions of a more novice learner, or pointing towards unbalanced ways of collaborative regulation in group settings, in which one group member is dominant in regulating other group members' activities or when goals or paths diversify (Schoor et al., 2015).

For the context of professional learning this opens up a new world of research with possibilities to bridge the field of SRpL and team learning research (Van den Bossche et al., 2011). First steps have been made in the context of ICT teams, in which empirical evidence has been found of the existence of socially shared regulation in workplace settings (Wijga et al., 2019). Important future research questions are not only how teams collaboratively regulate their knowledge construction, motivation, and behaviour, but also how these collaborative forms of regulation interplay with individual regulation of learning and how this affects both individual and team performance.

10.6.3 Research Avenue 3: Providing Adaptive Support of Professionals' Self-Regulated Learning

Not all employees manage to actively regulate their own learning in all situations and at all times (e.g., Littlejohn et al., 2016). Despite the promises of many descriptive and explanatory studies on SRpL that the outcomes of these studies could inform the design of interventions to support SRpL, the actual design of the interventions is often not realised. In the field of professional learning, we have mainly seen tools – especially coming from contexts of vocational education – to *document* self-regulated learning (e.g., via portfolios) (e.g., Kicken et al., 2009; Meeus et al., 2008; Strijbos et al., 2007; van Houten-Schat et al., 2018). Although this may help professionals to become more aware of the importance of self-regulated learning and to regulate their overall development at a higher abstraction level, it does often not give the just-in-time and just-in-place support that is needed for today's more agile way of working (Littlejohn, 2017). The third and most important research avenue is therefore to start developing and testing adaptive tools to support professionals' self-regulated learning to improve their performance.

For learning in educational settings, many tools have been developed and proved their success. Using principles of scaffolding (Azevedo & Hadwin, 2005), positive effects of instructor and computer-based prompts have been reported on the use of SRL strategies and learning outcomes. Scaffolding is a dynamic intervention, often by means of questioning, prompting and modeling, that is continuously adapted to the progress of the learner (and thus never the same for each participant) and eventually fades away (van de Pol et al., 2010). A recent review on the effects of SRL interventions for students in Higher Education (Jansen et al., 2019) revealed that various types of interventions (instruction, application, or prompting of SRL) all had positive effects on student achievement, but no evidence was found for specific design characteristics as moderators of the effects of SRL interventions on performance. Because of this lack of evidence no specific recommendations could be given from this review study on how to design future interventions (Jansen et al., 2019). For learning in collaborative settings, technological tools have been developed to support regulation of cognition, motivation,

and emotion (Järvelä et al., 2016; Järvenoja et al., 2017). For example, gStudy has been one of the first applications that showed how software can be used to both support and trace learning of individuals and in collaborative settings (Perry & Winne, 2006; Winne et al., 2010).

For work-related learning, some tools have been developed that are claimed to be suitable for self-initiated learning (e.g., employees can learn by themselves via apps), but these tools do not aim to adaptively support employees' SRL (see for example Nussbaumer et al. (2012)). Rather, these tools are often adaptive in terms of the learning content that is tried to match the employees' prior knowledge and learning goals (e.g., Dolog et al. (2007); (Lindstaedt et al., 2010) and not to adaptively co-regulate the learning of the professional. Moreover, most of these initiatives only have been evaluated from a usability perspective and not from an educational perspective. One best practice worth mentioning is the LearnB tool (Siadaty et al., 2012a, b, 2016b, c). The LearnB tool is "...implemented as an environment that allowed workplace learners to define goals, get recommendations which competences to study next, how to study these competences by receiving suggestions about learning plans and resources, and share experience with and receive updates about the progression of colleagues in the workplace" (Siadaty et al., 2016b, p. 1008). Very interesting results are that the social intervention (e.g., the possibility to inspect what operations other users performed) had the most impact on the engagement of participants in SRL strategy-use. This could indicate that social components might be a crucial asset of effective workplace learning interventions. Moreover, as the environment consisted of many components, the researchers also studied which components were most helpful for their learning. Interestingly, comparison of the trace data with the self-perception of the participants showed that what is perceived as helpful is often different from what actually is helpful (Siadaty et al., 2016b), which shows how important it is to not solely rely on self-report measures to evaluate the effects. This study is not only exemplary for how a tool could be designed that is grounded in SRpL research, but also in terms of how trace data and process analysis can reveal how it was used, the effects and how it can be further improved. Although SRpL is context-specific and SRpL interventions should be customized to the specific context, this set of studies could inspire researchers to develop and test similar environments for other contexts.

