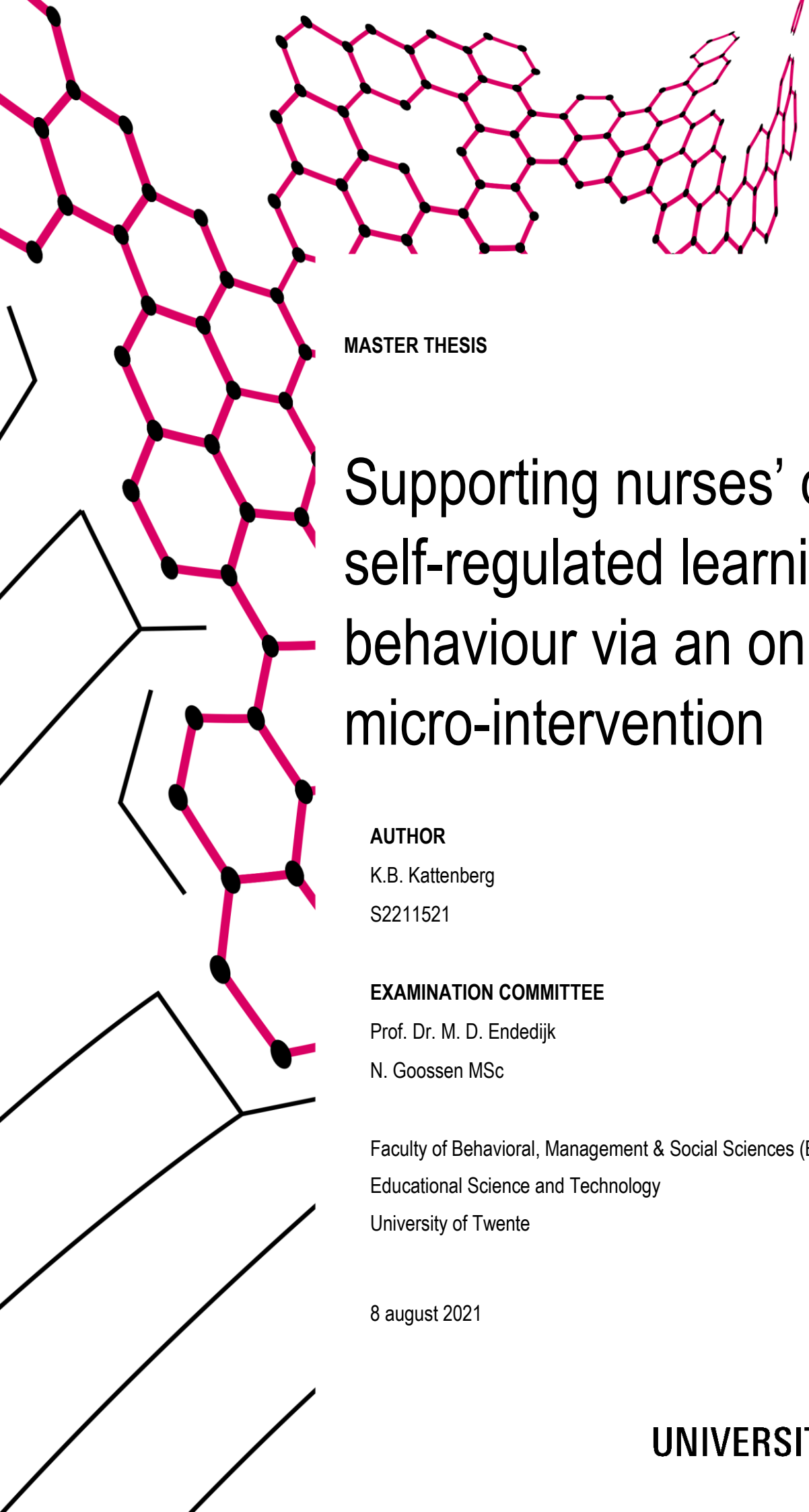

MASTER THESIS

Supporting nurses' daily self-regulated learning behaviour via an online micro-intervention

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Kim Kattenberg

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Abstract

Nursing is a dynamic profession and nurses need to stay up to date to perform well. Some changes where nurses have to deal with are disease patterns, treatment methods, medicine, improving biomedical science and ageing of the population which increases serious health issues. They are expected to take responsibility for their professional learning at the workplace, making the concept of lifelong learning increasingly important. Self-regulated learning (SRL) is a promising concept to approach lifelong learning at the workplace. However, nurses are not fully aware of SRL and find it especially hard to set learning goals and plan their learning process. One promising way to improve SRL behaviour is to increase the awareness of their learning strategies through the use of a daily diary. This could increase planning, self-monitoring, and self-reflection. Also, scaffolding has been suggested as a way to support learners in SRL. This study aims to investigate if an online micro-intervention supports nurses' SRL behaviour. This was done via a treatment reversal design, also known as ABAB design. To measure nurses' SRL behaviour, a daily questionnaire, performed via an app, was used. The app also released tips to the nurses during the intervention phases (B). The design takes place over 30 working days, in which the baseline phase and intervention occur three times each, and with 5 measurements each phase. Results showed that the nurses' (N = 11) daily SRL behaviour was not significantly higher in the intervention phases (B) than in the baseline phases (A). This is in contrast with the expectations because it was indicated that the social and organizational factors play a crucial role in supporting nurses' SRL. Suggestions for future research are to add personal factors to the micro-intervention such as prior knowledge. Additionally, the SRL attitude was measured before and after the use of the app because of the reactivity that comes along with the SRL measurement. Results showed that the nurses (N = 10) SRL attitude significantly changed after the daily SRL measurement, which was in line with the expectations. Each workday the nurses record their learning moments, which also requires them to reflect upon their self-regulated learning. This ongoing reflection about their self-regulated learning probably affected the nurses SRL attitude due to metacognitive monitoring. The findings recommended using a learning diary to become aware of the use and importance of SRL.

Keywords: *nurses, self-regulated learning, micro-intervention, daily questionnaire, a treatment reversal design*

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Introduction

Nursing is a dynamic profession and nurses need to stay up to date to perform well (Adriaansen, as cited in Pape 2019; CGMV et al., 2015). Some changes where nurses have to deal with are disease patterns, treatment methods (Berings, 2006), medicine, improving biomedical science (Murad et al., 2010), and ageing of the population which increases serious health issues (Maurits et al., 2016). Nurses are increasingly expected to take responsibility for their professional learning (Cuyvers, 2019). Professional learning contributes to the concept of lifelong learning (Ellinger, 2004). Self-regulated learning (SRL) is a very promising approach to lifelong learning at the workplace (Ellinger, 2004). SRL is a learning process through which learners transform their mental abilities into task-oriented activities, such as goal setting, planning, and reflection (Zimmerman, 2008).

However, nurses are not fully aware of SRL and demonstrate low daily SRL behaviour (Aagten, 2016). Nurses find it especially hard to set learning goals and plan their learning process (Kläser, 2018; Bloemendal, 2019). Additionally, Aagten (2016) found that nurses in most cases only showed planned behaviour when learning was made mandatory by the organisation. It seems that nurses experience professional learning as a requirement instead of a personal need (Kläser, 2018; Aagten, 2016). However, nurses must become aware of SRL and need to learn how to be self-regulated so that they can take responsibility to stay competent to provide good care for the patients.

Studies found that a diary, which increases the awareness of learning strategies, is not enough to support SRL behaviour daily. A combination with extra aid is needed to be more efficacious (Dörrenbäcker & Perels, 2016). Scaffolding is a way of supporting SRL (Ley et al., 2010). Scaffolds are tools, strategies and guides which are provided by humans or computer tutors. They help learners develop skills they do not yet possess (Reiser, 2002). Previous research has shown that scaffolding SRL behaviour has a positive effect on learners in educational settings. For example, Dabbagh and Kitsantas (2009) found that different pedagogical tools support SRL strategies, such as goal-setting and strategy enactment. However, little is known about supporting SRL behaviour in healthcare settings. Further research is needed to explore how nurses' SRL behaviour can be supported at the workplace.

This study aims to investigate whether an online micro-intervention support nurses' daily SRL behaviour during their work. Investigating whether micro-interventions increase the daily SRL behaviour could help to meet the challenge of how to support nurses in learning self-regulated. A daily questionnaire will be conducted to measure the nurses' SRL behaviour. Filing in daily items on every workday about your self-regulated learning behaviour stimulates awareness and reflection (Panadero et al., 2016). For this reason, this study also aims to

investigate whether the nurses' attitude towards SRL positively changed after the daily SRL measurement.

Theoretical Framework

Workplace Learning

Before nurses start working as a nurse, they receive initial schooling, but in the workplace, they still need to learn many skills (Adriaansen, as cited in Pape, 2019). The ability of nurses to keep learning and gaining knowledge and skills at their workplace is important for the quality and efficiency of treatments and care at the hospital (Bjørk et al., 2013). Jacobsen (in Bjørk et al., 2013) stated that human knowledge is the most important asset in a health care organization such as a hospital. Learning in a hospital setting can be both formal and informal. *Formal learning* is a structured form of learning (Hicks et al., 2007). Formal learning takes place through organised activities and educational experiences that are determined in advance, whereby the learning goals, learning outcomes and learning period is predetermined by the institution (Kyndt et al., 2009; Cuyvers, 2019). *Informal learning* occurs naturally in everyday experiences (Cofer, 2000). It is spontaneous and unplanned. The learner is responsible for their learning and it is no longer provided by the institution or other external parties (Noe et al., 2013). However, informal learning at the workplace is less recognized by employees than formal learning (Bjørk et al., 2013; Eraut, 2004).

Formal and informal learning can be considered as a scale, which goes from highly informal to highly formal and cannot be considered as a dichotomy (Baert et al., as cited in Kyndt et al., 2016). All learning consists of a degree of formality or informality (Hodkinson et al., 2003). However, the newest skills and knowledge at the workplace are learned and acquired often only through informal learning (Cofer, 2000; Marsick, as cited in Bjørk et al., 2013). The workplace is a great source of informally learning because it generates unplanned experiences (Cuyvers, 2019). For nurses, the workplace is very fruitful for informal learning, because most skills and knowledge are gained through day-to-day interaction in the staff rooms, the meeting rooms and patients rooms (Bjørk et al., 2013). Informal learning mostly occurs via interaction, because nurses are barely alone at the workplace, which results in discussions, giving advice, role modelling and collaboration in performing difficult tasks (Bjørk et al., 2013). Especially, interaction with colleagues of the same speciality is central in informal learning (Cuyvers, 2019).

Informal learning can be distinguished into three types based on different types of learning intentions (Eraut, 2004; Tynjälä, 2008). *Implicit informal learning* is learning without being aware of what you have learned and with no prior learning intentions. *Reactive informal learning* occurs when a learning need arises during an action or performance. The purpose of the action or performance is to complete the task instead of learning, but the learning is more conscious and intentional than implicit informal learning. *Deliberative informal learning* is

learning with the highest intentions, setting learning goals and reserving time to acquire the new knowledge. Learners actively participate in activities and interactions (Cleland et al., 2014; Cuyvers et al., 2016), which involves active engagement, setting learning goals, choosing and implementing learning strategies, evaluation, reflection. This is also in line with the principles of self-regulated learning (SRL) (Eraut, 2004; Schulz & Rossnagel, 2010). This study focuses on supporting this latter type of informal learning. Nurses need to be aware of their workplace learning and consciously regulated their learning processes.

Self-Regulated Learning

Self-regulated learning is a learning process through which learners adapt and orient their thoughts, motivations and actions towards the achievement of their personal learning goals. During this process, they constantly adapt to demands and challenges (Järvelä, & Hadwin, 2013, Zimmerman, 2008). Self-regulated learners are responsible for their learning process which requires multiple self-regulatory strategies (Fontana et al., 2015; Panadero, 2017). They monitor their functioning and compare their current state with their desired state and adapt their learning accordingly (Järvelä & Hadwin, 2013). During the learning experience, learners regulate their affective, (meta)cognitive, motivational behaviour processes by themselves (Panadero, 2017). These processes can be influenced by social and contextual aspects (Hadwin et al., 2017). Different concepts, such as intentional informal learning and deliberate practice rooted in workplace learning, are linked to the concept of self-regulated learning (Cuyvers, 2019). SRL is a proactive process that occurs before, during and after learning and which cyclically repeat and influence each other (Puustinen & Pulkinen, 2001). Within the research field of SRL, reference is often made to Zimmerman's three-phased model, which includes forethought, performance and self-reflection and each phase consist of several subprocesses (Cuyvers, 2019).

***Forethought phase*.** This phase takes place *before* the learning experience. It consists of setting personal goals and making personal plans based upon the environmental demands and challenges. Self-regulated learners orient their thoughts, motivations and select strategies for achieving their personal learning goals (Schunk & Zimmerman, 2012). The learners' motivation depends on self-efficacy beliefs about having the ability to learn and expectations of learning outcomes. Intrinsic interest is also important during this phase (Zimmerman, 2002). Through self-observation and awareness about their functioning learners compare their current state with the desired state, which is also known as monitoring (Hadwin et al., 2017; Järvelä, & Hadwin, 2013; Pintrich, 2000; Zimmerman, 2002).

Performance phase. This phase takes place *during* the learning experience. The self-regulated learners are working on the task and are highly cognitive active and learn from their

individual experiences (Hadwin et al., 2017). Learners revise and apply appropriate learning strategies and methods that were selected during the forethought phase (Zimmerman, 2002), which is also known as metacognitive control (Hadwin et al., 2017; Zimmerman, 2002). The most common type of control methods is imagery, self-instruction, attention focusing and task strategies. During the second phase, learners also observe their learning to gain knowledge about their functioning (Zimmerman, 2002). For example, experimenting with a certain strategy or recording how much time they spend on learning.

Self-reflection phase. This phase takes place *after* the learning experience. The self-regulated learners reflect and judge on their learning after the learning tasks are completed. They evaluate their performance and compare it to prior performances or performances from another person. Moreover, learners can also identify the cause of their failures or successes during this phase and they also assess if they are satisfied with their learning experience (Zimmerman, 2002). Finally, learners make future planning for their learning (Pintrich, 2000; Zimmerman, 2002). Based upon the learning experience learners can show defensive or adaptive reactions. Defensive reactions consist of avoiding new learning opportunities and adaptive reactions consist of developing a learning method or setting new learning goals (Zimmerman, 2002).

Alternative models argue that the SRL is an open process with evaluation and adaptation during each phase which could lead to loops back to a former phase (Cuyvers, 2019). The SRL framework of Zimmerman (2000) is described by the three different phases and its subprocesses, but other SRL models are described by SRL strategies, SRL-activities, SRL-components or micro-processes. In the end, they all refer to the idea that SRL needs to be initiated, monitored and evaluated by the learner itself (Panadero, 2017). Sitzmann and Ely (2011) examined the similarities of all the different SRL frameworks and developed a heuristic framework of all the fundamental components of SRL and each component is classified as regulatory agents, regulatory mechanisms or regulatory appraisals. *Regulatory agents* are initiators for SRL. *Regulatory mechanisms* are under the control of the learners and determine if the progress towards the learning goals runs efficiently. *Regulatory appraisals* involve assessing the learning experiences and the progress towards the learning goals. Table 1 provides an overview of the heuristic SRL framework of Sitzmann and Ely (2011) and the relationship with the subprocesses of the SRL framework of Zimmerman (2000).

