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*Determinants and Promotion of Self-Regulated Learning  
in Educational Contexts:  
The Potential of Web-based and Attendance-based Courses*

presented by  
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# List of Papers

This dissertation is based on the following papers, which are attached in the Appendices.

## **1<sup>st</sup> Paper I (Study I)**

van der Beek, S., Bellhäuser, H., Karlen, Y., & Hertel, S. (2019). New ways in fostering self-regulated learning at university: How effective are web-based courses when compared to regular attendance-based courses? *Zeitschrift für Pädagogische Psychologie*, 34(2), 117–129. <https://doi.org/10.1024/1010-0652/a000254>

## **2<sup>nd</sup> Paper II (Study II)**

van der Beek, S., Bellhäuser, H., Karlen, Y., & Hertel, S. (submitted). Förderung des Selbstregulierten Lernens an der Universität: Bedeutung individueller Eigenschaften von Studierenden für den Erfolg eines SRL-Trainings [Promotion of self-regulated learning at university: Importance of students' individual characteristics for success of SRL-training]. *Zeitschrift für Pädagogische Psychologie*.

## **3<sup>rd</sup> Paper (Study III)**

van der Beek, S., Bellhäuser, H., & Hertel, S. (2020). Do minimal interventions increase the participation rate in voluntary online training at high school? *Psychology Learning and Teaching*, 0(0), 1–23. <https://doi.org/10.1177/1475725720965002>

# Abstract

Self-regulated learning is an important skill to successfully study at school and university, but it is also of high importance for life-long learning (Commission of the European Community, 2000; Dignath & Büttner, 2008). The aim of this dissertation is to expand the knowledge about the trainability of self-regulated learning. To this end, the effectiveness of a web-based and an attendance-based self-regulated learning-training was compared, the role of individual characteristics as predictors of the effectiveness of self-regulated learning-training was examined, and the possibility of promoting the participation rate in voluntary self-regulated learning-training with minimal interventions was explored.

Study I showed that students of an attendance-based and web-based course with the aim of fostering self-regulated learning were very satisfied with both course formats, self-regulated learning was considered useful for studying, and the subjective and objective increases in learning were high. Furthermore, the findings of Study I suggest that self-regulated learning can be fostered in the web-based course as effectively as in the attendance-based course as there were no group differences. Moreover, the findings suggest that it is of relevance to differentiate between two training phases that promote different processes: A theory phase that fosters declarative metacognitive knowledge on self-regulated learning and an implementation phase where strategies of self-regulated learning are practiced.

The question of whether the effectiveness of a self-regulated learning-training intervention differs between participants depending on their individual characteristics was investigated in Study II. Results revealed that individual differences in personality – but not motivational factors – were related to the gain of self-regulated learning through respective training in a university context. More precisely, conscientiousness, agreeableness, and openness to experience significantly predicted increases in self-regulated learning, however, with varying importance for the two different phases of the training (theory versus implementation) and the training format (attendance-based versus web-based). Conscientiousness was related to both theory and implementation phases as well as both formats (attendance-based and web-based), agreeableness was only related to the theory phase and to the attendance-based format, and openness was as well only related to the attendance-based format but only in the implementation phase.

Finally, while Study I and II were conducted at university, Study III focused on high-school students and addressed the question of whether the participation rate in voluntary web-based self-regulated learning-training can be promoted by minimal interventions on utility value and implementation intention. Unexpectedly, the minimal interventions had no effect on the participation rate, suggesting that these interventions are not effective per se, but rather context dependent. Apart from that, students' expectation of success and average grade score proved to be positive predictors of training participation, which was also shown by latent profile-analyses. This suggests that initial motivation has an impact on voluntary training participation.

In conclusion, the findings of the studies indicate that self-regulated learning can be fostered in web-based and attendance-based formats, that training success of self-regulated learning is related to personality factors, and that motivation plays a role concerning training

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participation. This dissertation significantly contributes to previous research by showing that both a theory phase and an implementation phase are crucial when employing a training program, and that the extent of training success seems to be affected by personality traits. Moreover, the findings give reason to evaluate critically in which contexts minimal interventions are successful. This dissertation has a number of implications for theory and for future research and it can also provide practical advice for educational contexts.



# 1 Introduction

Self-regulation is a basic prerequisite for setting and achieving goals not only in the educational context, but in all areas of life, such as professional, school and university life, in leisure time activities, and in other learning areas throughout our life (e.g., Commission of the European Community, 2000; Perels et al., 2020; OECD, 2019; Sitzmann & Ely, 2011). In our complex society with the enormous increase in available information and due to globalization and digitalization that lead to rapid changes in our everyday work and school life, individuals have to be able to acquire new knowledge and abilities on their own to master the coming challenges (e.g., Rovers et al., 2019). When it comes to an educational context, such as school or university, this ability is described as self-regulated learning (SRL; Perels et al., 2020). According to Zimmerman and Schunk (2011) “[s]elf-regulated learning and performance refer to the process whereby learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals” (p. 1). SRL is an essential condition for studying successfully at school and university (e.g., Bellhäuser et al., 2016; Dignath & Büttner, 2008; Kitsantas et al., 2008; Schunk & Ertmer, 2000). Accordingly, research shows that SRL can positively influence students’ academic achievements (e.g., Kitsantas, 2002; Nandagopal & Ericsson, 2012; Valle et al., 2008; Zhu et al., 2016).