10.6.4 Conclusion: Building Blocks for a New Era of Research on Self-Regulation of Professional Learning

The importance of self-regulation of professional learning has been acknowledged from research, practice and policy perspectives. In order to move the research field conceptually and methodologically, and at the same time answer the pressing call for guidelines and tools on how professionals can be supported to self-regulate their learning – both individually and in collaborative settings – we have identified three

interrelated research avenues. That is, the need to use a temporal approach to better understand how the process of SRL unfolds over time in the work environment needs to be addressed. Further, we need to explore the social regulation of professional learning to be able to study regulation of professional learning in collaborative learning settings such as many of the contemporary workplaces are. Finally, instead of continuing the line of merely descriptive and explanatory research, we also need to start designing tools and interventions to adaptively support professionals' regulation of learning just-in-time and just-in-place. All three research avenues have already been taken up by SRL research in educational settings and in this way our paths seem to be paved. However, we often cannot simply copy operationalizations, methods and findings from the educational to the professional settings because of the different nature of the learning processes and contexts (Tynjälä, 2008). To forward our research along these proposed avenues for research, we urge for uniting expertise of researchers on SRpL with expertise of researchers from various other fields. Below we give some concrete suggestions for (interdisciplinary) collaborative research projects as a starting point for a new era of research on SRpL.

Our *first* suggestion is to start joint projects between researchers on SRpL and academic SRL to facilitate knowledge sharing and bridge the perspectives. Herein, we foresee studies on SRL in which the same learners are studied while they learn in different contexts either in parallel (e.g., in dual forms of education in which learners alternate between learning in educational settings and during practice placements), or subsequently by -for example- following these students over time during study-work transitions.

In addition, researchers in the field of professional learning are often specialized in studying a specific profession, either being medicine, teaching, engineering, etc. All these professional fields bring in unique characteristics, possibly influencing how we operationalize what skilful regulation of professional learning entails. For example, a self-employed architect who is working from home and communicates with clients at set times, might deal with different affordances and constraints for professional learning than a nurse working at the intensive care unit. However, this also results in difficulties to compare outcomes between studies. To get more insights in the domain-specificity of SRpL and how it could be operationalized and measured across professional domains, our *second* recommendation is to cross these boundaries and start projects in which professionals across professional domains are studied with the same research questions and – as far as possible – the same methods.

Moreover, not only the first research avenue, but also the other two avenues call for within-subject designs using multimodal data – using either qualitative, quantitative or mixed methods approaches – as the new standard. However, analysing data from multiple measurements of multiple sources and on various levels (individual, teams, organizations) is complex and it is easy to drown in the wealth of analysis techniques (e.g., Järvelä et al., 2019; Molenaar, 2014). Therefore, our *third* recommendation is to start collaborating with experts in for example data cleaning, data processing and visualization techniques by designing joint projects that serve research interests for all parties.

Our *fourth* and final recommendation is to start collaborating with the industry to develop apps, digital learning environments and other tools to facilitate employees in improving their self-regulation, their learning and performance. Many tools are already available, but often focus on a single aspect of work or learning and frequently lack solid grounding in theories on SRpL. For example, a risk might be that these tools take over the regulation of the learner and provide fixed support, instead of scaffolding the process of SRpL. As this type of collaboration might also be complicated because of different interests, intellectual property conflicts, etc., we recommend researchers to first explore to what extent existing free tools can already be used to support employees' SRpL. Exemplary is the work of Ley et al. (2014) and how they used existing tools such as Evernote (<https://evernote.com>) to start designing a way to scale informal learning. Another advantage of this approach is that after conducting studies with existing tools (that do not eat half of the research budget) a much more profound idea of the design requirements of a more customized tool to support SRpL can be obtained.