Table 1

Heuristic SRL framework of Sitzman & Ely (2011) and the relationship with the framework of Zimmerman (2002)

Regulatory categorization		SRL subprocesses
Regulatory agents	Regulatory agents initiate SRL toward the achievement of objectives	Goal-setting Strategic planning Self-efficacy Outcome expectations Intrinsic interest Learning goal orientation
Regulatory mechanisms	Regulatory mechanisms are the strategies that are instrumental for an efficient progress	Imagery Self-instruction Attention focusing Task strategies Self-recording Self-experimentation
Regulatory appraisals	Regulatory appraisals are instrumental in the evaluation of the progress towards the goals.	Self-evaluation Causal attribution Self-satisfaction/affect Adaptive/defensive

Note. This table is retrieved and adapted from Cuyvers (2019)

Self-regulated learning in a healthcare context

SRL plays an important role in nurses professional development and workplace learning (Cassidy, 2011; Gandomkar et al., 2018). Nurses are working in a dynamic and demanding clinical environment with many challenges and tasks which need to be performed good and quickly (Cuyvers, 2019). The professional performance of nurses need to be guaranteed (van de Wiel et al. 2011). The ability to actively engage and regulate their own learning experiences is necessary for the professional development of nurses' expertise (Ericsson, 2006). Nurses' SRL is described as a "*pro-active, reactive and/or implicit process orienting thoughts, motivation, and actions towards the achievement of goals, which is triggered by a challenge or demand related to performance and the need to respond adaptively to this*" (Cuyvers, 2019, p.169).

To describe an SRL framework in a healthcare context, Cuyvers (2019) used the heuristic SRL framework of Sitzmann and Ely (2011). In the categorization of *regulatory agents*, perceptions, analysis, prior experiences and goals are identified as key components

for SRL. Nurses mostly initiate learning because they experiencing a 'difficult' or 'challenging' case, task or situation in which they are affected as frustrations, excitement, feeling helpless and/or overwhelmed. However, at the start of a learning experience, a learning goal is often unclear. In the categorization *regulatory mechanisms,* learning components, planning, metacognitive awareness and metacognitive monitoring are key components for SRL. Strategic listening, consulting written sources, reading professional literature, scientific journals, protocols and google are often consulted during learning activities. Additionally, asking for help and feedback from colleagues and experts are ways of learning activities. Nurses often adopt an approach to learning based on their intuition. In the categorization *regulatory appraisal*, self-evaluation judgments and self-efficacy judgement are identified as key components. However, nurses indicated that it is hard for them to judge themselves about their learning experiences because it is often tied to the appraisal of their work performance.

Furthermore, Cuyvers (2019) added '*regulatory readiness'* as a new regulatory categorization to the SRL framework in a healthcare context (Figure 1). *Regulatory readiness* seems to appear conditional for SRL, which is indicated as the need before a task or situation can be perceived as a potential learning situation, learning goals can be set, or before an SRL process can start (Cuyvers, 2019). Being alert, wondering, and being aware of learning needs are key components in the categorization of regulatory readiness. Moreover, being aware of how and when learning could take place belongs to it. This can be supported by the use of resources, such as specialized applications, question banks and medical websites (Cuyvers, 2019).

In the SRL framework for healthcare context (Figure 1), it becomes clear that SRL is influenced by personal context, organizational and task factors (Cuyvers, 2019). The personal contextual factors include the nurses' speciality, personal organization and performance activities. The organizational and task factors include for example workload or support by the manager, these factors can influence the learning process (Tynjälä, 2013). Moreover, the individual learner factors, such as prior knowledge and motivation, also influence the nurses' SRL processes (Cuyvers, 2019). Although the focus of SRL is mainly on the individual regulatory processes, social and contextual influences also have an impact on nurses' SRL processes (Järvelä & Hadwin, 2013; Cuyvers, 2019). Other people in the work environment are important for SRL in the healthcare context. During interactions, co-regulation of learning and socially shared regulation could take place (Hadwin et al., 2017). These are processes in which learners share their regulations and the desired product of learning is a socially shared cognition (Hadwin et al. 2017).

Figure 1

Model of SRL in a healthcare context

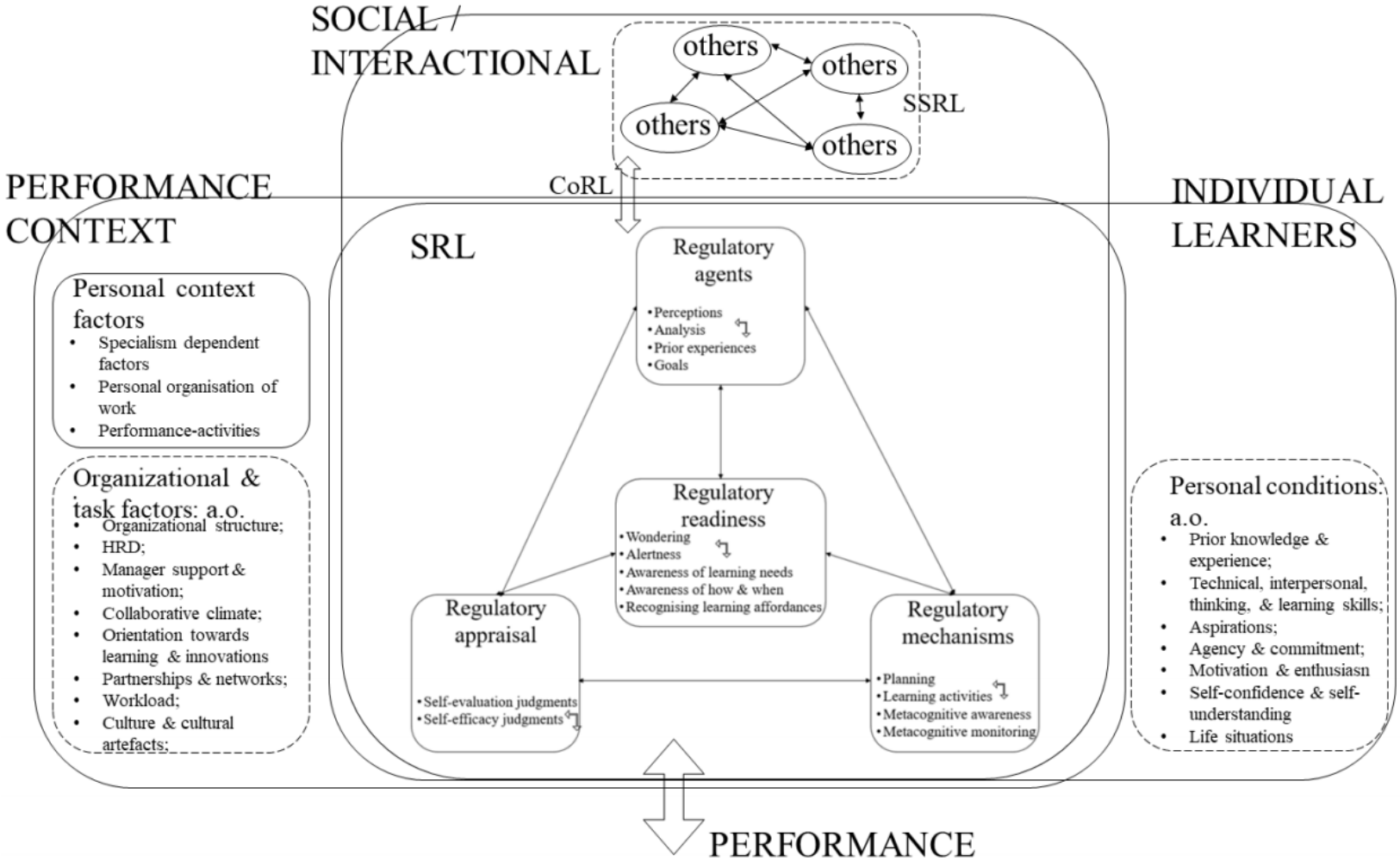


Figure 1. SRL framework in a healthcare context (Cuyvers, 2019)

SRL measurement

The measurement of SRL is not so obvious because it is an internal process and therefore not directly observable (Boekaerts & Corno, 2005). However, in the last few decades, researchers did succeed in developing several SRL measurement methods resulting in different historical waves of measuring SRL. These waves are interwoven with each other and are not seen as separate (Panadero et al., 2016). The first wave of SRL measurement is identified by a static manner of SRL assessment (questionnaires, surveys and interviews) mostly focusing on the learners' perspectives and beliefs (Zimmerman, 2008). The instruments were classified as an aptitude measurement of SRL meaning that the SRL was measured at a one-time point. In the second wave, a new definition of SRL was born in which behaviour, cognitive, metacognitive, motivational and emotional processes now also began to play an important role in SRL (Pintrich, 2000; Zimmerman, 2000). The measurement of SRL started to focus more on these processes that take place during SRL and are then classified as an event measurement in which SRL was measured during a specific task with a clear start and end of the learning activity (Panadero et al., 2016). Moreover, the measurement was then characterized as an online measurement that focused on the SRL activities during the learning tasks.

Currently, the third wave of SRL measurement has arrived, which is characterized by instruments that both measure and stimulate SRL (Panadero et al., 2016). An example of a measurement/intervention instrument would be a learning diary. A learning diary let learners reflect upon their learning experiences and this ongoing reflection affects the learners' SRL (Panadero et al., 2016). This effect is also known as *reactivity*, it will lead to individual changes due to the awareness of one's behaviour (Zimmerman, 2002). A learning diary has great potentials for increasing nurses' SRL because it creates more awareness of the importance of SRL and its components. Learners are reminded to plan their learning and reflect on their learning experiences. To control the intervention effect, other measures such as additional pre- and post-test is requested. Also, learners are not always reliable self-reporters so an additionally online method, such as an observation, is desired to avoid memory failure or socially-desired answers which will increase validity (Panadero et al., 2012, Vancouer et al., 2014).

Most of the research on SRL measurements is conducted in an educational context (Cuyvers et al., 2017) and not all of these methodologies for measuring SRL cannot be simply applied in a healthcare context. For example, video recordings or think-aloud methods brings privacy and ethical issues. However, Aagten (2016), Bloemendal (2018) and Pape (2019) did

manage to measure nurses' daily SRL behaviour via an adapted version of the Structured Learning Report originally developed by Endedijk et al. (2016). Moreover, they did manage to measure daily SRL behaviour through the use of an experience sampling method (ESM) via a mobile application. ESM requested participants to report their activities, emotions or other elements of their daily life by answering a short questionnaire upon receiving a notification. ESM relies on the concept of a diary study, but it differs in the way the questions are delivered to the participants (Van Berkel et al., 2017). In diary studies, participants answer questions at their initiation, while ESM prompts participants to answer a short questionnaire. This reduces the time gap between the daily experience and the reflection on the studied phenomena.

Online micro-interventions

Previous research showed that online micro-interventions are used successfully (Bunge et al., 2017; Lokman et al., 2017) and are ideal to support SRL in an online environment (Artino & Stephens, 2009). Online micro-interventions are delivered via the internet, which aims for behavioural change and symptom improvement (Ritterband et al., 2003), which in this study case is the improvement in nurses' SRL behaviour. An online intervention is connected to the internet but can also be used offline, such as in mobile phone applications. Compared to conventional interventions, such as face-to-face approaches, online micro-interventions differ greatly (Ritterband et al., 2003). The online micro-interventions include the necessity for hardware, such as a smartphone or tablet. Online micro-interventions also differ in the presence of professional support and the extent of interaction, it allows users to engage in self-tests, exercises, chat or gaming elements. The online micro-intervention can also allow the users to share content, concerning ideas, emotions, and requests for support or help. Lastly, the online micro-interventions can differ in flexibility, the design can be very simple or very extended with highly personalized content.

In comparison with regular interventions, a major advantage of micro-interventions is preventing large numbers of dropouts (Eysenbach, 2005) because micro-intervention do not last too long and are not too intensive (Bolier & Abello, 2014). Micro-interventions last only a few minutes, which can be a one-off or repeated several times, and may respond to the needs of individuals (Elefant et al., 2017). Additionally, previous research shows that the use of micro-interventions has many benefits, such as usability, low costs, engagement and effects (Jeken, 2019). Smartphones have great potentials as an engaging and low-cost micro-intervention tool. Moreover, it can be used multiple times and repeatedly in contrast to a professional person that provides an intervention.

Micro-interventions can be divided into two types, namely *just-in-time adaptive* and *ecological momentary* (Fuller-Tyszkiewicz et al., 2019). *Just-in-time adaptive* interventions

provide the right amount and type of support at the appropriate time (Nahum-Shani et al., 2018), which is done by algorithms and adaptive technology. The system indicates when there is a need for support based on an individual's internal or contextual state. For example, someone's stress level or GPS location. *Ecological momentary* interventions are treatments that individuals can use in their natural environment daily, whenever they like or want to (Heron & Smyth, 2010). In this study design, nurses will receive scaffolds via a mobile app as an online micro-intervention, which will be further explained later. Since messages are more effective when delivered at the right time (Fogg, 2003), this micro-intervention is sent before just their work shift so it can be applied directly during their shift. The nurses cannot always open the micro-interventions whenever they like or want to, because they are delivered based upon their work schedule. For this, the current micro-intervention in this study could be considered as *just-in-time adaptive*. However, when the micro-interventions are made available in the app, the nurses always have the choice of viewing them or not. Based on this consideration, an *ecological momentary* intervention is used in this study.

Scaffolds

To support the daily SRL behaviour, nurses will receive scaffolds via an app as a micro-intervention. Scaffolding can take several forms such as hints, prompts, feedback, illustrations or interactive features (Devolder et al., 2012) and are delivered by a variety of agents, namely teachers, coaches, peers or computers (Azevedo et al., 2005). Scaffolds can be divided into *soft* and *hard* scaffolds (Simons & Klein, 2007). *Soft scaffolds* are dynamic and will be applied when a learner has a specific learning need. In contrast, *hard scaffolds* are static and are developed in advance based on typical learning difficulties. Hard scaffolds include two specific types; *conceptual scaffolds*, which guide a learner in what to consider when a task is already defined, and *strategical scaffolds*, which guide a learner in how to approach a task (Devolder et al., 2012). This study focused on strategical scaffolding, guiding nurses in SRL at the workplace.

Previous research on nurses' SRL behaviour showed that nurses did not show SRL behaviour when it comes to setting learning goals and controlling their strategies, it was often unintended and unconscious (Aagten, 2016; Bloemendal, 2019). Siadaty et al. (2016) indicate that social and organizational factors should be included in the scaffolding intervention to support the forethought and engagement phases. Additionally, Littlejohn et al. (2012) believe that sharing knowledge and creating networks is a crucial factor to support SRL at the workplace. The SRL model for the healthcare context of Cuyvers (2019) emphasises also that the social and organizational context plays a crucial role in nurses' SRL. Lastly, the systematic review of van Houten-Schat et al. (2018) emphasis that social factors such as peers, coaches,

or supervisors and contextual factors have a positive influence on SRL in healthcare. To conclude, it seems important that the scaffolding micro-intervention in this study has social and contextual factors to support the nurses' regulatory agents and mechanisms.