SRL is a major key to success – this holds particularly true in situations with scopes for decision-making and less external regulation. This is typically the case a) in preparation for graduation from high school, where students have to study and revise the learning material of their last semesters on their own, b) at university, where students mostly have to learn on their own and decide on their own how to structure their studies, or c) with a special type of learning format, namely, web-based learning where students can decide on their own where and when they want to study. Nevertheless, students often show deficits in their knowledge about SRL and their ability to study in a self-regulated way (Peeverly et al., 2003; Randi & Corno, 2000; Stark & Mandl, 2005), revealing the need of supporting students to become better self-regulated learners.

In the educational context, numerous intervention studies aiming at promoting SRL indicate that a training course can improve SRL-skills (e.g., Bellhäuser, et al., 2016; Dörrenbächer & Perels, 2016a; Schmitz & Wiese, 2006; see also meta-analyses by Dignath & Büttner, 2008; Dignath et al., 2008). However, some fundamental issues have remained unanswered so far. In a world where web-based training is more and more required, it would be desirable to know whether this format is as effective as an attendance-based one. Yet, there is only little information available about the comparison of the effectiveness of interventions conducted in different formats, namely attendance-based and web-based learning. And now, imagine you implement an SRL-training course which has proven effective for one group of learners, but is not of success for your group of interest. This leads to the demand of a better understanding of learners’ characteristics that might foster or hinder the effect of an SRL-intervention in order to advise not only researchers, but also teachers and learners themselves on their effects in interventions. Moreover, imagine that you provide an SRL-training course,

but no one attends due to a lack of motivation. Thus, it seems reasonable to gain more information about ways to motivate students to engage in SRL-training. Therefore, to contribute to SRL-research, this dissertation takes a closer look at these research desiderates.

While the first paper of this dissertation addresses whether attendance-based and web-based courses fostering SRL at university are equally effective, the second paper analyzes the influences of personal characteristics on the success of an SRL-course. The third paper shifts to school context and addresses the question if the participation rate in voluntary SRL-training can be increased.

This dissertation starts with a theoretical overview of SRL-models (Chapter 2), highlights how attendance-based and web-based training can support SRL (Chapter 3), and addresses factors influencing SRL-increase through training (i.e., personality, motivation; Chapter 4). Then, it presents an approach, namely minimal interventions, to foster the participation in voluntary SRL-training (Chapter 5). The aims, research questions, methodological approaches, and the study design of this dissertation are summarized in Chapter 6. After a description of the empirical papers that form the heart of this dissertation (see also Appendices A, B, and C) in Chapter 7, this thesis ends with a general discussion on the key findings in regard to their implications for theory and practice, as well as for future directions (Chapter 8).

It is to mention that during the last year of this dissertation, the coronavirus pandemic came up. Due to this situation with its drastic and sudden changes in educational and occupational settings, SRL has gained additional importance.

## 2 Theoretical Considerations about Self-Regulated Learning

Self-regulated learning, often synonymously described as self-organized, self-directed or autonomous learning is described in several models (e.g., Boekaerts, 1999; Schmitz & Wiese, 2006; Zimmerman, 2000). A common feature of these models is that they describe the learners as having an active role in planning, controlling, and monitoring their learning process independently. Further, they all postulate that the learners' motivation, cognition, and metacognition are crucial for successful learning. The definition of Zimmerman and Schunk (2011) that „[s]elf-regulated learning and performance refers to the processes whereby learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals” (p. 1) underlines these attributes.

SRL-models can be categorized into component- and process-models (e.g., Perels et al. 2020; Wirth & Leutner, 2008). Whereas component-models focus more on the competencies and learners' characteristics (e.g., Boekaerts, 1999; Boekaerts & Niemivirta; 2000), process-models focus on the different phases or processes of SRL (e.g., Pintrich, 2004; Schmitz & Wiese, 2006; Winne & Hadwin, 1998; Zimmerman, 2000). Component-models consider the different levels of SRL and do not focus on the sequence of the learning process, whereas process models describe the ideal learning process by specifying the needed competences for each phase.

An example of a *component-model* is the three-layer model of Boekarts (1999) which, for example, served as the theoretical basis for SRL assessment within PISA (Otto et al., 2015). Boekarts (1999) describes SRL as an interaction between cognitive and motivational processes, related to three different regulation areas, which are represented in her model as three concentric layers or circles. In the innermost circle, where the regulation of processing modes takes place, the cognitive strategies are chosen. The middle layer focuses on the use of metacognitive knowledge and skills for the regulation of the learning process. The outer circle contains the regulation of the self with the choice of goals and resources.