Concluding, the past two decades of research on self-regulation of professional learning consisted of mainly descriptive and exploratory research, which resulted in various conceptualizations and insights in influencing factors. To answer the pressing call for insights in how to support SRpL in the daily work context, we need more understanding of the temporal aspects of the process of SRpL – including social regulation of professional learning – as it unfolds in individual and collaborative settings. In line with the ideas of the third wave of measuring SRL (Panadero et al., 2016), measuring and intervening can go hand in hand, resulting in studies that give insights in the process of SRL while also intervening in it. Therefore, the time is right to start designing and experimenting with tools to adaptively support SRpL in the daily work context. To achieve these goals, interdisciplinary collaboration is crucial. Altogether, by exploring these avenues for research, we have tried to identify some crucial building blocks for a new era of research on self-regulation of professional learning.

References

- Azevedo, R., & Hadwin, A. F. (2005). Scaffolding self-regulated learning and metacognition – Implications for the design of computer-based scaffolds. *Instructional Science*, 33(5), 367–379.
- Bauer, J., & Gruber, H. (2007). Workplace changes and workplace learning: Advantages of an educational micro perspective. *International journal of lifelong education*, 26(6), 675–688. <https://doi.org/10.1080/02601370701711364>
- Bellemare, C., Bissonnette, L., & Kröger, S. (2014). *Statistical power of within and between-subjects designs in economic experiments*.
- Bersin, J. (2018). *A new paradigm for corporate training: Learning in the flow of work*. Retrieved from <https://joshbersin.com/2018/06/a-new-paradigm-for-corporate-training-learning-in-the-flow-of-work/>
- Billett, S. (2001). Workplace pedagogic practices: Participatory factors in localised arrangements. *Knowledge Demands of the New Economy*, 1, 93–101.
- Billett, S. (2004). Workplace participatory practices: Conceptualising workplaces as learning environments. *Journal of Workplace Learning*, 16(6), 312–324.

- Brydges, R., Manzone, J., Shanks, D., Hatala, R., Hamstra, S. J., Zendejas, B., & Cook, D. A. (2015). Self-regulated learning in simulation-based training: A systematic review and meta-analysis. *Medical Education*, 49(4), 368–378.
- Butler, D. L., Lauscher, H. N., Jarvis-Selinger, S., & Beckingham, B. (2004). Collaboration and self-regulation in teachers' professional development. *Teaching and Teacher Education*, 20, 435–455.
- Cairns, L., & Malloch, M. (2011). Theories of work, place and learning: New directions. In M. Malloch, L. Cairns, K. Evans, & B. O'Connor (Eds.), *The SAGE handbook of workplace learning* (pp. 3–16). SAGE.
- Candy, P. C. (1991). *Self-direction for lifelong learning*. Jossey-Bass.
- Confessore, S. J., & Kops, W. J. (1998). Self-directed learning and the learning organization: Examining the connection between the individual and the learning environment. *Human Resource Development Quarterly*, 9(4), 365–375.
- Cuyvers, K. (2019). *Unravelling medical specialists' self-regulated learning in the clinical environment*. Dissertation, University of Antwerp.
- Cuyvers, K., Van den Bossche, P., & Donche, V. (2020). Self-regulation of professional learning in the workplace: A state of the art and future perspectives. *Vocations and Learning*, 1–32.
- Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review*, 20, 391–409. <https://doi.org/10.1007/s10648-008-9083-6>
- Dolog, P., Kravcik, M., Cristea, A., Burgos, D., Bra, P. D., Ceri, S., ... Tattersall, C. (2007). *Specification, authoring and prototyping of personalised workplace learning solutions*.
- Ellinger, A. D. (2004). The concept of self-directed learning and its implications for human resource development. *Advances in developing human resources*, 6(2), 158–177. <https://doi.org/10.1177/1523422304263327>
- Ellström, P.-E. (2001). Integrating learning and work: Problems and prospects. *Human Resource Development Quarterly*, 12(4), 421–435. <https://doi.org/10.1002/hrdq.1006>
- Endedijk, M. D., Brekelmans, M., Sleegers, P., & Vermunt, J. D. (2016). Measuring students' self-regulated learning in professional education: Bridging the gap between event and aptitude measurements. *Quality & Quantity*, 50(5), 2141–2164. <https://doi.org/10.1007/s11135-015-0255-4>
- Engelmann, K., & Bannert, M. (2019). Analyzing temporal data for understanding the learning process induced by metacognitive prompts. *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2019.05.002>
- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26, 247–273. <https://doi.org/10.1080/158037042000225245>
- Fontana, R. P., Milligan, C., Littlejohn, A., & Margaryan, A. (2015). Measuring self-regulated learning in the workplace. *International Journal of Training and Development*, 19(1), 32–52. <https://doi.org/10.1111/ijtd.12046>
- Garrison, D. R. (1997). Self-directed learning: toward a comprehensive model. *Adult Education Quarterly*, 48(1), 18–33.
- Gijbels, D., Raemdonck, I., Verweken, D., & Van Herck, J. (2012). Understanding work-related learning: The case of ICT workers. *Journal of Workplace Learning*, 24(6), 416–429.
- Greene, J. A., Plumley, R. D., Urban, C. J., Bernacki, M. L., Gates, K. M., Hogan, K. A., ... Panter, A. T. (2019). Modeling temporal self-regulatory processing in a higher education biology course. *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2019.04.002>
- Guglielmino, P. J., Guglielmino, L. M., & Long, H. B. (1987). Self-directed learning readiness and performance in the workplace: Implications for business, industry, and higher-education. *Higher Education*, 16(3), 303–317.
- Guile, D., & Griffiths, T. (2001). Learning through work experience. *Journal of Education and Work*, 14, 113–131.
- Hadwin, A. F., & Oshige, M. (2011). Self-regulation, coregulation, and socially shared regulation: Exploring perspectives of social in self-regulated learning theory. *Teachers College Record*, 113, 240–264.