Siadaty et al. (2012) have designed scaffolding interventions with social and contextual factors to support SRL at the workplace. For example, the scaffolding intervention 'User Recommendations of Learning Goals ' or 'Organizational Recommendations of Competences and Learning Paths', which also seems to be a suitable scaffold for the nurses' SRL behaviour. These interventions from Siadaty et al. (2012) aimed to inform learners about the context of their organization in terms of the learning objectives and the availability of resources. It helps learners to better know the learning opportunities in their organization and make better decisions about their learning plan. Moreover, according to Belland, Kim, and Hannafin (2013), displaying learners reliable strategies and learning goals could help learners by choosing appropriate strategies to accomplish a learning goal. To set a concluding hypothesis: by informing nurses about the learning goals, strategies and learning opportunities within the hospital, their SRL behaviour could be supported.

Present Study

This study aims to investigate if micro-interventions increases the SRL behaviour of nurses in a hospital context. Through a prompt daily questionnaire via the app, SRL behaviour will be measured and it will be investigated if there is a difference in SRL behaviour when nurses receive the micro-interventions or not. It is expected that the SRL behaviour is higher when nurses receive a micro-intervention during their workday. It is especially expected that the micro-interventions support the nurses' regulatory agents and mechanisms. Figure 2 illustrates the hypothetical data (Pustejovsky et al., 2021), whereby the red line represents the days when the nurses did not receive micro-interventions and the blue line represents the days when the nurses did receive micro-interventions. Additionally, this study also examines the extent to which nurses indicate that they intended to do something with the tips about learning goals, learning strategies and learning opportunities.

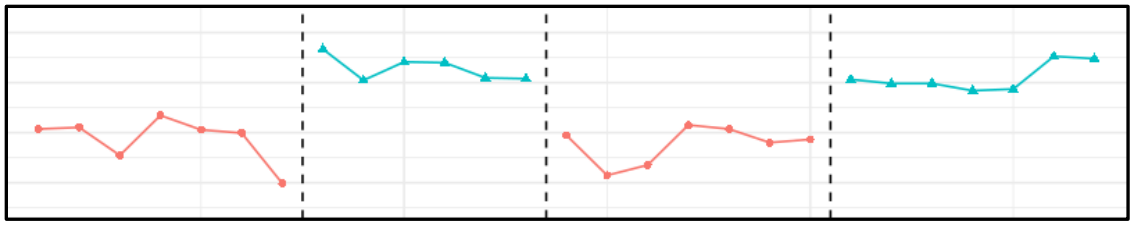
However, the app will also function as an intervention tool because the daily reflection on their learning experiences, may also affect the participants' SRL (Panadero et al., 2016). In this study, also the SRL attitude of the nurses is measured before and after the use of the app to control the effect of the measurement in this study design. The following research questions were formulated to test the effectiveness of the online micro-intervention on nurses' SRL behaviour and attitude:

1. Is there a significant effect of the online micro-intervention on the nurses' SRL behaviour?

   a. Is there a significant effect of the online micro-intervention on the nurses' planning behaviour?
   b. Is there a significant effect of the online micro-intervention on the nurses' strategy control?
   c. Is there a significant effect of the online micro-intervention on the nurses' future planning?
2. To what extent do the nurses indicate that they are intended to do something with the tips they receive during the intervention?
3. Does the SRL attitude of the nurses significantly change after the daily SRL measurement?

Figure 2

Hypothetical data outcome



Note. The x-axis represents SRL measurements and the y-axis represents the SRL behaviour score

Methodology

Design

This study was conducted in a hospital context and has a within-single-case design. The single-case design refers to the participants under investigation (Smith, 2012), which in this case are the nurses. In within-series designs, the performances of participants are measured within each condition of the study and compared between different conditions (Kratochwill & Levin, 2014). In contrast to an experimental group design, in this study, participants provide their control data for comparison in a within-subject design (Smith, 2012). The comparison involves periods which are also known as phases. In this design, the representative baseline phase will be compared to the intervention phase. The aim is to determine if the independent variable (IV), which is the online micro-intervention (scaffolds), affects the dependent variable (DV), which are nurses SRL behaviour.

This design is known as the treatment reversal design (also known as an ABAB design), which involves a baseline phase (A) and an intervention phase (B) with further repetitions of the baseline phase (A) and the intervention phase (B) (Valentine et al., 2016). In the baseline phase, nurses will fill in their learning moments each day that they worked on the app. In the intervention phase, the nurses will also fill in their learning moment each day, but will also receive a micro-intervention. So, the nurses' SRL behaviour will be measured over multiple time points, with a micro-intervention being introduced and reintroduced at certain points in time.

The design takes place over 30 working days, in which the baseline phase and intervention occur 3 times each, and with 5 measurements each phase. According to Kratochwill et al. (2010), the treatment reversal (ABAB) design minimal requires 4 phases with at least 3 data points per phase to meet evidence standards. So only the nurses who meet these required minimum measurements will be included in the results. Based on the recommendations of Panadero et al. (2016), a pre and post questionnaire and the daily measurement of the app process are combined. It was recommended not to rely exclusively on one instrument, which is, in this case, the daily questionnaire via the app, but to add pre- and post-test so that the effect of the SRL measurement method is taken into account (Schmitz & Perels, 2011; Panadero et al., 2016).

Participants

The population of focus was hospital nurses from Ziekenhuis Groep Twente (ZGT). The medium-sized hospital ZGT is located at Hengelo and Almelo and provides medical care for 390.000 citizens in the region. In total there are more than 3.200 employees at the ZGT

(Ziekenhuisgroep Twente, 2018). Using convenience sampling, nurses were approached to participate by the head of three different departments, namely the dialysis department, mother-child department, and the child-teen department. Nurses who were willing to participate in this study were involved. The condition to be able to participate in this study was to have a smartphone at the workplace so that the app can be installed on their phone.

The study design required a sample size of at least six nurses (N = 6) to find reliable effects on the micro-interventions (Bouwmeester & Jongerling, 2020). To ensure that at least six nurses complete the study, 30 nurses were consulted to participate in the study, of which 20 nurses were willing to participate. To prevent the risk of drop-outs, the potential effect of the app on SRL has been made explicit to the nurses through the informed consent letter. This is important in this ecological design of the micro-interventions because the performance of the learner (nurse) counts (Panadero et al., 2016). In the end, a total of 14 nurses completed the pre- and post-test (see Table 2 for their background characteristics) and a total of 11 nurses completed the study according to the design criterium of Kratochwill et al. (2010), which means minimal 4 phases and with 3 measurements each phase. However, one nurse did not complete the post-test, resulting in a total of 10 nurses that both completed the pre- and post-test as the minimum required daily SRL measurements.

Table 2

Nurses' background characteristics

Variable	Categories	Frequency	Percentage
Gender	Male	1	7.1%
	Female	13	92.9 %
Age	26 - 30 years	1	7.1%
	31 - 35 years	3	21.4%
	36 – 40 years	2	14.3%
	41 – 45 years	2	14.3%
	46 - 50 years	3	21.4%
	51 – 55 years	2	14.3%
	61 – 65 years	1	7.1%
Highest level of education	In-service	6	42.9%
	HBO bachelor	5	35.7%
	HBO master	3	21.4%

Work experience	0- 5 years	1	7.1%
	11 -15 years	5	35.7%
	21-25 years	3	21.4%
	More than 26 years	5	35.7%
Work department	Dialysis	6	42.9%
	Mother-child	6	42.9%
	Child-teen	2	14.3%
Work hours per week	17-24 hours	8	57.1%
	25-32 hours	5	35.7%
	33-40 hours	1	7.1%

Note. Results of nurses (*N* = 14) that completed the pre- and post-test

Instrumentation

Subscription questionnaire

To install the app, nurses needed a registration code. They received this code when they completed the subscription questionnaire, which involved the general background questionnaire and the first SRL attitude questionnaire (pre-test).

General background questionnaire. To gain more insight into the participants, a general background questionnaire was taken (Appendix A*).* Nurses answered questions about their age, gender, the highest achieved level of education, number of hours working, work experience, and their profession in the hospital. Questions were selected on relevance in context and theory, based on previous research in similar contexts (Aagten, 2016; Bloemendal, 2019).

SRL attitude questionnaire. To measure the SRL attitude of nurses before and after the intervention, a general SRL attitude questionnaire was taken (Appendix B). The self-rating instrument is adapted to the SRL questionnaire 'self-direction in learning processes' developed by Raemdonck (2006). All the 14 items of this questionnaire were positively stated and respondents were asked to rate each item on a 5-point Likert scale ranging from 1 for 'strongly disagree' to 5 for 'strongly agree'.

Ethica data application

In this study, the Ethica Data application (ED app) was used as a platform for the SRL measurement and micro-interventions. The app was installed on their mobile phone and they were allowed to carry their mobile phone with them during working hours especially for this

study. The ED app emerged from a research project at the University of Saskatchewan (Ethica Data, 2020). The app allows to objectively measure the behaviour of participants. During the baseline and intervention phases, nurses needed to fill in an SRL questionnaire every workday. Additionally, in the intervention phases, nurses received tips before their work shift as a micro-intervention. After the 30 working days, nurses needed to fill in the post-test via the app about their SRL attitude. To check whether the app was functioning properly, a pilot study was conducted.

Daily SRL questionnaire. To measure nurses' daily SRL behaviour at the workplace, an ESM was used. Collecting self-reports across multiple days provides a profound insight into the daily life experience which are in this case the regulation of learning at the workplace. Moreover, answering the questionnaire in a natural environment provides a more accurate picture of the participants' behaviour than in a laboratory environment (Van Berkel et al., 2017). The current version of the questionnaire was based on the adapted versions of Aagten (2016), Bloemendal (2019) and Pape (2019), which also used the questionnaire in a healthcare context (Appendix C). The roots of this questionnaire come from The Structured Learning Report developed by Endedijk et al. (2016). The questions represented the three phases of SRL: forethought, performance and self-reflection, as described by the SRL framework Zimmerman (2000). For the SRL framework in the healthcare context described by Cuyvers (2019), this would mean that the questionnaire represented the three regulatory categories: agents, mechanism and appraisals. The items of the questionnaire referred to the learning moments the nurses experienced that specific working day.

The daily questionnaire consists of one open item and ten closed-ended items. However, routing through the questionnaire took place, based on the given answers. Consequently, not all items were displayed to the nurses. After the nurses had completed the daily questionnaire, the option to fill in an extra 'learning moment' was displayed, which meant that they go through the questionnaire for the second time with another learning moment of their working day in their mind. Due to low percentages of the completed extra learning moments, these results were not included.

Micro-intervention. During the intervention phase, nurses received tips about learning goals, opportunities and strategies from other digital peers (Appendix D). This micro-intervention is an adaptation from the micro-interventions 'recommended available competencies, learning paths, learning activities and knowledge assets' developed by Siadaty (2013), which showed that recommendations from other users are useful for the planning phase of their SRL processes. To find out more about what the nurses were intended to do with the tips they received, the question *'Do you plan to do something with this tip*?' was asked

(Appendix E). The nurses could choose between the following answer options: *'Yes'*, *'Yes*, *but not today*', *'I don't know'* or '*No*'.

Procedure

To carry out the study, approval was requested at the Ethical Committee (EC) of the Behavioural, Management and Social Sciences (BMS) Department of the UT and the research committee of the ZGT. Also, the required privacy and General Data Protection Regulation (GDPR) standards were met, because this study used the ED-app, which stores private data of the participants. Moreover, an informed consent letter has been set up (Appendix F). It made clear what the goal of this study is, how the study will be carried out, that the results of the study will be anonymized, that their participation is completely voluntary, and that they can stop their participation at any time. Contact details are also provided in case the nurses have any further questions. Lastly, to ensure that the ED app matches the work schedule of the participants, permission has been personally requested from the participants.

The education advisors of ZGT approached the head of the three nursing departments; the dialysis department, the mother-child department, and the child-teen department. The head of the nursing departments informed nurses about the study and organized a meeting, where the researchers and their study were introduced. Because of the COVID-19, meetings were mostly online and flyers were spread by e-mail. After the meeting, nurses received an e-mail with the informed consent letter, a web link to the subscription (general background + pre-test) for the ED app, and instructions for downloading and installing the ED app on their mobile phones. Nurses who were willing to participate could react by filling in the subscription, otherwise, they could ignore this e-mail. After the participants completed the subscription, they received a personal registration code via e-mail, which allowed them to log in to the ED app.

In the next 30 working days, participants used the ED app to answer the daily SRL questions. It took 2 to 5 minutes to fill in the daily questions each time. Just before the end of each work shift, the nurse was allowed to complete the questionnaire. In the intervention phases, the participants also received tips, just before the start of each work shift. After the participants completed all daily questionnaires during the 30 working days, they were asked to fill in the post-test, which was also done via the ED app.

To make sure the participants did not forget to fill in the ED app, notifications and reminders were sent out via the ED app, based on their work schedule. Additionally, updates and encouragement via the department's newsletter were sent each month to motivate the participants, and to keep them informed about the ED app. At the end of the study, participants will be thanked for their participation. Eventually, after analysing the data and drawing

conclusions, the results will be shared with the participants and other interested parties inside ZGT.

Data analysis

To investigate if the micro-interventions affects the nurses' daily SRL behaviour at the workplace, the baseline phase and the intervention phase from the treatment reversal design will be compared. Because the SRL measurement in the ED app may affect the nurses SRL due to daily reflection, the difference between the pre- and post-test is also analysed, based on the advice of Panadero et al. (2016).

Daily SRL behaviour

Only the nurses (*N* = 11) that completed the study according to the design criterium of Kratochwill et al. (2010) will be included in the data analysis for the daily SRL behaviour. To answer the question of whether there is an effect of the online micro-intervention on the nurses' daily SRL behaviour, it will be first determined what the extent of SRL behaviour was during the daily learning moments at the workplace. This is done based on the same approach in the studies of Aagten (2016), Bloemendal (2019) and Pape (2019). Every workday nurses answered a short questionnaire about their learning experiences. To determine the nurses' SRL behaviour concerning the regulatory agents, the items about learning intentions (item 4 and 5) of the daily SRL questionnaire are used. To determine the nurses' SRL behaviour concerning the regulatory mechanisms, the items about strategy control (items 7 and 8) are used. Lastly, to determine the nurses' SRL behaviour concerning the regulatory appraisal, the item about future planning (item 11) is used. The categorical scores of all these items are converted to a numerical score to determine the extent of SRL behaviour (Table 3). Each answer option (categorial score) is marked as a fully SRL behaviour (1.0), a bit SRL behaviour (0.5), or no SRL behaviour (0) score. In contrast to previous studies, a numerical score of 0 (no SRL behaviour) is also given when nurses indicated that they experienced no learning moment.

To get insight into the (un)completed daily SRL questionnaires and the item categories, a descriptive analysis will be performed, with a distinction made between the baseline and intervention phase. Additionally, to see if there is a significant difference in item categories between the baseline phase and the intervention phase, a chi-square test with a pairwise z-test with a 0.05 significance level will be performed. Only the overarching categories will be included, which are the **bold** categories in Table 3.

To see if there is a visual difference in the SRL behaviour scores between the baseline phase and the intervention phase, a visual analysis will be performed via the web application single-case design hierarchical linear model (scdhlm) version 0.5.2 (Pustejovsky et al., 2020).

Lastly, to measure the effectiveness of the micro-intervention, the baseline phases and the intervention phases will be compared via the web application scdhlm. This app is used to compute the between case standardized mean difference (BC-SMD) effect size estimates. The effect size is estimated as the difference in the mean of observations in the baseline and intervention phases, divided by the within-case standard deviation of the baseline (Valentine et al., 2016).