One of the most influential *process-models* is the social cognitive model by Zimmerman (2000), which was based in the cognitive framework by Bandura (1986). Zimmerman (2000) describes self-regulation as a cyclical feedback loop of three phases: forethought, performance or volitional control, and self-reflection. This model can be applied to different contexts, and when it comes to learning, one can speak of SRL. The cyclical nature of the model postulates that the outcome of each phase influences processes in the subsequent phases. This suggests that self-regulation is not stable, but can be proactively and reactively adapted (Zimmerman, 2000). Zimmerman's model was used as a basis by other researchers to discuss the conceptual understanding of SRL, which led to a further extension of the original model. For example, Pintrich's (2004) SRL-model consists of phases similar to the model by Zimmerman (forethought, performance/volitional control, reflection) but includes an additional phase “monitoring”, located between forethought and control. Pintrich (2004) also adds to every phase

four areas for regulation, namely cognition, motivation, behavior, and learning context, as learners can regulate these areas.

Another widely applied adaptation of Zimmerman's (2000) SRL-model is the one by Schmitz and Wiese (2006). But unlike Zimmerman's conceptualization, Schmitz and Wiese (2006) specify the self-regulation process for a concrete situation, namely learning. In line with Zimmerman (2000), Schmitz and Wiese (2006) describe SRL as a process that comprises a cyclical sequence of three phases: the preaction, action, and postaction phases (see Figure 1). This process definition underlines the cyclical nature of self-regulation. In this model all variables in one phase are also both affected by previous learning phases and predictive of the subsequent learning process. Therefore, the postaction phase of one learning cycle influences the preaction phase of the next cycle. Its phase structure can serve as the basis of an SRL-training structure, which can be divided with regard to the phases. Several researchers used the model for the evaluation of such training programs in different ways: It was implemented for traditional pre-/post-training comparisons as well as for the evaluation of temporally varying behavioral aspects to capture more fine-grained temporal fluctuations (e.g., Bellhäuser et al..

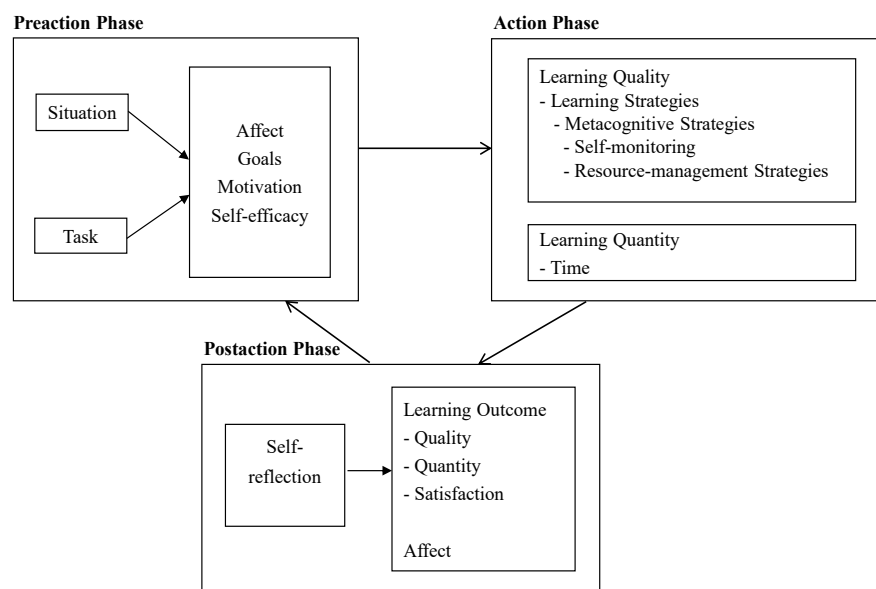


Figure 1. Process Model of Self-Regulated Learning by Schmitz and Wiese (2006).

The *preaction phase* is characterized by preparing to learn. Based on the situational demands and the given task, learners set goals that they try to achieve during the learning process. Goal setting facilitates the evaluation of the learning outcome in the future process and has various positive effects. It gives direction to behavior and motivation to persist in a certain task and it enhances self-regulation by affecting motivation, learning and self-efficacy (Kozlowski & Bell, 2006), it supports individuals by focusing on a task, selecting and applying