- Hadwin, A. F., Järvelä, S., & Miller, M. (2011). Self-regulated, co-regulated, and socially-shared regulation of learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 65–84). Routledge.
- Hadwin, A. F., Järvelä, S., & Miller, M. (2017). Self-regulation, co-regulation, and shared regulation in collaborative learning environments. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed.). Routledge.
- Hardy III, J. H., Day, E. A., & Steele, L. M. (2018). Interrelationships among self-regulated learning processes: Toward a dynamic process-based model of self-regulated learning. *Journal of Management*, 0149206318780440.
- Harteis, C., & Billett, S. (2008). The workplace as learning environment. *International Journal of Educational Research*, 47, 209–212.
- Hashim, J. (2008). Competencies acquisition through self-directed learning among Malaysian managers. *Journal of Workplace Learning*, 20(4), 259–271.
- Illeris, K. (2007). *How we learn: Learning and non-learning in school and beyond*. Routledge.
- Jacobs, R. L., & Park, Y. (2009). A proposed conceptual framework of workplace learning: Implications for theory development and research in human resource development. *Human Research Development Review*, 8, 133–150. <https://doi.org/10.1177/1534484309334269>
- Jansen, R. S., van Leeuwen, A., Janssen, J., Jak, S., & Kester, L. (2019). Self-regulated learning partially mediates the effect of self-regulated learning interventions on achievement in higher education: A meta-analysis. *Educational Research Review*, 100292.
- Järvelä, S., & Hadwin, A. F. (2013). New frontiers: Regulating learning in CSCL. *Educational Psychologist*, 48(1), 25–39.
- Järvelä, S., Kirschner, P. A., Hadwin, A. F., Järvenoja, H., Malmberg, J., Miller, M., & Laru, J. (2016). Socially shared regulation of learning in CSCL: Understanding and prompting individual- and group-level shared regulatory activities. *International Journal of Computer-Supported Collaborative Learning*, 11(3), 263–280. <https://doi.org/10.1007/s11412-016-9238-2>
- Järvelä, S., Malmberg, J., Haataja, E., Sobocinski, M., & Kirschner, P. A. (2019). What multimodal data can tell us about the students' regulation of their learning process? *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2019.04.004>
- Järvenoja, H., Järvelä, S., & Malmberg, J. (2015). Understanding regulated learning in situative and contextual frameworks. *Educational Psychologist*, 50(3), 204–219.
- Järvenoja, H., Järvelä, S., & Malmberg, J. (2017). Supporting groups' emotion and motivation regulation during collaborative learning. *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2017.11.004>
- Joo, B.-K., Park, S., & Oh, J. R. (2013). The effects of learning goal orientation, developmental needs awareness and self-directed learning on career satisfaction in the Korean public sector. *Human Resource Development International*, 16(3), 313–329.
- Jossberger, H., Brand-Gruwel, S., Boshuisen, H., & van de Wiel, M. (2010). The challenge of self-directed and self-regulated learning in vocational education: A theoretical analysis and synthesis of requirements. *Journal of Vocational Education & Training*, 62(4), 415–440.
- Kicken, W., Brand-Gruwel, S., Van Merriënboer, J. J. G., & Slot, W. (2009). Design and evaluation of a development portfolio: How to improve students' self-directed learning skills. *Instructional Science*, 37, 453–473.
- Knowles, M. S. (1975). *Self-directed learning. A guide for learners and teachers*. Association Press.
- Kyndt, E., & Baert, H. (2013). Antecedents of employees' involvement in work-related learning: A systematic review. *Review of Educational Research*, 83(2), 273–313. <https://doi.org/10.3102/0034654313478021>
- Lajoie, S. P., Zheng, J., Li, S., Jarrell, A., & Gube, M. (2019). Examining the interplay of affect and self regulation in the context of clinical reasoning. *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2019.101219>
- Ley, T., Cook, J., Dennerlein, S., Kravcik, M., Kunzmann, C., Pata, K., ... Trattner, C. (2014). Scaling informal learning at the workplace: A model and four designs from a large-scale