Table 3

SRL behaviour categories and the SRL behaviour scoring

Variable	Categories	SRL behaviour	Score
Learning intentions	**Unplanned learning**	Not	0
	Learning wish		
	Extern regulated		
	- stimulated by others	Not	0
	- necessary from the organization	Not	0
	Intern regulated		
	- it was needed for the role in my team	A bit	0.5
	- not satisfied with previous experience	A bit	0.5
	- wanted to practice	A bit	0.5
	- preparing for the future	A bit	0.5
	- curiosity	A bit	0.5
	Planned learning		
	Extern regulated		
	- stimulated by others	A bit	0.5
	- necessary from the organization	A bit	0.5
	Intern regulated		
	- it was needed for the role in my team	Fully	1
	- not satisfied with previous experiences	Fully	1
	- wanted to practice	Fully	1
	- preparing for the future	Fully	1

	- curiosity	Fully	1
Strategy control	**No conscious choice**	No	0
	Conscious choice		
	- but do not know why	A bit	0.5
	- a suggestion from another	A bit	0.5
	- there was no other way	Fully	1
	- this was the fastest/easiest way	Fully	1
	- this manner works the best for me	Fully	1
Future planning	**No new plans**	No	0
	Applying and trying in practice		
	- did not go the way I wanted it, so I will try again	A bit	0.5
	- know now what to do I a similar situation	A bit	0.5
	- what I learned, I will keep doing	A bit	0.5
	- what I learned, I will apply in practice	A bit	0.5
	- what I learned, I try in another situation	A bit	0.5
	Setting new learning goals		
	- what I learned, I keep on developing	Fully	1
	- I will set up new learning goals	Fully	1
	- I will share this learning moment with others	Fully	1
No learning moment experience		Not	0.0

Micro-intervention intentions

To answer the question of whether nurses are intended to do something with the received tips, a descriptive analysis of the answers of the single item questionnaire '*Do you plan to do something with this tip?*', will be performed. Each micro-intervention day, the nurses received two tips about learning goals, learning opportunities or learning strategies. To see whether there is a relationship between the received type of micro-intervention and the SRL behaviour score during that day, a one-way ANOVA analysis will be performed. Lastly, to see

if there is a relationship between the nurses' intentions based upon the received tips and the SRL behaviour score during that day, a two-way ANOVA analysis will be performed.

SRL attitude

To answer the question on the change of the nurses' SRL attitude, a descriptive analysis will first be performed to gain insight into the nurses' SRL attitude before and after the use of the ED app. Second, to measure if nurses' SRL attitudes positively changed after using the ED app, a paired sample t-test will be conducted in SPSS to compare the scores of the first and the second questionnaire for nurses' SRL attitudes. In the first part of the study, 20 nurses answered 14 statements with the five-point Likert scale, with a score of 5 for totally agree and a score of 1 for totally disagree. In total 14 nurses completed the pre- and post-test and 11 nurses completed the required number of daily SRL questionnaires. However, one nurse did not complete the post-test and only the nurses (N = 10) who completed both pre- and post-test as the required daily SRL questionnaires, will be included for this data analysis. This is because of the reactivity effect in the SRL measurement, which is described by Panadero et al. (2016). Only for these nurses, the SRL attitude is expected to be positively changed by filling in the daily SRL questionnaires.

Results

First, the results of the nurses' daily SRL behaviour at the workplace will be presented. A comparison between the baseline and the intervention is made. Moreover, the results of the nurses' intentions based upon the tips they received during the intervention phases will be presented. Second, the results of the pre- and post-test regarding the nurses' SRL attitude will be presented and compared.

Self-regulated learning behaviour at the workplace in the baseline and intervention phases

The 11 remaining nurses that completed the study according to the design criterium of Kratochwill et al. (2010), could complete a total of 330 questionnaires, which are 165 during the baseline phase and 165 during the intervention phase. However, a total of only 248 daily questionnaires were completed (Table 4). Of the completed daily questionnaires, 89 daily questionnaires (42 in baseline and 47 in intervention) showed that the nurses did not experience a learning moment. Nurses did experience a learning moment in 159 of the daily questionnaires (84 in baseline and 75 in intervention). In 30 cases (17 in baseline and 13 in intervention) nurses first asked for a hint which led to nurses indicating that they did experience a learning moment on 17 daily questionnaires (11 in baseline and 6 in intervention) and did not experience a learning moment on 13 daily questionnaires (6 in baseline and 7 in intervention). Results of the chi-square test showed that there is no significant relationship between experiencing a learning moment and the phases ($X^2(1) = 0.80$, $p = 0.37$). This means that nurses in the baseline phase experienced a learning moment as often as in the intervention phase.

A total of 79 daily questionnaires (37 in baseline and 42 in intervention) were not completed, of which 25 cases (14 in baseline and 11 in intervention) indicated that nurses did not work that day. Other than the other 57 cases (25 in baseline and 32 in intervention), reasons for not completing the daily questionnaire are not known with certainty. In three cases (2 in baseline and 1 in intervention), nurses indicated that they had experienced a learning experience, but then stopped completing daily questionnaires.

Table 4

Frequency Table: completion of the daily questionnaire in each phase

Daily questionnaire	Baseline		Intervention		Total	
	N	*%*	*N*	*%*	*N*	*%*
Completed	128	77.6%	123	74.5%	248	76.1%

Experienced a learning moment	84	52.1%	75	46.1%	159	49.1%
Did not experienced a learning moment	42	25.5%	47	28.5%	89	27.0%
Not completed	37	22.4%	42	25.5%	82	23.9%
Did not work that day	14	8.5%	11	6.7%	25	7.6%
Other	25	13.9%	32	18.8%	57	16.4%
Total	165	100%	165	100%	330	100%

Learning intentions

In Table 5, the frequencies of the learning intention item categories are presented. In the baseline phase, 13.1% of the learning intentions were fully self-regulated, 15.5% of learning intentions were a bit self-regulated and 71.4% were not self-regulated. In the intervention phase, 16.0% of the learning intentions were fully self-regulated, 10.6% were a bit self-regulated and 73.3% were not self-regulated. Results of the chi-square test showed that there is no significant relationship between the categorial learning intentions variables (bold variables in Table 5) and the phases ($X^2(2) = 0.12$, $p = 0.94$). This means that the nurses did or did not plan their learning or had learning wishes just as often in both phases.

Table 5

Frequency Table: learning intention categories in each phase

Learning intentions	SRL behaviour	Baseline		Intervention	
		N	*%*	*N*	*%*
Unplanned learning	Not	59	70.2%	51	68.0%
Learning wish		12	14.3%	11	14.7%
Extern regulated	Not	1	1.2%	4	5.3%
Intern regulated	A bit	11	13.1%	7	9.3%
Planned learning		13	15.5%	13	17.3%
Extern regulated	A bit	2	2.4%	1	1.3%
Intern regulated	Fully	11	13.1%	12	16.0%
Total		84	100%	75	100%

Strategy control

In Table 6, the frequencies of the strategy control item categories are presented. In the baseline phase, 47.7% of the strategy controls were fully self-regulated, 7.1% of learning intentions were a bit self-regulated and 51.2% were not self-regulated. In the intervention phase, 38.7% of the learning intentions were fully self-regulated, 1.3% were a bit self-regulated and 60.0% were not self-regulated. Results of the chi-square test showed that there is no significant relationship between making a conscious choice for strategy and the phases ($X^2(1) = 1.24$, $p = 0.27$). This means that the nurses' made conscious and non-conscious choices for a strategy just as often in both phases.

Table 6

Frequency Table: strategy control categories and the occurrence in each phase

Strategy control	SRL behaviour	Baseline		Intervention	
		N	*%*	*N*	*%*
No conscious choice	Not	43	51.2%	45	60.0%
Conscious choice		41	54.8%	30	40.0%
I do not know	A bit	0	0.0%	1	1.3%
Someone give this manner as a suggestion	A bit	6	7.1%	0	0.0%
This was the fastest and easiest way	Fully	15	17.9%	11	14.7%
This manner works best for me	Fully	15	17.9%	13	17.3%
There was no other way	Fully	5	11.9%	5	6.7%
Total		84	100%	75	100%

Future planning behaviour

In Table 7, the frequencies of SRL behaviour on future planning is presented. In the baseline phase, 19.0% of the future planning showed a fully SRL behaviour, 70.2% showed a bit SRL behaviour and 10.7% did not show SRL behaviour. In the intervention phase, 28.0% of the future planning showed a fully SRL behaviour, 50.7% showed a bit of SRL behaviour and 21.3% did not show SRL behaviour. Results of the chi-square test showed that there is a significant relationship between the future planning categories and the day type ($X^2(2) = 6.69$, $p = 0.04$). Looking at the column proportions, the category 'applying and trying in practice' does significant differ. This means that nurses significantly apply and trying in practice what they have learned more often in the baseline phase than in the intervention phase.

Table 7

Frequency Table: future planning categories and the occurrence in each phase

Future planning	SRL behaviour	Baseline		Intervention	
		N	%	*N*	%
No new plans	Not	9	10.7%	16	21.3%
Applying and trying in practice	A bit	59	70.2%	38	50.7%
Setting new learning goals	Fully	16	19.0%	21	28.0%
Total		84	100%	75	100%

The effect of the micro-interventions on the nurses' SRL behaviour

To see if the nurses showed significant more SRL behaviour during the intervention phase than in the baseline phase, visual analysis and an effect size analysis were performed via the web application scdhlm (Pustejovsky, Chen and Hamilton, 2020). It was expected that nurses showed more SRL behaviour in the intervention phase than in the baseline phase, because of the micro-interventions.

Visual analysis

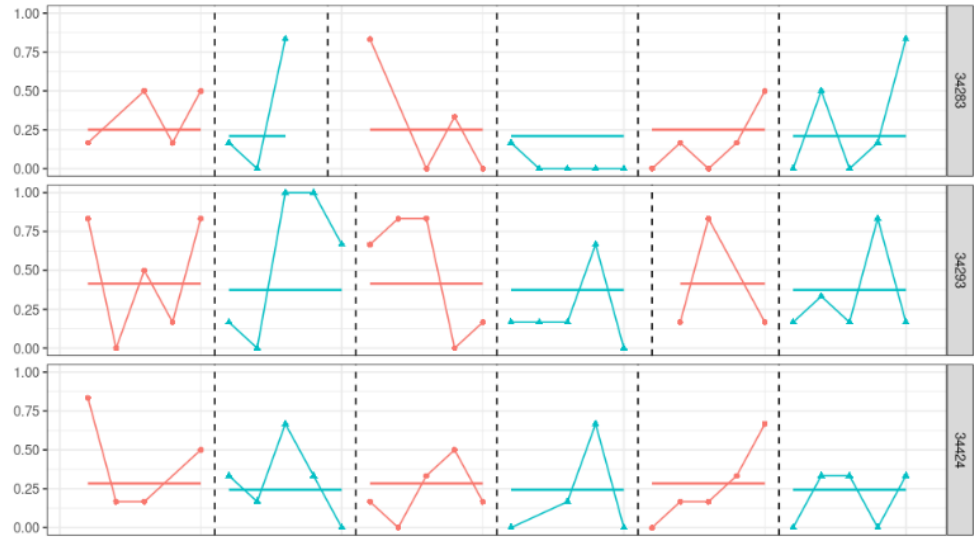
To give a visual impression of SRL behaviour during each phase, the results of the first three participants are shown (Figure 3, 4, 5, and 6). Appendix G shows the graphs of all participants. The horizontal lines resemble the mean score for each phase (red for baseline and blue for intervention). The results of the SRL behaviour demonstrated many fluctuations in the graphs Figure 3). This means that the nurses did not show a consequent and stable SRL behaviour during each phase. It seems that the extent of SRL behaviour differs per learning experience. Therefore, the figure suggests that the SRL behaviour did not tend to be necessarily higher in the intervention phases than during the baseline phases.

Visual analysis on each of the three SRL sub behaviours, namely learning intentions, strategy control and future planning, shows approximately the same pattern as the graphs on total SRL behaviour (Figure 4, 5, and 6). So, the figures also suggest that the SRL behaviour during each sub SRL behaviour also did not tend to be higher in the intervention phase than in the baseline phase. The visual analysis on the learning intentions (Figure 4) showed that nurses mostly have no SRL behaviour, especially the first and third nurses. This means that they mostly had no intentions to learn something. However, there are still some outliers in all the graphs. The visual analysis on the strategy control showed that nurses showed fully SRL behaviour during their strategy control processes or did not show it at all (Figure 5). This means

that nurses did not make a conscious choice for their strategy or they made a conscious choice based upon previous experiences. Finally, nurses showed a more consequent SRL behaviour for future planning (Figure 6) in comparison with the graphs about learning intentions and strategy controls. Nurses mostly scored 'a bit' of SRL behaviour meaning that they mostly will try and apply what they have learned in practice.

Figure 3

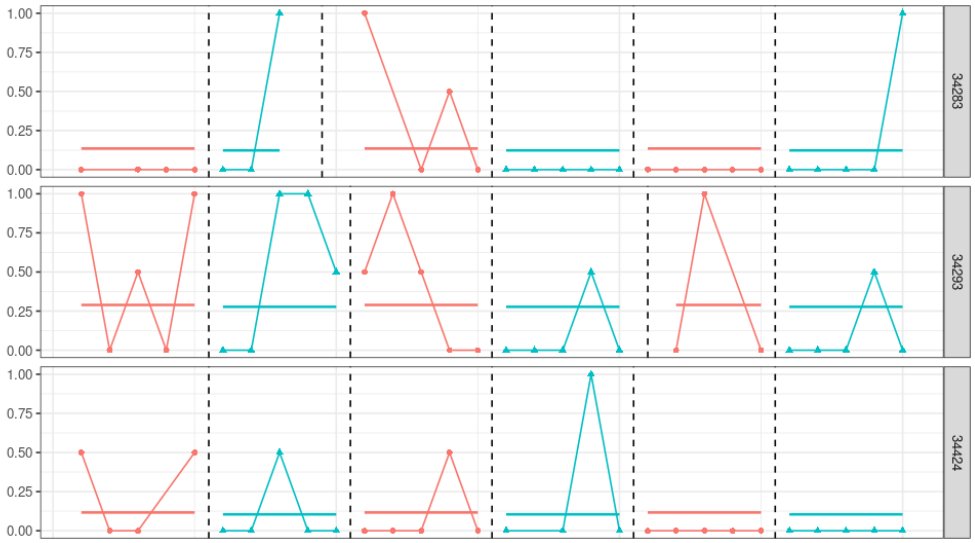
Visual analysis SRL behaviour



Note. The x-axis represents SRL measurements and the y-axis represents the SRL behaviour score