relevant strategies, and monitoring their progress (Schunk, 2001). Specific and demanding goals affect the performance outcome in the best way (Locke & Latham, 1990). Furthermore, motivation is a key concept of self-regulated learning, not only in the preaction phase but also during the whole learning process (Perels et al., 2007; Schmitz & Wiese, 2006). The model by Schmitz and Wiese (2006) focuses on two types of motivation: intrinsic and extrinsic (Ryan & Deci, 2000); intrinsic motivation “refers to doing something because it is inherently interesting or enjoyable” (p. 55), while extrinsic motivation “refers to doing something because it leads to a separable outcome” (p. 55). Both types of motivation result in a more valuable learning outcome. However, in the long term, intrinsic motivation has better results on the learning process because it leads to high-quality learning (Ryan & Deci, 2000). Self-efficacy is another key-concept that can have positive effects on effort, persistence and achievement (Schmitz & Wiese, 2006; Schunk & Ertmer, 2000). In the model by Schmitz and Wiese (2006), it is regarded as a state concept that can change over time and is affected by the learning process and results (Schmitz & Wiese, 2006). Despite cognitive and motivational aspects, affects are also important during the whole learning process. For example, anxiety can be an emotional reaction to difficult tasks, whereas hope of success can be a reaction to interesting and challenging tasks (Pekrun et al., 2002). Based on these components of the preaction phase, the learners choose strategies and plan actions in order to achieve their goals.

In the *action phase*, where the actual learning takes place, learners implement their chosen strategies and control their actions. Successful learning is characterized by the appropriate implementation of task-specific and general strategies. Three types of learning strategies can be distinguished: cognitive, metacognitive, and resource-management strategies (Pintrich et al., 1993; Schmitz & Wiese, 2006; Wild & Schiefele, 1994). First, cognitive strategies include for example, structuring, summarizing, elaborating and repeating of learning contents. Second, metacognitive strategies focus on planning, regulation and monitoring. Self-monitoring, understood as the observation of one’s actions (Zimmerman, 2000), is important during the action phase because it is used to check the actual performance and can influence the self-regulation (Schmitz & Wiese, 2006). Third, resource-management strategies include internal resources, such as effort, time-management, and attention-management, and external resources, which comprise social support in terms of learning groups and experts or the use of literature. Apart from that, volitional strategies are also crucial for the learning process because they serve to maintain and optimize the execution of actions (Kuhl & Fuhrmann, 1998; Schmitz & Wiese, 2006). These strategies include attention and motivation control, strategies against procrastination and strategies to handle distractions. Distractions that occur during the learning phases (e.g., phone calls, not-task related thoughts) can lead to procrastination, which implies postponing the given task, a frequent problem in daily learning behavior (e.g., Tice & Baumeister, 1997). Apart from the described variables, the quantity of learning is related to the time a learner invests during this phase. The invested time can often be seen as a predictor of desirable learning outcomes but it does not result in good learning outcomes per se (Schmitz & Wiese, 2006).

The central elements in the *postaction phase* are self-reflection and evaluation of the learning process. The learners compare the actual learning outcome with their previously set

goals. The evaluation of the learning outcome comprises the quality and the quantity of the outcome and satisfaction with the learning result. Based on these evaluations and reflections of the learning process, consequences for further learning can be derived: the strategies or the goals may be adapted for the following learning cycle. This can be further influenced by one's attribution of the learning outcomes and the frame of reference that someone uses (Schmitz & Schmidt, 2007). The attributional style is the way in which people explain the cause of events (Abramson et al., 1991), and it has influence on emotions, motivation and performance (Peterson & Barret, 1987; Rheinberg & Fries, 2010). There are three attributional dimensions: stability (stable versus variable), locus (internal versus external), and globality (global versus specific; Peterson, 1991). An optimistic attributional style can be described as the tendency to attribute negative events to external, variable, and specific causes (Peterson & Barret, 1987). Thus, it is desirable to explain failure by, for example, a lack of effort or the implementation of the wrong learning strategies (e.g., Perels et al., 2005). The attributional style is also closely linked to the frame of reference, defined as a standard against which a result is compared (Rheinberg & Fries, 2010). Here, three frames can be distinguished: individual, criterion-oriented, and social frame of reference. The individual frame of reference, which is seen as most motivating, includes the comparison of one's current performance with one's previous (Lüdtke & Köller, 2002; Rheinberg & Fries, 2010). The criterion oriented frame of reference includes the comparison of one's performance with an objective measure, and the social frame of reference refers to the comparison of one's own performance with the performance of other persons (e.g., other students).

To sum up, the process-model by Schmitz and Wiese (2006) provides a framework that includes a variety of cognitive, motivational, behavioral, and affective variables in each learning phase, which are important for successful learning. It has therefore been used for the development of SRL-training and, moreover, for the evaluation of respective training sessions (e.g., Bellhäuser et al., 2016; Perels et al., 2007; Schmitz & Wiese, 2006; Werth et al., 2012). Therefore, it was also chosen to be the theoretical core of this dissertation guiding planning, implementation and evaluation of the SRL-training in Study I and II.

## 3 Promotion of Self-Regulated Learning

The previously mentioned literature demonstrates the high relevance of SRL for study success but also that SRL-abilities are not always thoroughly developed (e.g., Dignath & Büttner, 2008; Peverly et al., 2003). However, research suggests that SRL can be fostered with interventions. There is a variety of SRL-interventions that differ, for example, with regard to the receiver, the trainer, the specific context, the duration, the format, and/or the content. For both designing and evaluating SRL-training, it is necessary to have a solid theoretical background to define and inform about the relevant criteria of success (e.g., Dignath & Büttner, 2008; Perels et al., 2020; Wirth & Leutner, 2008).