- design-based research effort. *British Journal of Educational Technology*, 45(6), 1036–1048. <https://doi.org/10.1111/bjjet.12197>
- Lindstaedt, S., Kump, B., Beham, G., Pammer, V., Ley, T., Dotan, A., & De Hoog, R. (2010). *Providing varying degrees of guidance for work-integrated learning*. Paper presented at the European conference on technology enhanced learning.
- Littlejohn, A. (2017). Learning and work: Professional learning analytics. In *Handbook of learning analytics* (pp. 269–277).
- Littlejohn, A., Milligan, C., Fontana, R. P., & Margaryan, A. (2016). Professional learning through everyday work: How finance professionals self-regulate their learning. *Vocations and Learning*, 9(2), 207–226.
- Loyens, S. M. M., Magda, J., & Rikers, R. M. J. P. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, 20, 411–427.
- Manuti, A., Pastore, S., Scardigno, A. F., Giancaspro, M. L., & Morciano, D. (2015). Formal and informal learning in the workplace: A research review. *International Journal of Training and Development*, 19(1), 1–17.
- Margaryan, A., Littlejohn, A., & Milligan, C. (2013). Self-regulated learning in the workplace: Strategies and factors in the attainment of learning goals. *International Journal of Training and Development*, 17(4), 245–259.
- Meeus, W., Van Petegem, P., & Meijer, J. (2008). Portfolio as a means of promoting autonomous learning in teacher education. *Educational Research*, 50, 361–386.
- Milligan, C., Fontana, R. P., Littlejohn, A., & Margaryan, A. (2015). Self-regulated learning behaviour in the finance industry. *Journal of Workplace Learning*, 27(5), 387–402. <https://doi.org/10.1108/jwl-02-2014-0011>
- Molenaar, I. (2014). Advances in temporal analysis in learning and instruction. *Frontline Learning Research*.
- Nussbaumer, A., Berthold, M., Dahrendorf, D., Schmitz, H.-C., Kravcik, M., & Albert, D. (2012). *A mashup recommender for creating personal learning environments*. Paper presented at the international conference on web-based learning.
- Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, 8, 422.
- Panadero, E., & Järvelä, S. (2015). Socially shared regulation of learning: A review. *European Psychologist*, 20(3), 190–203. <https://doi.org/10.1027/1016-9040/a000226>
- Panadero, E., Klug, J., & Järvelä, S. (2016). Third wave of measurement in the self-regulated learning field: When measurement and intervention come hand in hand. *Scandinavian Journal of Educational Research*, 60(6), 723–735.
- Perry, N. E., & Winne, P. H. (2006). Learning from learning kits. *Educational Psychology Review*, 18, 211–228.
- Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press.
- Puustinen, M., & Pulkkinen, L. (2001). Models of self-regulated learning: A review. *Scandinavian Journal of Educational Research*, 45(3), 269–286.
- Raemdonck, I. (2006). *Self-directedness in learning and career processes. A study in lower qualified employees in Flanders*. PhD, Universiteit Gent, Gent.
- Raemdonck, I., de Grip, A., Segers, M., Thijssen, J., & Valcke, M. (2008). Self-directedness in learning and career as predictors of employability in low-qualified employees. *Gedrag & Organisatie*, 21(4), 386–405.
- Raemdonck, I., Van der Leeden, R., Valcke, M., Segers, M., & Thijssen, J. (2012). Predictors of self-directed learning for low-qualified employees: A multi-level analysis. *European Journal of Training and Development*, 36, 572–591.
- Raemdonck, I., Gijbels, D., & Van Groen, W. (2014). The influence of job characteristics and self-directed learning orientation on workplace learning. *International Journal of Training and Development*, 18(3), 188–203.