Figure 4

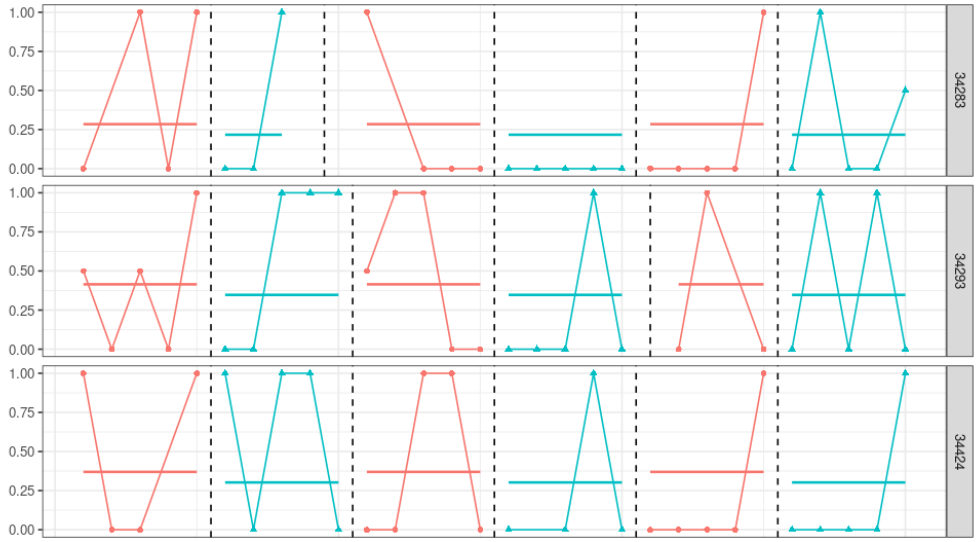
Visual analysis for learning intentions



Note. The x-axis represents SRL measurements and the y-axis represents the SRL behaviour score

Figure 5

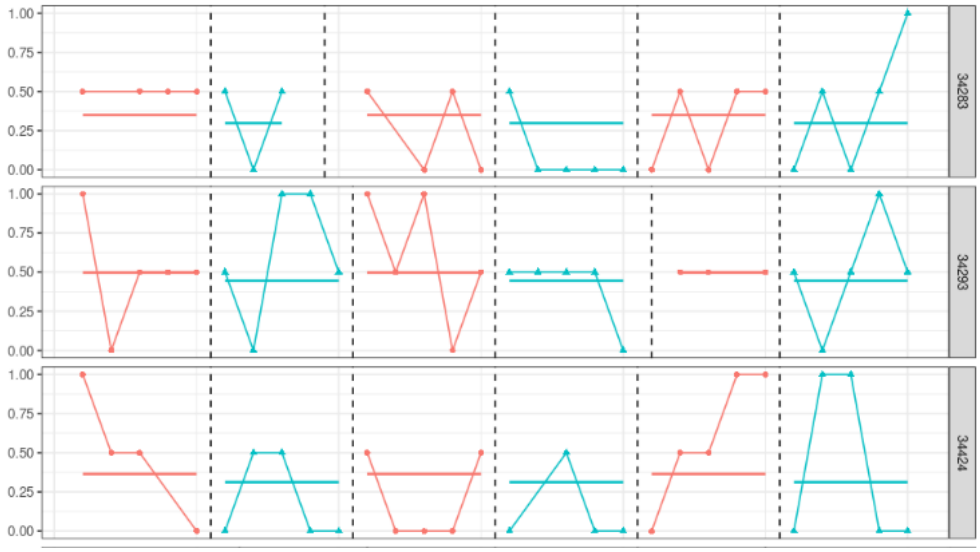
Visual analysis for strategy control



Note. The x-axis represents SRL measurements and the y-axis represents the SRL behaviour score

Figure 6

Visual analysis for future planning



Note. The x-axis represents SRL measurements and the y-axis represents the SRL behaviour score

Effect size

The effect size analysis showed for the total SRL behaviour a BS-SMD estimate of -0.1517 with a 95% CI [-0.4007, 0.0973]. This means that it can be concluded with 95% confidence that the micro-interventions does not affect the nurses' SRL behaviour. The BC-SMD estimates for the sub SRL behaviours are also calculated. The effect size analysis for the learning intentions showed a BS-SMD estimate of -0.0407 with 95% CI [-0.2861, 0.2047]

the effect size for the strategy control showed a BS-SMD estimate of -0.1615 with 95% CI [-0.4101, 0.0872] and the effect size analyses for future planning showed a BS-SMD estimate of -0.1541 with 95% CI [-0.4296, 0.1214]. This means that the micro-intervention also does not affect each nurses' sub SRL behaviour. To sum up, none of the BC-SMD estimates of the SRL behaviour variables showed that the micro-interventions affects the nurses' SRL behaviour (Table 8). It was expected that the micro-interventions supports the nurses' SRL behaviour, especially the regulatory agents and mechanisms. However, the results of the effect size analysis are not in line with the expectations.

Table 8

Effect Size Analysis: micro-intervention on the SRL behaviour variables

Variable	*BC-SMD estimate*	*Std. Error*	*95% CI (lower)*	*95% CI (upper)*
Learning intentions	-0.0407	0.1246	-0.2861	0.2047
Strategy control	-0.1615	0.1262	-0.4101	0.0872
Future planning	-0.1541	0.1398	-0.4296	0.1214
Total SRL behaviour	-0.1517	0.1264	-0.4007	0.0973

Micro-interventions

On each intervention day, the nurses received a micro-intervention containing a combination of two types of tips, which could be about learning goals, learning strategies or learning opportunities. After each tip, the nurses were asked if they intended to do something with this tip. On 132 of the 165 micro-interventions, nurses (*N* = 11) answered what their plans were based upon the received micro-intervention (Table 9). The nurses are least likely to indicate that they will do something with the tips on the same day. For learning goals, nurses most indicate that they did not know if they would do something with the tips (42.7%). For learning opportunities, nurses also most indicate that they did not know if they would do something with the tips (37.8%). For learning strategies, nurses most indicate that they would do something with the tips, but not on the day they received the tip (39.0%).

Table 9

Frequency Table: planning intentions for each type of micro-intervention

Planning intentions	Learning goals		Learning opportunities		Learning strategies	
	N	*%*	*N*	*%*	*N*	*%*
Yes	4	4.9%	7	8.5%	9	11.0%
Yes, but not today	26	31.7%	28	34.1%	32	39.0%
I do not know	35	42.7%	31	37.8%	26	31.7%
No	17	20.7%	16	19.5%	15	18.3%
Total	82	100%	82	100%	82	100%

Table 10 gives an overview of the descriptives of the different micro-intervention days and the daily SRL behaviour score. On the days when the nurses (*N* = 11) received a micro-intervention consisting of the combination of tips on learning opportunities and strategies, the mean SRL behavioural score was 0.23 (*SD* = 0.28), for the combination of tips on learning goals and strategies the mean SRL behavioural score was 0.21 (*SD* = 0.29) and for the last combination of learning goals and opportunities the mean SRL behavioural score was 0.30 (*SD* = 0.31). A one-way ANOVA was conducted to compare the daily SRL behaviour score between the different combinations of tips on the micro-interventions days (Table 11). Results showed that there was no significant difference between the combinations ($F(2, 103) = 1.00$, $p = 0.37$).

Table 10

Descriptives of the daily SRL behaviour score by micro-intervention days

Micro-intervention days	*N*	*Mean*	*Std. Dev.*
Combination 1: learning opportunities and strategies	32	0.23	0.28
Combination 2: learning goals and strategies	38	0.21	0.29
Combination 3: learning goals and opportunities	36	0.30	0.31

Table 11

One-way ANOVA of daily SRL behaviour by micro-intervention days

	Df	*F*	*Sig.*
Between groups	2	0.997	0.373
Within groups	103		
Total	105		

Table 12 gives an overview of the descriptives of the learning intentions based upon the two tips the nurses (*N* = 11) received in the micro-interventions and the daily SRL behaviour score. A two-way ANOVA was conducted to compare the daily SRL behaviour with the different intentions of the nurses (*N* = 11) based on the micro-interventions (Table 13). Results showed that the nurses' intentions based upon tip 1 have no significant effect on the daily SRL behaviour ($F(3,91) = 0.55$, $p = 0.65$). The nurses' intentions based upon tip 2 also have no significant effect on the daily SRL behaviour ($F(3, 91) = 0.84$, $p = 0.48$). Lastly, the interaction between the nurses' intention based upon tips 1 and 2 has no significant effect on the daily SRL behaviour ($F(8, 91) = 0.39$, $p = 0.92$). So whether the nurses plan to do something with the tips received in the micro-interventions has no significant influence on their daily SRL behaviour.

Table 12

Descriptives of the daily SRL behaviour score by intentions based upon micro-intervention

Tip 1	Tip 2	*N*	*Mean*	*Std. Dev.*
Yes	Yes	4	0.29	0.37
	Yes, but not today	3	0.17	0.17
	I do not know	2	0.50	0.24
	No	0		
Yes, but not today	Yes	2	0.33	0.47
	Yes, but not today	19	0.28	0.29
	I do not know	7	0.33	0.42
	No	5	0.20	0.36
I do not know	Yes	4	0.46	0.46
	Yes, but not today	16	0.27	0.32
	I do not know	17	0.21	0.25

	No	7	0.21	0.23
No	Yes	2	0.33	0.00
	Yes, but not today	11	0.15	0.30
	I do not know	3	0.11	0.10
	No	4	0.08	0.17

Table 13

Two-way ANOVA of daily SRL behaviour by intentions

Sources	*Df*	*F*	*Sig.*
Intentions based upon tip 1	3	0.553	0.647
Intentions based upon tip 2	3	0.841	0.475
Intentions based upon tip 1 * intentions based upon tip 2	8	0.391	0.923
Error	91		
Total	106		

Nurses' self-regulated learning attitude

Only the nurses (*N* = 10) that completed the study according to the design criterium of Kratochwill et al. (2010) and completed both pre- and post-test were involved in this analysis. Results of the pre-test showed that the mean score of the nurses' SRL attitude before using the ED-app was 3.86 (*SD* = 0.16). This means that on average nurses answered that they approximately agree on the 14 statements about self-regulated learning at the workplace. Results of the post-test showed that the mean score of the nurses SRL attitude after using the ED-app was 4.04 (*SD* = 0.21). This means that on average nurses answered that they also approximately agree on the 14 statements about self-regulated learning at the workplace. To see if there was a significant difference between nurses SRL attitudes before and after the SRL measurement, a paired sample t-test was performed (Table 14). Nurses scored a higher SRL attitude on the post-test than on the pre-test (*M* = -0.19, *SD* = 0.25). Results of the paired sample t-test showed there was a significant difference between the pre-test and post-test, *t*(9) = -2.39, *p* = 0.04. The effect size analysis showed a Cohen's d of 0.76, which is close to a large effect. To conclude, the SRL measurement in this study had a significant effect on the nurses' SRL attitude, which confirms the expectations.

Table 14

Paired sample t-test: nurses' SRL attitude pre- and post-test

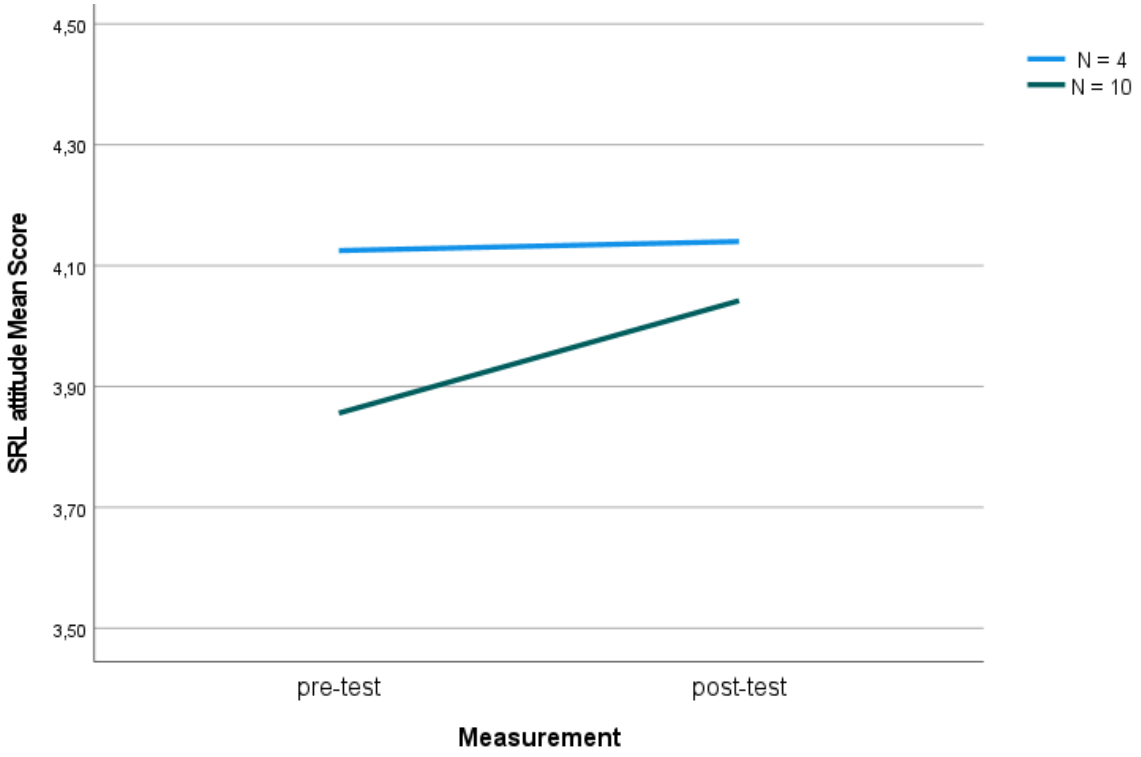
	Mean	*Std. Dev.*	*S.E. Mean*	*t*	*df*	*Sig. (2-tailed)*
Pre-test	3.8571	0.1649	0.05	-2.391	*9*	0.040
Post-test	4.0429	0.2054	0.06			

Note. N = 10

Figure 7 visualize the nurses' SRL attitudes growth from the pre-test to the post-test. The green line represents the nurses (*N* = 10) that did complete the required number of SRL measurements. The blue line represents the nurses (*N* = 4) that did not complete the required number of SRL measurements. They also show some visual grow in SRL attitude but results of the paired sample t-test confirm that the nurses (*N* = 4) did not show a significant change in SRL attitude between the pre-test (*M* = 4.12, *SD* = 0.55) and the post-test (*M* = 4.14, *SD* = 0.39) conditions; *t*(3) = -0.17, *p* = 0.873.

Figure 7

The nurses' SRL attitude from the pre-test to the post-test



Discussion

The main aim of this study was to investigate the effect of a micro-intervention on the nurses' daily SRL behaviour. To do so, the study has used a treatment reversal design (ABAB design) in which the nurses received a micro-intervention during the intervention phases (B). The micro-interventions consists of a combination of two tips about the learning goals, opportunities, or strategies in the hospital context. The daily SRL behaviour was measured by an ESM via the ED app. This way of measuring SRL could influence the participant's SRL (Panadero et al., 2016), and therefore a pre- and post-test about their SRL attitude was conducted. In this discussion part, the findings and implications of this study will be discussed, which is divided into two parts: nurses' daily SRL behaviour and SRL attitude. Subsequently, the limitations and recommendations for future research will be discussed and eventually, there will be a general conclusion.

Nurses' daily SRL behaviour

This study found that the current micro-intervention did not increase the nurses' daily SRL behaviour which is not in line with the expectations of this study. It was expected that informing nurses about the context of their organization in terms of the learning objectives and the availability of resources, helps them to better know the learning opportunities in their organization and make better decisions about their learning plan (Siadaty et al., 2016). Additionally, Littlejohn et al. (2012) believe that sharing knowledge and creating networks is a crucial factor to support SRL at the workplace. The SRL model for the healthcare context of Cuyvers (2019) emphasises that the social and organizational context plays a crucial role in nurses' SRL. So it is surprising that the study found that the current micro-intervention does not support the nurses' SRL behaviour.