In the following chapter, central literature about SRL-interventions and their criteria of success will be presented. In particular, school and university contexts are addressed, because they are mainly relevant for SRL-interventions since students often show deficits in their knowledge about SRL and their ability to learn in a self-regulated way (e.g., Dignath & Büttner, 2008; Peverly et al., 2003; Randi & Corno, 2000; Stark & Mandl, 2005). Especially students in their last year at school and at university are confronted with an autonomy which can lead to learning problems.

### 3.1 SRL-Interventions in a School-Context

It has been shown that students in various age groups can be successfully trained and that SRL-skills are associated with improved academic achievement (e.g., Dignath & Büttner, 2008; Hattie et al., 1996; Kitsantas, 2002; Zhu et al., 2016). It has been emphasized that it is advantageous to already promote SRL in school students because of its positive effects on academic performance, learning motivation and because of its importance for life-long learning (Dignath & Büttner, 2008). This dissertation focuses on the secondary school-level because it is hypothesized that students in the upper classes face more autonomy, for example they can choose their advanced courses by themselves and have to prepare for graduation on their own. Therefore, they may have a special need in being supported in their SRL. The meta-analysis by Dignath and Büttner (2008) gives an overview of characteristics that make SRL-interventions most effective in primary and secondary school contexts. With regard to training implemented at secondary level, the authors found that in particular training conducted by skilled trainers is more effective than training carried out by teachers. Training including group-work has a positive impact, and training including different types of strategies like cognitive, metacognitive and motivational strategies is more effective than training including only one type of strategy. In addition, training that also provides students with metacognitive knowledge about strategies and that describes the benefits of the applied strategies is most effective in fostering SRL (e.g., Leopold & Leutner, 2015). The duration of the training positively relates to its effectiveness. Furthermore, training can be distinguished according to whether the learning strategies are trained directly or indirectly (Otto et al., 2015). In contrast to direct interventions, in indirect interventions, the students themselves are not trained. In indirect

interventions, teachers or parents are trained in order to either be able to teach the learning strategies, be able to design learning environments in a way that students are encouraged to use learning strategies, or to act as a role model for the actual person of interest. Research shows that mostly direct training or the combination of both direct and indirect training is more effective than only indirect ones (e.g., Friedrich & Mandl, 1992; Otto et al., 2009).

There are numerous interventions that were conducted at school and required physical attendance (e.g., Dignath & Büttner, 2008; Dignath et al., 2008; Ferreira & Simão, 2012; Perels et al., 2009; Perels et al., 2005; Randi & Corno, 2000; Schuster et al., 2018; Werth et al., 2012; Zimmerman, 1990). These studies empirically show that SRL of school students can be effectively promoted with attendance-based interventions.

### 3.2 SRL-Interventions in a University-Context

Programs to foster learning strategies are also implemented in a university context. As university students face a more autonomous environment than in school, but often show a deficit in their knowledge and application of SRL, it is crucial to support students with respective training (e.g., Bembenutty, 2011; Kitsantas et al., 2008). Such training can be categorized into five categories: 1. learning-to-learn courses with a focus on supporting students to become self-regulated learners, 2. supplemental instruction (learning strategies for a specific course), 3. programs for underprepared students (e.g., for university preparation), reading and writing courses, and 4. learning assistance centers that provide a variety of services (Simpson et al., 1997). According to Weinstein et al. (2000), learning-to-learn courses have the greatest potential to positively influence academic performance and strategy transfer because students develop a repertoire of declarative, procedural, and conditional knowledge with self-regulation strategies that they can transfer to other learning situations. Moreover, content-independent learning-to-learn courses can reach a variety of students and therefore show an economic benefit. The effectiveness of promoting SRL in university students has been shown in several studies and meta-analyses (e.g., Benz, 2010; Dörrenbächer & Perels, 2016a; Hattie et al., 1996; Perels et al., 2020; Zhu et al., 2016). For example, Schmitz and Wiese (2006) showed the effectiveness of SRL-training with civil engineering students. SRL-strategies were taught by two assistant researchers in four weekly sessions of two hours each and the experimental group also filled out standardized learning diaries for five weeks. Results of the pre-/posttest comparison showed that the intervention successfully increased SRL-strategies in the experimental group, which resulted in an increase of self-efficacy, an increase of all metacognitive and resource-oriented strategies (except for monitoring and time-management), and an increase of volitional strategies (except for self-motivation). Furthermore, data were analyzed by time-series analyses to study the continuous development of variables and to test whether a certain component of the training has an effect on its corresponding dependent variable in the diary. Interrupted time-series analyses indicated that not all sessions had an effect on the trained variables. Trend analyses for state variables showed a decrease in negative affect before and after studying, and an increase in intrinsic and extrinsic motivation, self-efficacy, quality of learning, satisfaction with studying, and positive affect after studying. Total study