- Raemdonck, I., Thijssen, J. G. L., & Greef, M. D. (2017). Self-directedness in work-related learning processes. Theoretical perspectives and development of a measurement instrument. In M. Göller & S. Pallonimie (Eds.), *Agency at work - An agentic perspective on professional learning and development* (pp. 401–423). Springer.
- Roe, R. A. (2008). Time in applied psychology. *European Psychologist*, *13*(1), 37–52. <https://doi.org/10.1027/1016-9040.13.1.37>
- Schoor, C., Narciss, S., & Körndle, H. (2015). Regulation during cooperative and collaborative learning: A theory-based review of terms and concepts. *Educational Psychologist*, *50*(2), 97–119. <https://doi.org/10.1080/00461520.2015.1038540>
- Schunk, D. H., & Greene, J. A. (2017). Historical, contemporary, and future perspectives on self-regulated learning and performance. In *Handbook of self-regulation of learning and performance* (pp. 17–32). Routledge.
- Schunk, D. H., & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist*, *32*(4), 195–208.
- Siadaty, M., Gašević, D., Jovanović, J., Milikić, N., Jeremić, Z., Ali, L., ... Hatala, M. (2012a). *Learn-B: A social analytics-enabled tool for self-regulated workplace learning*. Paper presented at the proceedings of the 2nd international conference on learning analytics and knowledge.
- Siadaty, M., Gašević, D., Jovanović, J., Pata, K., Milikić, N., Holocher-Ertl, T., ... Hatala, M. (2012b). Self-regulated workplace learning: A pedagogical framework and semantic web-based environment. *Journal of Educational Technology & Society*, *15*(4), 75–88.
- Siadaty, M., Gasevic, D., & Hatala, M. (2016a). Trace-based micro-analytic measurement of self-regulated learning processes. *Journal of Learning Analytics*, *3*(1), 183–214.
- Siadaty, M., Gašević, D., & Hatala, M. (2016b). Associations between technological scaffolding and micro-level processes of self-regulated learning: A workplace study. *Computers in Human Behavior*, *55*, 1007–1019.
- Siadaty, M., Gašević, D., & Hatala, M. (2016c). Measuring the impact of technological scaffolding interventions on micro-level processes of self-regulated workplace learning. *Computers in Human Behavior*, *59*, 469–482.
- Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin*, *137*(3), 421–442. <https://doi.org/10.1037/a0022777>
- Solomon, N., Boud, D., & Rooney, D. (2006). The in-between: Exposing everyday learning at work. *International Journal of Lifelong Education*, *25*, 3–13.
- Straka, G. A. (2000). Conditions promoting self-directed learning at the workplace. *Human Resource Development International*, *3*(2), 241–251. <https://doi.org/10.1080/136788600402708>
- Srijbos, J., Meeus, W., & Libotton, A. (2007). Portfolio assignments in teacher education: A tool for self-regulating the learning process? *International Journal for the Scholarship of Teaching and Learning*, *1*(2), 1–16.
- Tillema, H. H., & Kremer-Hayon, L. (2002). “Practising what we preach” – Teacher educators’ dilemmas in promoting self-regulated learning: A cross case comparison. *Teaching and Teacher Education*, *18*, 593–607.
- Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, *3*, 130–154. <https://doi.org/10.1016/j.edurev.2007.12.001>
- van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher-student interaction: A decade of research. *Educational Psychology Review*, *22*(3), 271–296. <https://doi.org/10.1007/S10648-010-9127-6>
- van de Wiel, M. W. J., Szegedi, K. H. P., & Weggeman, M. C. D. P. (2004). Professional learning: Deliberate attempts at developing expertise. In H. P. A. Boshuizen, R. Bromme, & H. Gruber (Eds.), *Professional learning: Gaps and transitions on the way from novice to expert*. Kluwer.
- Van den Bossche, P., Gijssels, W. H., Segers, M., Woltjer, G., & Kirschner, P. A. (2011). Team learning: Building shared mental models. *Instructional Science*, *39*(3), 283–301. <https://doi.org/10.1007/s11251-010-9128-3>