The lacking effect of the online micro-intervention on the daily SRL behaviour could be explained by the response which we received by email. Several nurses indicated that they were enthusiastic about the app and that they are becoming aware of what they are learning at the workplace, but that the tips were already known to them and thus not relevant. Cuyvers et al. (2020) showed that both personal and contextual factors play an important role in SRL at the workplace. A personal factor such as prior knowledge could be added to the micro-interventions because most studies reported this as an influential factor (van Houten-Schat et al., 2018). Also, van Houten-Schat et al. (2018) explain that there is an important interaction between the personal and contextual factors going on and that an individual approach is needed to help nurses with their SRL behaviour. Identifying potential gaps in competencies is a critical factor in a recommendation system and it needs to be highly accurate to gain the learners' trust (Pu et al., 2021). Another explanation could be given by the type of social support in the micro-intervention. The tips in the micro-interventions came from programmed

colleagues who are not real colleagues. Siadaty et al. (2016) explain that social interaction needs to be real-time, seamless and transparent. Allowing real nurses from the same speciality to share their learning tips and experiences could also be a suitable adaptation to the micro-intervention. Awareness of the learning activities of their colleagues is a crucial factor for SRL, especially for the regulatory agents and mechanisms. Additionally, the insights into the learning moments of colleagues offer at the same time support in evaluating and reflecting on their learning, so for regulatory appraisals. Results of the current study show that nurses mostly will apply and try what they have learned in practice, but by making this adjustment in the micro-intervention, one would expect nurses to choose to share their learning with others more often. This could have a positive effect on the behavioural SRL score for regulatory appraisals. Moreover, during these social interactions, socially shared regulation could take place. In socially shared regulation, personals are achieved through social interaction (Hadwin et al. 2017).

This study found also that it did not matter if nurses received a tip on goals, strategies or opportunities for the daily SRL behaviour score. Moreover, when nurses did indicate that they had intentions to do something with the tips they received on the intervention days, there was also no significant effect on the SRL behaviour during that specific day. An explanation could be that the work environment may not facilitate the creation of learning plans by nature. Literature shows that the learning of nurses mostly happens ad-hoc (Cuyvers et al., 2016). The learning is based upon everyday experiences, concerning the treatment and diagnosis of the patients. Learning activities arise from challenging tasks, problem-solving and overcoming gaps in competencies (Cleland, Leaman, & Billett, 2014). This is also in line with the results of this study, namely nurses mostly did not plan their learning experience. This also emerged from the studies by Aagten (2016), Cuyvers (2019) and Bloemendal (2019). Also, Berkhout et al. (2017) noticed that nurses' SRL behaviour is little planned and there is a limitation in goal setting. Each workplace environment has its different requirements for employees to learners self-regulated and adaptations on the SRL framework are needed (Cuyers et al., 2020). Perhaps the difficulty to plan to learn and set goals in advance is just the nature of SRL in healthcare consequently hard to change with micro-interventions. A suggestion would be to change to focus on dealing with learning at the moment and what they are going to do with the experience, so on regulatory mechanism and appraisals. For example by letting real colleagues share their learning experiences as was suggested earlier.

SRL attitude

This study measured SRL by ESM, so every workday nurses filled in a short questionnaire about their learning experiences. However, the SRL measurement influences the nurses because it let nurses reflect on their learning experiences every day (Panadero et

al., 2016). Before the use of the app, nurses showed a positive attitude towards self-regulated learning at the workplace, because overall they agreed to statements about their SRL attitude. Although they already had a positive attitude towards SRL before the app, the nurses scored significantly higher on SRL attitude, after the SRL measurement via the app. In sum, the SRL measurement via the app leads to a positive SRL attitude change by the nurses. These results are in line with the reactivity effect described by Panadero et al. (2016). Each workday the nurses record their learning moments, which also requires them to reflect upon their self-regulated learning. This ongoing reflection about their self-regulated learning probably affected the nurses SRL attitude due to metacognitive monitoring (Zimmerman, 2002). Via a diary, learners get more information about their learning processes and allow them to reflect better on their learning (Panadero et al., 2016). Also, the diary could promote learning and create more awareness of the importance of SRL (Schmitz & Perels, 2011). This is also in line with the reactions we received by email wherein nurses mentioned they increased their awareness of learning at the workplace. Results of this study also showed that when nurses did not complete the required amount of SRL measurement via the app there was also a positive growth, however, the SRL attitude did not significantly change. So to change the SRL attitude significantly, nurses must consult the app more often to record their learning moments.

Limitations and future research

The nurses who participate in this study were recruited voluntarily, making it very likely that the nurses were already interested in workplace learning. They are willing to develop themselves further and devote time and energy to this learning project. The pre-test also showed that nurses' attitudes to SRL were positive. This means that the sample may not represent all nurses in the hospital, but only nurses with a positive attitude towards SRL and are willing to learn and participate in a project that contributes to their professional development. Follow-up research should find a way to include nurses who have a low attitude towards SRL if there are any.

According to Veenman (2011), retrospective self-reports have a high probability of bias by memory failure. Moreover, personal reflection is an individual barrier for nurses in SRL (van Houten-Schat et al., 2018), which could lead to problems with filling in the daily questionnaire. It may be possible that nurses may not have filled in the short questionnaire in the app according to the real learning experience and their actual behaviour. For that, valid and reliable measurement of SRL in healthcare measuring, other measurement techniques besides self-reports methods should be added (Cuyvers, 2020). For example using methods measuring SRL during work-related learning tasks (Vancouver et al., 2014), such as think-aloud methods, observations, video registrations. This reduces the delay between actual behaviour and measurement and thereby minimise the disturbances caused by memory failure (Veenman,

2011). However, online measurements are limited within the hospital context for ethical and privacy-sensitive reasons. Moreover, due to COVID-19, online measurements were not possible at all during this study. Researchers were not allowed at the workplace. Future research could measure SRL via a combination of an online and offline measurement for a more reliable picture of the nurses' SRL behaviour during the workday.

In addition, it is recommended to critically reconsider the measurement of SRL behaviour in a healthcare context. Even though the current SRL measurement tool has been used before in healthcare settings, some variables can be re-examined with today's knowledge. Each workplace environment has its different requirements for employees to learners self-regulated (Cuyers et al., 2020). One can critically ask how we, for example, should assess nurses' learning intentions. Literature shows that the learning of nurses mostly happens ad-hoc (Cuyvers et al., 2016). Item 5 of the current daily SRL questionnaire explicitly asks whether they had planned to learn this in advance and this item is included in the SRL behaviour score. An adaptation of the questionnaire could be to ask only what their learning intentions were at that moment and not necessarily whether it was planned before their work shift. More investigation is needed regarding SRL behaviour in healthcare settings to develop accurate SRL self-report measurements.

The nurses (N = 11) that filled in the required amount of measurements, could complete a total of 330 daily questionnaires but, in practice, 248 daily questionnaires have been filled in. The more daily questionnaires have been filled in, the more reliable the nurses' SRL behaviour score during the two different phases is. Some nurses mentioned notifications were not received or at the wrong moments. This could be explained by the limitations of technical possibilities in the ED app. Moreover, the hectic nature of COVID-19 at the workplace was also a disturbance to making the app work optimally. The nurses' work schedules could change rapidly, which meant that the planned questionnaires in the app no longer corresponded to the nurses' pre-set working days in the app. When this happened at short notice, it could not be adjusted and the nurses could not fill in a daily questionnaire. It could be that the app will be more effective when the COVID-19 situation is calmer, but this study gives also cause for future studies to look for an app that adapts itself automatically to work schedules because in the current app this was done manually.

Conclusion and recommendation

This study investigated the effect of micro-intervention on the nurses' daily SRL behaviour. Results showed that the current micro-intervention has no effect on the nurses' SRL behaviour but the ED app has a significant effect on the nurses' SRL attitude. SRL in healthcare is a more complex process than in other work contexts and more literature is

needed to further explain the SRL framework in healthcare. This study gives cause to further investigate the nature of SRL in the healthcare context in-depth so that the limited literature can be expanded. A better understanding of this framework could help in developing a suitable micro-intervention to support nurses' SRL behaviour. This is important because ultimately nurses are expected to keep up with their professional development. Together, it is recommended to continue creating awareness of their SRL by using a learning diary, however, adjusting the current micro-intervention could help nurses to perform SRL. For example, including personal factors, such as prior knowledge, in the micro-interventions. Or by letting nurses share tips about their learning experiences by themselves forcing them to reflect on their learning experiences, which is likely to support regulatory appraisals. Becoming aware of the learning experiences of colleagues could also provide support for regulatory agents and mechanisms. So to raise nurses' awareness of and support for SRL, a learning diary can be used where nurses can choose to share their learning experiences with colleagues. In addition, it is advised to provide tips on learning goals, learning strategies and learning opportunities in the workplace, taking into account the nurses' prior knowledge. The last two components (sharing experiences and prior knowledge) require further investigation.

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Appendix A

General background questions (in Dutch)

1. **Wat is je geslacht?**
    - Man
    - Vrouw
    - Overige
2. **Wat is je leeftijd?**
    - < 20 jaar
    - 21 – 25 jaar
    - 26 – 30 jaar
    - 31 – 35 jaar
    - 36 – 40 jaar
    - 41 – 45 jaar
    - 46 – 50 jaar
    - 51 – 55 jaar
    - 56 – 60 jaar
    - 61 – 65 jaar
    - > 60 jaar
3. **Wat is je hoogst afgeronde opleiding?**
    - Basisonderwijs
    - Voorgezet onderwijs
    - Mbo 2
    - Mbo 3
    - Mbo 4
    - In-service opleiding
    - Hbo bachelor
    - Hbo master/+
    - Universitaire bachelor
    - Universitaire master
4. **Hoeveel jaren werkervaring heb je in de zorg?**
    - 0 -5 jaar
    - 6 – 10 jaar
    - 11 – 15 jaar
    - 16 – 20 jaar
    - 21 – 25 jaar
    - > 26 jaar

5. **Welke functie heb je binnen ZGT?**
    - *open antwoord*
6. **Op welke afdeling ben je werkzaam?**
    - Kinderafdeling
    - Moeder-kindafdeling
    - Dialyseafdeling
7. **Hoeveel uur per week werk jij gemiddeld?**
    - 1 – 8 uur
    - 9 – 16 uur
    - 17 – 24 uur
    - 25 – 32 uur
    - 33 – 40 uur

Appendix B

Self-Regulated Learning attitude questionnaire (in Dutch)

1. **Ik zal nooit te oud zijn om nieuwe dingen te leren voor mijn werk.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
2. **Ik vind altijd wel tijd als ik iets wil leren.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
3. **Ik neem initiatief als ik merk dat ik iets kan leren wat nuttig is voor mijn werk.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
4. **Ik voel zelf aan wanneer het nodig is om iets bij te leren voor mijn werk.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
5. **Leren vind ik een belangrijk aspect in mijn arbeidsleven.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
6. **Ik geef niet op wanneer ik iets moeilijks aan het leren ben.**
    - Helemaal eens
    - Eens
    - Neutral

- Oneens
- Helemaal oneens

7. **Ik streef naar uitwisseling van ervaring met mensen die gemotiveerd zijn in hun werk.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
8. **Ik test mezelf om tew eten of ik iets grondig heb geleerd.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
9. **Het afgelopen jaar leerde ik voor mijn werk veel dingen op eigen initiatief.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
10. **Ik zoek vaak informatie op om meer te weten over onderwerpen in mijn vakgebied waarin ik geïnteresseerd ben.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
11. **Wanneer ik leer, begrijp ik meer van de wereld om mij heen.**
    - Helemaal eens
    - Eens
    - Neutral
    - Oneens
    - Helemaal oneens
12. **Ik onderneem graag leeractiviteiten op eigen houtje.**
    - Helemaal eens
    - Eens

- Neutral
- Oneens
- Helemaal oneens

13. Ik weet welke stappen ik moet ondernemen als ik iets nieuws wil leren.

- Helemaal eens
- Eens
- Neutral
- Oneens
- Helemaal oneens

14. Ik ben graag betrokken bij projecten op het werk waar kansen worden geboden om te leren.

- Helemaal eens
- Eens
- Neutral
- Oneens
- Helemaal oneens

Appendix C

Daily questionnaire in ED-app (in Dutch)

Titel: werkdag 1 **Notifications** • **0 minuten:** Het leermoment staat vanaf nu open. Laat weten of je hebt gewerkt én of je hebt geleerd vandaag! - *Registreer jouw leermoment(en) tijdens je afgelopen werkdienst. Heb je tóch niet gewerkt óf niks geleerd? Laat dit ook weten. Alvast bedankt!* • **60 minuten:** Herinnering: Laat weten of je hebt gewerkt én of je hebt geleerd vandaag! - *Registreer jouw leermoment(en) tijdens je afgelopen werkdienst. Heb je tóch niet gewerkt óf niks geleerd? Laat dit ook weten. Alvast bedankt!* **Expiry time: 24 uur**
Section 1
Je eerste werkdag zit erop en wat goed om jou hier te zien! **Heb jij iets geleerd tijdens je werkdienst vandaag?** ☐ *Ja (>3)* ☐ *Nee (>22)* ☐ *Geef mij een hint (>2)* ☐ *Ik heb niet gewerkt vandaag. (>22)*
Section 2
Misschien heb je iets geleerd op deze manier ... - Ging iets anders dan verwacht? - Ben je iets nieuws te weten gekomen? - Heb je hulp en/of advies gevraagd? - Heb je iets opgezocht? - Had je een gesprek met een collega? - Heb je iets voor het eerst gedaan of toegepast? ☐ *Ja (>3)* ☐ *Nee (>22)*
Section 3
Wat heb je geleerd? Beschrijf hieronder zo eerlijk mogelijk wat je hebt geleerd vandaag. Er zijn geen foute of goede antwoorden.

[type your answer here / max. 250] (>4)

4a. Had je gepland om dit te gaan leren?

- *Ja (>5)*
- *Niet specifiek voor dit moment, maar ik had wel de intentie om dit te leren (>5).*
- *Nee, ik heb dit niet gepland.(>6)*

4b. Wat was de hoofdreden om dit te leren?

Kies de beschrijving die het beste bij jouw leermoment past.

- *Ik was niet tevreden met een eerdere ervaring.*
- *Ik wilde ergens mee oefenen.*
- *Ik wilde mijzelf voorbereiden op toekomstige situaties.*
- *Ik was nieuwsgierig naar iets.*
- *Anderen stimuleerde mij om mijzelf hierin te ontwikkelen.*
- *Het was nodig voor mijn rol in het team.*
- *Het moest van de leidinggevende.*

5. Op welke manier heb jij geleerd?

Kies de beschrijving die het beste bij jouw leermoment past.