time, effective study time and quantity of learning, however, showed no increase. Thus, there was a deeper understanding of the learning material, even if students did not invest more time for studying. The authors conclude that both evaluation methods showed either similar results or discrepancies in the way that pre-/posttest comparisons showed no change whereas trend analyses indicated a change. This suggests that the latter measure is more sensitive to change. Dörrenbächer and Perels (2016a) also successfully promoted university students SRL-skills within the framework of a content-independent SRL-training. Students who participated in the training and also filled out a learning diary for 49 days in order to foster self-monitoring of learning processes showed the best improvement, whereas effects on a working efficiency test as an objective measure were not found. In this study, data were analyzed with control group comparisons and time-series analyses as in Schmitz and Wiese's (2006) study. Hofer and Yu (2003) conducted a learning-to-learn course teaching SRL, and students showed increases in their mastery orientation to learning, their self-efficacy for learning and their cognitive strategy use as well as a decline in test anxiety. The assumption that SRL-training effects can be long lasting and are associated with academic achievement is indicated by the study of Bail et al. (2008), who showed that - four semesters after the intervention - the trained students had higher grades.

Besides the described studies, which apply holistic training, there are also several studies focusing on specific SRL strategies like reflection, attribution or time-management (e.g., Häfner et al., 2015; Masui & De Corte, 2005). Although these studies proved to be effective, the aim of this dissertation is to implement training covering all SRL-phases with their belonging SRL-strategies because all strategies are important for successful learning and moreover, such comprehensive SRL-interventions should lead to optimal performance and motivation and facilitate the evaluation of students' learning strategies (Cleary et al., 2008). Apart from that, the above described studies emphasize that content-independent SRL-interventions have the advantage of fostering cross-curricular competence supporting learning in any kind of subject and of being advantageous for various groups of students. Furthermore, findings suggest that training programs that include both instructional conditions for imparting knowledge, and practice conditions for applying the content that was learned are most effective in supporting students to improve their SRL-skills (e.g., Masui & De Corte, 2005; Reeves & Stich, 2011).

Taken together, research shows that SRL can effectively be promoted in attendance-based training in the university context. Such attendance-based training, however, can only reach a limited number of learners and for example, time and place where the training is conducted are set. Thus, against the background of globalization and digitalization, the demand for web-based solutions is growing. Therefore, to overcome limitations of attendance-based courses and to exploit the potential of web-based learning formats, web-based SRL-training increasingly comes into the focus of both practitioners and researchers.

#### 3.3 A New Form of SRL-Interventions: Web-Based Training

As web-based training is common practice in a work-related context, it is important that students gain appropriate (technological) skills already in higher education, leading to the demand of offering web-based courses at university (e.g., Laurillard, 2008). In the context of digitalization, web-based courses have also been developed and implemented at university as a new form of education and such formats are becoming increasingly important (e.g., Benz, 2010; Matuga, 2009; Waheed et al., 2016). Web-based learning programs are transmitted through a digital device. The device delivering the learning material can be any electronic device like a computer (desktop or laptop), tablet, smartphone, game console or virtual reality displays (Mayer, 2017). The fact that web-based training courses are already established in the work-related context is not the only reason why to embed web-based learning in the educational context. Web-based courses offer many advantages that make them attractive. For example, learners do not have to be physically present and they can choose their preferred study times. This format's flexibility also allows for higher levels of autonomy and self-determination (e.g., Kop, 2011; Kop & Fournier, 2010; Sehra et al., 2014; Shachar & Neumann, 2003), which is both an advantage and a challenge for students (e.g., Huber & Helm, 2020). Apart from that, nowadays, web-based learning is gaining in importance in Germany, which is emphasized by the *DigitalPakt* of the German government, and just recently mostly all over the world, this format is increasing in significance as the ongoing coronavirus pandemic demands web-based solutions in the educational context (e.g., BMBF, 2020; Huber & Helm, 2020; Iglhaut, 2020). In this regard, for example, Manfred Prenzel emphasizes that the pandemic can also have a positive side, when the crisis leads to an increase of students' self-learning competences (Möller, 2020). This suggests that web-based learning formats and, moreover, web-based courses that foster SRL are more in demand than ever.

Web-based courses can be different in terms of the number of participants and whether they are presented in a synchronous (the teacher holds the lesson online at a specific time) or in an asynchronous way (teacher and students are not together at the same time, thus teaching does not take place in real time). Massive open online courses (MOOCs) are an example of an online course that reaches a large number of enrollments. For almost ten years, a growing number of universities has offered MOOCs, but dropout rates have been extremely high (Margaryan et al., 2015; Onah et al., 2014). There are many explanations under discussion: a lack of instructional quality, anonymity or the lack of a community spirit, a lack of competences for web-based courses (media literacy) to be able to engage in meaningful interaction or a lack in motivation, in confidence or a lack of organization and structuring of learning activities (e.g., Kop, 2011; Kop & Fournier, 2010; Margaryan et al., 2015; Overbaugh & Nickel, 2011; Sehra et al., 2014).