- Van Eckelen, I. M., Boshuizen, H. P. A., & Vermunt, J. D. (2005). Self-regulation in higher education teacher learning. *Higher Education*, 50, 447–471. <https://doi.org/10.1007/s10734-004-6362-0>
- van Houten-Schat, M. A., Berkhout, J. J., van Dijk, N., Endedijk, M. D., Jaarsma, A. D. C., & Diemers, A. D. (2018). Self-regulated learning in the clinical context: A systematic review. *Medical Education*, 52, 1008–1015. <https://doi.org/10.1111/medu.13615>
- Vangrieken, K., Boon, A., Dochy, F., & Kyndt, E. (2017). Group, team, or something in between? Conceptualising and measuring team entitativity. *Frontline Learning Research*, 5(4), 1–41. <https://doi.org/10.14786/flr.v5i4.297>
- Veenman, M. V. J. (2011). Alternative assessment of strategy use with self-report instruments: A discussion. *Metacognition and Learning*, 6(2), 205–211. <https://doi.org/10.1007/s11409-011-9080-x>
- Volet, S., Vauras, M., & Salonen, P. (2009). Self- and social regulation in learning contexts: An integrative perspective. *Educational Psychologist*, 44(4), 215–226. <https://doi.org/10.1080/00461520903213584>
- Wijga, M., Endedijk, M. D., & Veldkamp, B. (2019). *Understanding social regulation at the workplace: An examination of different modes of regulation and variation in quality*. Paper presented at the 19th Biennial EARLI Conference, Aachen, Germany.
- Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15–32). Routledge.
- Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications*. Lawrence Erlbaum.
- Winne, P. H., Hadwin, A. F., & Gress, C. (2010). The learning kit project: Software tools for supporting and researching regulation of collaborative learning. *Computers in Human Behavior*, 26(5), 787–793. <https://doi.org/10.1016/j.chb.2007.09.009>
- Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of educational psychology*, 81(3), 329.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice*, 41, 64–70.
- Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166–183.
- Zimmerman, B. J., & Schunk, D. H. (Eds.). (2011). *Handbook of self-regulation of learning and performance*. Routledge.

Prof. Dr Maaïke D. Endedijk is Professor of Professional Learning and Technology at the University of Twente. Her research interests are workplace and professional learning, self-directed learning, and learning communities. Recently started projects focus on learning in relation to the energy transition, health care transformation and the digital transformation.

Dr Katrien Cuyvers is guest professor ‘Learning in Organisations’ and ‘Health Science Education’ at the University of Antwerp, Department of Training and Education Sciences and Antwerp School of Education. She is also a post-doctoral researcher “Learn@work” at the Spaarne Gasthuis/ University of Twente, The Netherlands. Her overall research interests relate to workplace learning and professional learning, specifically self-regulation of workplace learning and professional learning and co-regulated learning at the workplace, in particular in health-care environments, as well as methodological approaches to measure these.