Ik heb geleerd door:

- *Weet ik eigenlijk niet.*
- *Iets te doen/ervaren.*
- *Te experimenteren/testen.*
- *Evalueren/reflecteren op een werkervaring..*
- *Verkrijgen van informatie.*
- *Het observeren van anderen.*
- *Het discussiëren met anderen.*
- *Feedback van anderen te krijgen.*
- *Workshop/cursus volgen.*

☐ *Uitleg/les/instructie te geven.*
6a. Had je deze manier van leren van te voren bedacht? ☐ *Ja, ik heb hier over nagedacht. (>8)* ☐ *Nee, dit was een onbewuste keuze. (>9)*
6b. Je geeft aan deze manier van te voren hebben gekozen. **<u>Waarom</u> koos jij voor deze manier?** ☐ *Ik weet het niet.* ☐ *Een andere manier was niet mogelijk.* ☐ *Iemand anders gaf deze manier als een suggestie.* ☐ *Dit was de makkelijkste/snelste manier om het te leren.* ☐ *Vergeleken met andere manieren, werkte dit het beste voor mij.*
7a. Waren andere mensen betrokken bij je leermoment? Denk hierbij aan collega's, patiënten, ect. ☐ *Ja (>10)* ☐ *Nee (>11)*
7a. Wie waren er betrokken bij dit leermoment? **Er zijn meerdere antwoorden mogelijk.** ☐ *Collega uit mijn eigen team.* ☐ *Collega uit een ander team.* ☐ *Expert binnen het ZGT.* ☐ *Expert buiten het ZGT.* ☐ *Mijn leidinggevende.* ☐ *Patiënt en/of betrokkene.*
8. Hoe ga je nu verder met dit leermoment? **Kies de beschrijving die het beste bij jouw leermoment past.** ☐ *Ik heb geen nieuwe plannen.* ☐ *Het ging niet op de manier zoals ik wilde, dus ik ga het opnieuw proberen.*

- *Ik weet nu precies wat ik de volgende keer in een vergelijkbare situatie ga doen.*
- *Wat ik heb geleerd, blijf ik zo doen.*
- *Wat ik heb geleerd, ga ik verder ontwikkelen.*
- *Wat ik heb geleerd, wil ik in de praktijk gaan toepassen.*
- *Wat ik heb geleerd, wil ik gaan proberen in een andere situatie.*
- *Op basis van dit leermoment, stel ik nieuwe doelen op.*
- *Dit leermoment ga ik delen met anderen.*

9. Je hebt nu één leermoment ingevuld voor vandaag. Wil je nog een extra leermoment invullen?

- *Ja (>13)*
- *Nee (>11)*

Herhaling

Graag zien we je de volgende keer weer terug!

Appendix D

Scaffolding tips (in Dutch)

Tips	Learning goals	Learning opportunities	Learning strategies
Micro-intervention day 1		Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Irma: "In de personeelsruimte zijn altijd wel collega's aanwezig die deelnemen aan discussies en/of ervaringen delen. Probeer hier eens aan deel te nemen of naar te luisteren. Bovendien, zijn er veel verpleegkundigen die er van houden om hun advies of mening te geven. **Vraag ze gerust...".**	Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Lisa: "Een manier waarop je kunt leren is door advies te vragen aan je collega's. **Probeer het vandaag eens toe te passen als je ergens niet uit komt."**
Micro-intervention day 2	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Sofie: "Eén van mijn leerdoelen was om de behandeling van		Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt

	een geïnfecteerde pacemaker onder de knie te krijgen. **Denk eens na over welke behandelingsmethodieken jij beter onder de knie wilt krijgen**."		de tip van Ruby: "**Probeer eens te luisteren naar wat collega's te vertellen hebben of hoe collega's onderling met elkaar communiceren**. Dit is misschien een wat passievere leerstrategie, maar zeker niet minder leerzaam!"
Micro-intervention day 3	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Wilma: "Tegenwoordig moeten we steeds meer administratieve taken voltooien. Ik wilde graag leren hoe ik een document moest inscannen. Denk vandaag eens na over de leerdoelen die jij zou kunnen opstellen betreft administratie of techniek, bijv. de omgang computers?"	Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Pim: "Samenwerking biedt kansen voor leermomenten. Beginnende verpleegkundigen kunnen leren van ervaren verpleegkundigen. Máár ervaren verpleegkundigen leren ook door de rol aan te nemen van een coach, expert of leraar. Denk vandaag eens na over jouw rol	

		als ervaren of beginnende collega...	
Micro-intervention day 4		Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van André: "Gesprekken met patiënten kunnen ook waardevolle leermomenten opleveren. Hoe reageert de patiënt? Wat doe jij? Denk eens na over de leermomenten die jij hieruit kan halen."	Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Wouter: "Ga eens de discussie aan met die ene collega die juist anders dan jij denkt of handelt, dit levert vaak interessante en leerzame gesprekken op."
Micro-intervention day 5	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Mark: "Mijn leerdoel was om meer kennis op te doen over diabetes type 1. Over welk ziektebeeld wil jij meer weten? Of wil je juist iets weten over specifieke medicijnen? Stel deze leerdoelen op."		Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Ruth: "Probeer vandaag eens andere collega's te observeren. Wat zie je? Wat valt je op? Doe jij dat ook zo?"

Micro-intervention day 6	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Feline: "Contact met patiënten en de betrokkenen is belangrijk in ons vak. Ik wilde mijzelf graag ontwikkelen op het gebied van het uiten van empathie. Denk vandaag eens na over de vaardigheden betreft het contact met patiënten die jij zou willen verbeteren."	Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Fabian: "Op de werkvloer zijn er dagelijks problemen en/of confrontaties. Dit zijn waardevolle leermomenten. Waar loop jij wel eens tegen aan? Hoe ga jij deze kans benutten voor een leermoment? Denk hier eens over na... "	
Micro-intervention day 7		Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Allard: "Hoewel je op de werkvloer veel samenwerkt met collega's, heb je af en toe een moment voor jezelf. Bijvoorbeeld tijdens het handen wassen of schoonmaken. Hier ben jij alleen met je eigen gedachten. Benut deze kans	Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Sander: "Evalueer eens je werkervaringen samen of alleen. Beoordeel resultaten, trek conclusies en maak vervolgplannen. Stel jezelf vragen zoals: Wat ging er

		vandaag eens voor bijvoorbeeld reflectie."	goed/slecht? Waarom? Wat kan er beter? Wat gaan we voorzetten?"
Micro-intervention day 8	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Rob: "Om jezelf professioneel te kunnen ontwikkelen, is het erg waardevol om zelfinzicht te hebben. Mijn leerdoel was om mijn sterke en zwakke punten in kaart te brengen. Heb jij inzicht in jouw sterke/zwakke punten? Misschien kun jij dit ook wel als leerdoel opstellen..."		Leerstragieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Floor: "Problemen op de dagelijkse werkvloer komen wij allemaal wel eens tegen, wanneer je deze eens samen of alleen gaat analyseren, kom je tot interessante inzichten, doe je kennis op en ontwikkelen je vaardigheden. Denk vandaag eens na over welke problemen op de werkvloer jij zou kunnen analyseren."
Micro-intervention day 9	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de	Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de	

	tip van Petra: "Een vaardigheid die je ook als leerdoel kunt stellen is het geven van feedback. Zo wilde ik graag mijn collega's en studenten goede feedback kunnen geven, want dit vond ik soms nog best wel lastig. Ik heb nu een manier gevonden waarbij ik mij prettig voel en toch eerlijk kan zijn. "	tip van Frank: "De mondelinge overdracht biedt kansen voor leermomenten. De verpleegkundigen lezen de overdacht voor, stellen vragen, nemen deel aan discussies, geven complimenten voor goede observaties en handelingen. Probeer vandaag eens te kijken welke leermomenten jij hieruit kan halen."	
Micro-intervention day 10		Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Petra: "Het klaarmaken van medicijnen biedt kansen om het gebruik van verschillende medicatie te bediscussiëren of om hulp te vragen aan collega's. Persoonlijke ervaringen kunnen hier worden gedeeld. Denk eens na over	Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Linde: "Vraag eens of je collega je komt observeren (bijvoorbeeld tijdens een patiëntgesprek) en laat hem/haar je feedback geven. Dit kan soms spannend zijn, maar het is een zeer effectieve

		welke leermomenten jij hieruit haalt."	manier op jouw leerdoelen te bereiken."
Micro-intervention day 11	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Maartje: "Het kan soms erg stressvol zijn op de werkvloer. Ik wilde kunnen relativeren op mijn werk en mijzelf niet laten beïnvloeden door stress of door collega's. Hoe ga jij hier mee om? Denk vandaag eens na of jij hierover ook leerdoelen kunt opstellen."		Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Denise: "Raadpleeg het internet, lees boeken of kijk eens in het foldertje in de personeelskamer, wellicht staat daar wat interessants in of vind je antwoorden op jouw leervragen."
Micro-intervention day 12	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Judith: "Ik wilde graag mijn management vaardigheden verder ontwikkelen, bijvoorbeeld 'gestructureerder te werk gaan'. Hoe zijn jouw management vaardigheden? Kun jij	Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Edwin: " Is/komt er bij jouw op de werkvloer nieuw apparatuur? Nieuw apparatuur zijn namelijke triggers voor leergesprekken. Hier kun (on)bewust veel leren. "	

	hierover ook leerdoelen opstellen? Denk er eens over na..."		
Micro-intervention day 13		Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Tom: "Het organiseren van taken leidt tot leerzame discussies waarbij er wordt gekeken naar de complexiteit van patiënten, de competenties van de verpleegkundigen, wie kan/moet van wie iets leren, hoeveel werk kan de verpleegkundige aan, ect. Welke leermomenten kun jij hieruit halen? Denk er eens over na..."	Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Marianne: "Bekijk eens het cursusaanbod, misschien zit er een cursus tussen die goed aansluit bij jouw leerdoel(en)."
Micro-intervention day 14	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Stef: "Ik wilde graag mijn leiderschap vaardigheden ontwikkelen. Hierbij dacht ik aan begeleiding geven, hulp		Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Sanne: "Door te reflecteren

	bieden, bijeenkomsten leiden, beoordelingen van teamleden uitvoeren. Hoe kan jij je leiderschap vaardigheden ontwikkelen? Welke doelen heb jij? Denk hier eens over na..."		op werkervaringen, doe je nieuwe inzichten op. Door middel van reflectievragen leer je hoe en waarom je bepaalde gedrag laat zien. Wat gebeurde er? Welke persoonlijke talenten heb je ingezet? Wat maakte het succesvol? Probeer deze vragen vandaag eens aan jezelf te stellen wanneer je een werkervaring hebt opgedaan."
Micro-intervention day 15	Leerdoelen geven specifiek aan wat je concreet wilt bereiken op het gebied van kennis, inzichten en vaardigheden. Hier volgt de tip van Bas: "Het ziekenhuis is een grote organisatie en ik wilde graag de verschillende rollen binnen het ziekenhuis beter begrijpen. Hoe goed ken jij het ZGT? Weet jij hoe alles reilt en zeilt? Wat zou je nog willen weten? Denk vandaag eens na over deze	Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Soraya: "Het contact met artsen levert ook leerzame momenten op. Verpleegkundigen kunnen bijvoorbeeld betrokken worden in het beoordelen van een wond. Hierbij kunnen ze bijvoorbeeld leren	

	vragen en stel eventueel leerdoelen voor jezelf op."	over de geuren van verschillende bacteriën. Heb jij wel eens contact met een arts of expert? Zo ja, denk eens na over de leermomenten die jij hieruit kan halen..."	

Note. Tips are based on the literature of Kyndt, Vermerie, & Cabus (2016), Bloemendal (2019), and Bjørk Tøien, Sørensen (2013).

Appendix E

Scaffolding micro-intervention in ED-app (in Dutch)

Titel: Tips voor werkdag 6 **Description: tips 1 / mi 1** **Triggering Logic** **Notifications** • **0 minuten:** Er zijn tips beschikbaar! - Bekijk de tips voorafgaand je werkdienst. Wellicht helpen ze je vandaag tijdens het leren op de werkvloer. • **60 minuten:** Herinnering: Er zijn tips beschikbaar! - Bekijk de tips voorafgaand je werkdienst. Wellicht helpen ze je vandaag tijdens het leren op de werkvloer. **Expiry time:** 24 uur.
Section 1
We hebben tips voor jou! Vanaf nu zul je **vóór je werkdienst,** af en toe een tip ontvangen van andere collega's. Zij zullen met je delen aan welke leerdoelen zij hebben gewerkt, welke leeractiviteiten zij hebben uitgevoerd en welke leerkansen zij zijn tegenkomen op het werk. De eerste tips zijn beschikbaar, klik snel op **volgende** om ze te bekijken!
Section 2
Leerkansen zijn momenten en gelegenheden waarin het leren plaats kan vinden. Hier volgt de tip van Irma: **"In de personeelsruimte zijn altijd wel collega's aanwezig die deelnemen aan discussies en ervaringen delen. Probeer hier eens aan deel te nemen of naar te luisteren. Bovendien, zijn er veel verpleegkundigen die er van houden om hun advies of mening te geven. Vraag ze gerust...".**
Ben je van plan iets met deze tip te gaan doen? - Ja - Ja, maar niet perse vandaag. - Weet ik nog niet - Nee

Section 3
Leerstrategieën zijn concrete manieren die je (bewust) kunt inzetten tijdens het leren, zodat je je leerdoel makkelijker en soepeler kunt bereiken. Hier volgt de tip van Lisa: **"Een manier waarop je kunt leren is door advies te vragen aan je collega's. Probeer het eens te doen als je bijvoorbeeld ergens zelf niet uit komt."**
Ben je van plan iets met deze tip te gaan doen? - Ja - Ja, maar niet perse vandaag - Weet ik nog niet - Nee
Section 4
5. Veel succes met je werkdienst vandaag! Graag zien we je terug aan het einde van je werkdienst, zodat je je leermoment weer kunt registreren!

Appendix F

Informed Consent Letter (in Dutch)

Informatiebrief onderzoek

In het aanmeldingsgedeelte van het onderzoek, volgt de vraag of je akkoord gaat met onderstaande informatie. Deze vraag kun je met 'AKKOORD' of 'NIET AKKOORD' beantwoorden.

1. Wat is het doel van het onderzoek?

Het ZGT is op zoek naar de passende ondersteuning voor een continue professionele ontwikkeling door middel van werkplek leren. Het doel van dit onderzoek is meer te weten te komen over hoe het werkplek leren binnen het ZGT ondersteund kan worden. Dit wordt gedaan door jou te vragen je leermomenten gedurende 30 werkdagen bij te houden door het gebruiken van de Ethica Data app (ED-app). Aan de hand van deze ervaringen kan er worden gemeten of de ondersteuning via de ED-app werkt. De resultaten van deze studie worden gedeeld met de ZGT Academie om de ondersteuning voor werkplek leren (nog) beter af te stemmen op de behoefte van verpleegkundigen.

2. Wat wordt er van je verwacht?

De verwachting is dat je de vragen zo eerlijk mogelijk probeert in te vullen. Er zijn geen goede of foute antwoorden. Het gaat erom hoe jij een leermoment beleefd en/of ervaren hebt. Belangrijk is wel dat je alle vragen beantwoordt en dat je het onderzoek tot het einde toe afrondt, zodat we voldoende metingen kunnen doen die bijdragen aan de uitkomst van het onderzoek. We willen je vragen om de vragen in de app individueel te beantwoorden, zonder met je collega's te overleggen. Je beslist zelf of je meedoet aan dit onderzoek, jouw deelname is en blijft geheel vrijwillig. Ook nu jouw afdelingshoofd je heeft gevraagd deel te nemen, ben je vrij in jouw keuze. Als je besluit niet mee te doen, hoef je verder niets te doen. Je hoeft géén reden te verschaffen om niet deel te nemen en je hoeft dan ook geen vragenlijst in te vullen. Als je wel meedoet, mag je ten alle tijden bedenken om alsnog te stoppen. Ook hiervoor hoef je géén reden te geven. Er wordt niemand ingelicht over jouw besluit. Als jij je voortijdig of na uit het onderzoek terugtrekt, dan worden de antwoorden van de vragenlijsten en tiim-app verwijderd en niet meer gebruikt voor het onderzoek.