Courses fostering SRL in the university context have not only been effectively implemented as attendance-based courses, but also as web-based formats (e.g., Bellhäuser et al., 2016; Cranwell et al., 2014; Feng & Chen, 2014; Hu, 2007; Kauffman et al., 2008; Núñez et al., 2011; Tsai et al., 2011). For example, Núñez et al. (2011) showed that students who participated in their SRL online training, which consisted of 13 weekly sessions, substantially improved their declarative knowledge about SRL, their use of learning strategies, their deep

learning approaches and academic achievement. Another study (Bellhäuser et al., 2016) developed a web-based SRL-course that was based on the SRL-model by Schmitz and Wiese (2006) and consisted of three weekly lessons. The researchers implemented questionnaires and learning diaries to assess gain in SRL due to the program. Results showed that the training had significant effects on SRL-knowledge, SRL-behavior and self-efficacy. Time-series analyses revealed a positive linear trend in SRL and showed intervention effects for each of the three lessons but not for the control group.

Based on the presented research, it can be concluded that SRL can be effectively fostered in university students via attendance- and web-based courses. This leads to the question, whether both formats are equally effective. The few studies investigating this question revealed ambiguous findings (see Bernard et al. 2004). It has been shown that students are more satisfied with attendance-based courses (e.g., Allen et al., 2002), but it has also been shown that web-based courses lead to better academic performance (e.g., Shachar & Neumann, 2003). In other studies, however, no differences were found, for example, in terms of satisfaction or perceived learning (Overbaugh & Nickel, 2011; Sitzmann et al., 2006). The study of Sitzmann et al. (2006) speaks in favor of web-based courses when it comes to declarative knowledge, but attendance-based courses when it comes to fostering procedural knowledge, and when it comes to group work, students face more challenges in web-based courses (Smith et al., 2011). However, the quality of the aforementioned studies may be criticized as they often lacked a detailed description of the methodology and the formats' contents (e.g., Bernard et al., 2004; Tallent-Runnels et al., 2006). Moreover, many studies in this field have been conducted 10-15 years ago and might not represent the current state, given that the distribution of digital media and its use for work, study and school is rapidly changing these days (e.g., Kop & Fournier, 2010). Web-based learning formats are becoming more and more important and also more desirable. Therefore, it is essential to analyze the comparison of these formats under the current, changed conditions.

In summary, previous research on promoting SRL clearly shows the benefit of different SRL-interventions in the educational context. Given the growing number, demand and feasibility of web-based courses on the one hand and the lack of respective comparative studies on the other, the question arises whether or to what extent web-based-learning formats differ from regular attendance-based training in the context of SRL. Therefore, one central aim of this dissertation is to close this research gap by implementing a web-based and a parallelized attendance-based course fostering SRL among university students in order to compare their effectiveness.

## 4 One Fits All? Individual Differences in SRL and Differential Effects of SRL-Training

Usually, a course is offered with the expectation that all recipients should benefit in the same way. However, several circumstances might influence the success of an intervention and thus the students' learning success (e.g., Schober et al., 2015). Individual characteristics can differentially affect learning situations and thus change into different learning experiences so that some people may benefit more than others from the same intervention. The reason may lie inside or outside the person as, for example, learners may be more or less attracted by different situational and contextual cues. Some people may be more or less motivated to participate in a web-based course than in an attendance-based one. Thus, learners may not only differ in their expectations about the course, but also in regard to their motivation, personality, achievement level or their (initial) competence taught in the training. Knowledge of both, facilitating and inhibiting factors of individual training success would offer the valuable possibility of adapting interventions to learners' needs.

In the university context, it is distinguished between three major categories that influence learning success: students' individual characteristics (e.g., motivation, knowledge, competencies), lesson characteristics (e.g., teaching strategies), and environmental features (e.g., family, media; see Eckert et al., 2015). King and Boyatt (2014) identified several factors influencing adoption of e-learning at university: institutional infrastructure (examples of successful implementation of e-learning: exploration of tools and skill-development to use them, creation, monitoring, and updating of resources), staff attitudes and skills in using technology (examples: technological and pedagogical support of teachers), and perceived student expectations (examples: availability of digital resources anytime, virtual contact with teachers and students). This study shows the complexity of the interplay of the different factors that influence (web-based) training success and the necessity of a differentiated, individual perspective.