3. Welke risico's zijn er mogelijk?

Er is geen risico's bij deelname aan dit onderzoek. Deelname aan het onderzoek is geheel veilig. Er wordt GEEN persoonlijke informatie gedeeld en er worden geen antwoorden openbaar gemaakt!

4. Wat zijn mogelijke voor- en nadelen van deelname aan dit onderzoek?

Voordelen:

• Deelname aan dit onderzoek geeft je ondersteuning en een moment van reflectie op jouw leren op de werk, wat vervolgens weer bijdraagt aan jouw professionele ontwikkeling.

• Daarnaast levert je deelname informatie op waarmee het ZGT vooruit kan met het faciliteren van het werkplekleren. Nadelen:

• Het kan spannend zijn en niet meteen vertrouwd voelen om je persoonlijke leerervaringen te delen voor wetenschappelijke doeleinden.

• Ook kost het onderzoek de nodige tijd (30 werkdagen).

5. Wat gebeurt er met je gegevens?

• Standaard inzage (geanonimiseerd): de hoofdonderzoekers (Kim Kattenberg en Linda Gerrits) en de supervisors van het onderzoek (Prof. dr. Maaike Endedijk en Nick Goossen Msc, Universiteit van Twente).

• Bewaartermijn: wij zijn verplicht je onderzoeksgegevens 10 jaar te bewaren (in een afgeschermde map op de server van de Universiteit Twente). Daarvoor geef je toestemming als je meedoet aan dit onderzoek. Als je dat niet wilt, kun je niet meedoen aan dit onderzoek.

• Jouw gegevens zullen gecodeerd opgeslagen en bewaard worden. Dit betekent dat niet direct te herleiden is van wie de gegevens afkomstig zijn. Alleen de onderzoekers hebben toegang tot de sleutel van de codes, en daarmee tot de direct herleidbare gegevens van de vragenlijsten. De andere betrokkenen hebben alleen toegang tot de indirect herleidbare gegevens. Tevens worden gegevens in rapportages/publicaties niet herleidbaar (geanonimiseerd) verwerkt.

6. Zijn er extra kosten/is er een vergoeding wanneer je besluit aan dit onderzoek mee te doen?

Je krijgt geen vergoeding voor jouw medewerking aan dit onderzoek en er zijn geen extra kosten aan verbonden.

7. Heeft de ethische toetsingscommissie van medisch onderwijsonderzoek dit onderzoek goedgekeurd?

Om te toetsen of het onderzoek niet schadelijk is voor deelnemers wordt voorafgaand aan ieder onderzoek goedkeuring gevraagd bij de Commissie Ethiek (CE) van de faculteit Behavioural, Management and Social Sciences (BMS) van de Universiteit Twente (UT). Ook voor dit onderzoek binnen het ZGT is goedkeuring gevraagd en verleend voor de uitvoering via de ethische commissie van de UT.

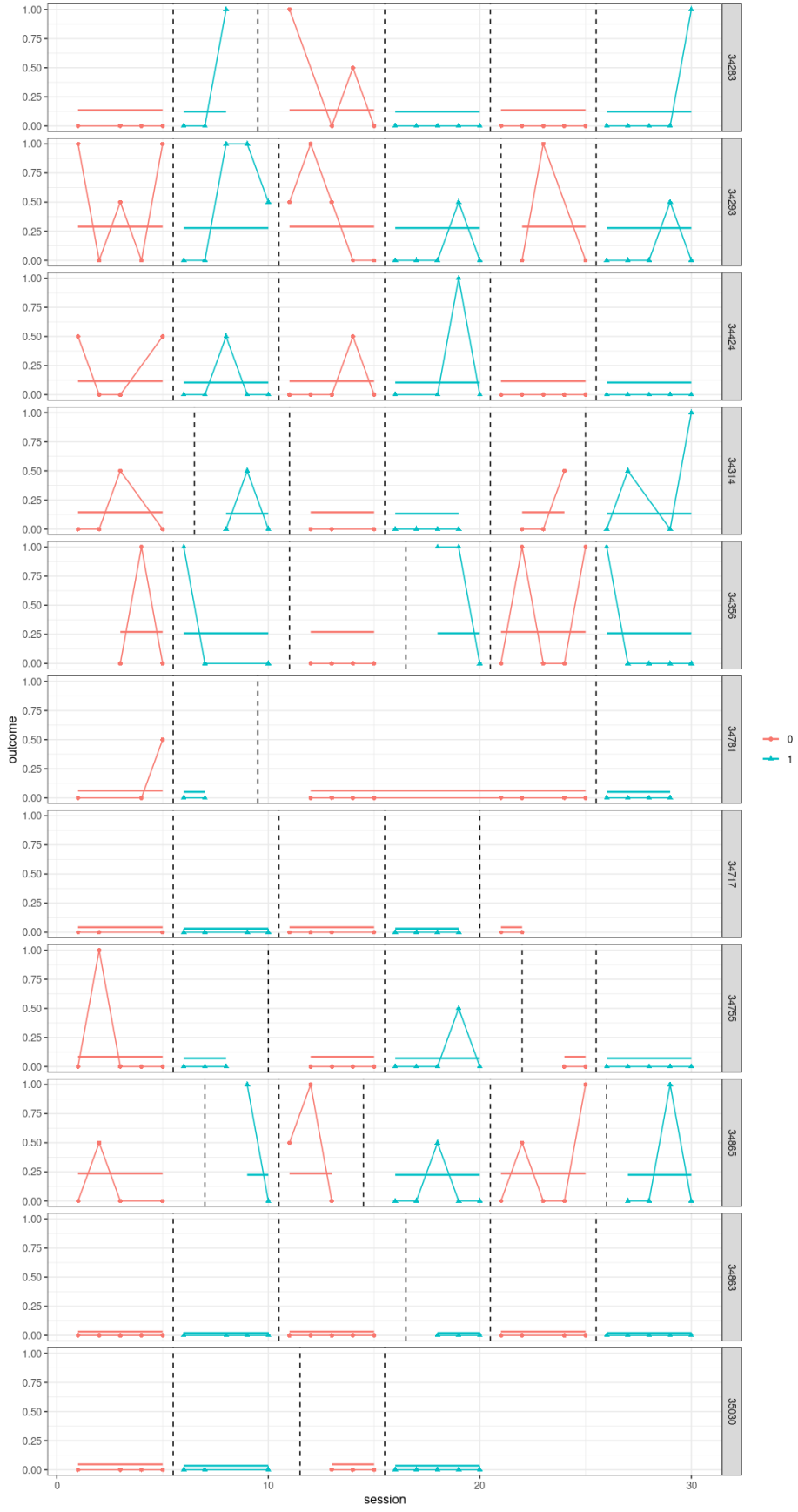
8. Wil je verder nog iets weten?

Voor vragen en onduidelijkheden kun je contact opnemen met Kim Kattenberg

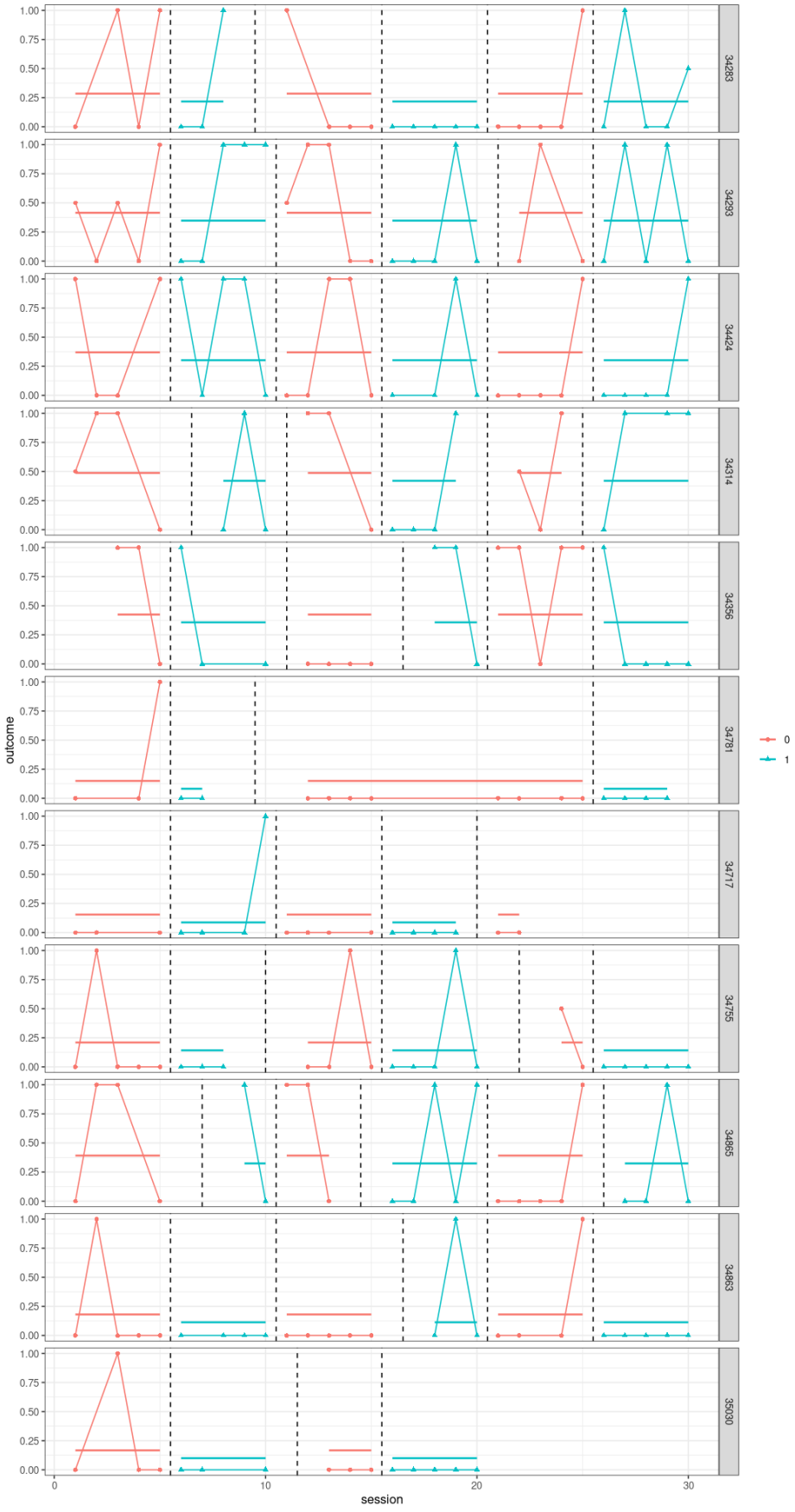
(k.kattenberg@zgt.nl) en/of met Linda Gerrits (l.gerrits@zgt.nl). Mocht je liever iemand spreken van de ZGT Academie, dan kun je contact opnemen met Dianne Reinders (d.reinders@zgt.nl) of Jolan van Otten (j.vanotten@zgt.nl).

Appendix G

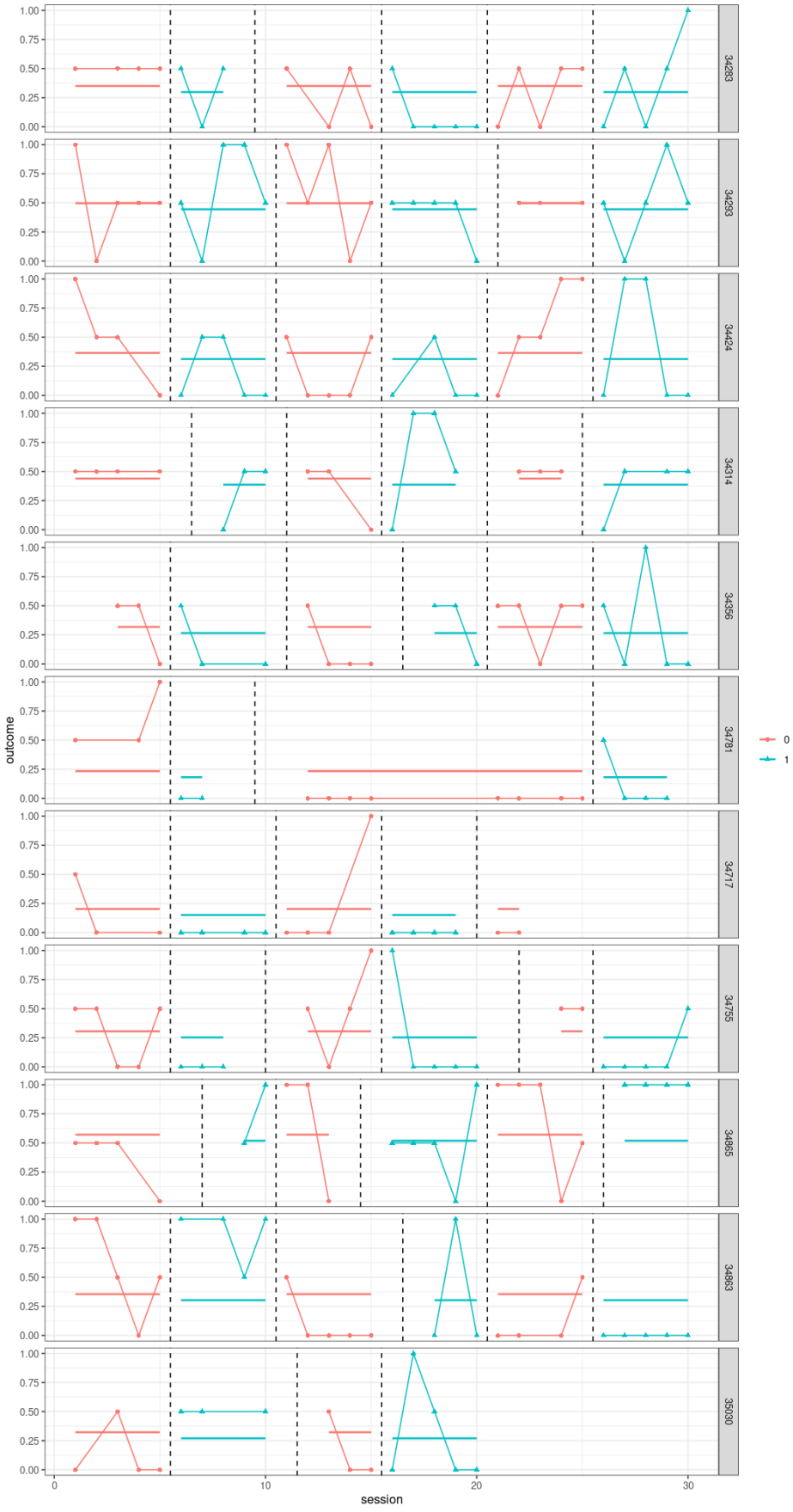
Visual analysis learning intentions



Visual analysis strategy control



Visual analysis future planning



Visual analysis total SRL behaviour