This dissertation focuses on factors belonging to the individual learner as they are of special interest from a psychological perspective. Eckert et al. (2015) emphasize the meaning of individual characteristics by referring to the fact that 50 percent of the interindividual differences in academic performance are explained by differences in students' cognitive and motivational characteristics. Thus, adaptive and individual testing and training, that considers learners' individual characteristics, is discussed as a valuable approach in the field of educational psychology (e.g., Deing; 2019; Eckert et al., 2015; Fischer et al., 2020; Gold, 2018). It should be the aim to support learners with different competences and characteristics to maximize their learning success. To achieve this ideal, a proper diagnosis of the learners' characteristics is needed.

In the context of SRL, investigating and understanding individual differences and their contribution to differential training effects has several advantages (e.g., Lapka et al., 2011). First, this complements the knowledge of which individual characteristics are relevant in the context of SRL. Second, identification and differentiation of global and differential training

effects is possible. Third, it is important for further action decisions because misinterpretations can be avoided, that is for example, stopping supposedly ineffective training. Fourth, the training's effectiveness can be increased through an individually tailored approach. Therefore, to contribute to the understanding of how an SRL-intervention works and to detect qualitative differences between the learners, it should be analyzed how individual characteristics influence the SRL-training's success, namely how these affect SRL-strategies. Above all, the combination of global and differential analyses should lead to new findings, as this will allow specific training effects to be identified and more precise conclusions to be drawn. Effects of personal characteristics on interventions are specified as an aptitude-treatment interaction (e.g., Preacher & Sterba, 2019). Moreover, a good fit between person and environment (PE-fit) is expected to have positive influence on learning (see Pawlowska et al., 2014).

Emerging empirical evidence points to both individual differences in SRL-competences among students as well as individual differences regarding the trainability of SRL. Concerning achievement, it has been shown that students of different achievement levels differ in their use of SRL-strategies. Overall, high-achieving students apply more and more diverse SRL-strategies than low-achieving students (Kitsantas, 2002; Nandagopal & Ericsson, 2012; Sundre & Kitsantas, 2004). Apart from that, research shows that learners with different SRL-skills benefit to varying degrees from SRL-training (e.g., Dörrenbächer & Perels, 2016b; González-Pienda et al., 2014; Schmidt et al., 2010). These studies, however, do not yet show clear patterns of findings.

Besides achievement and SRL-skill level, personality factors as well as motivation seem to be related to different levels of SRL (Bidjerano & Dai, 2007; McCrae & Löckenhoff, 2010; Vermetten et al., 2001). Motivation is of high practical relevance in an educational context, as it can be influenced with rather little effort, a fact which is important when we think of adaptive learning situations (Eckert et al., 2015). Furthermore, it incrementally predicts academic achievement over intelligence (e.g., Kriegbaum et al., 2018). Apart from that, it has been shown that there are relationships between personality factors and SRL-strategies (e.g., Bidjerano & Dai, 2007), but these relationships have not been examined in the context of the trainability of SRL. As has already been pointed out to consider the context of SRL-interventions, Zeidner et al. (2000) also pointed to the need to investigate the relationship between SRL and personality. Hence, this dissertation focuses in detail on the role of motivation and personality as individual characteristics that influence SRL-training success.

## 4.1 Differences related to Personality

Personality describes individual differences that remain relatively stable over time and across situations, explaining cognition, behavior and emotions (Hogan et al., 1996). One of the best-researched and widely accepted theoretical frameworks of personality is the big five personality model, consisting of openness to experience, conscientiousness, extraversion, agreeableness and neuroticism (McCrae & Costa, 1987). People who are *open to experience* tend to enjoy new experiences, are curious and broad-minded, *conscientious* people tend to control their behavior in line with their set goals, *extraverts* favor intensive and frequent

interpersonal interactions, they are energetic and optimistic. *Agreeableness* describes the tendency to meet others with sympathy and to act selflessly, and people with a high degree of *neuroticism* tend to experience multiple forms of emotional suffering and are easily irritable (McCrae & Löckenhoff, 2010). Personality is a central variable for learning and can fundamentally support or hinder the use of learning strategies (Heinström, 2000; Kokkinos et al., 2015). Moreover, the operationalization of these big five traits include self-regulatory tendencies and it has been shown that SRL is related to personality traits (e.g., Bidjerano & Dai, 2007). Therefore, it can be expected that people vary in their SRL as they vary in their personality traits. Moreover, it is argued that personality traits influence how students interact with their academic environment and therefore influence the relationship between ability and achievement (Eilam et al., 2009). Thus, the effectiveness of SRL-training might also be affected by these underlying personality traits. The basic assumption here is that personality traits are substantially related to SRL-strategies and influence the effectiveness of SRL-training additionally due to their assisting function in such learning contexts.

With regard to theoretical definitions of the big five personality traits and empirical findings to learning strategies, one can state that openness to experience has a positive relationship to learning and SRL-strategies as relations to learning discipline, time management, critical thinking, elaborative, metacognitive and motivational SRL-strategies have been shown (Bidjerano & Dai, 2007; Chamorro-Premuzic & Furnham, 2003; Ruffing et al., 2015). Moreover, as open people like new learning experiences and may be motivated to try out new learning strategies (Barrick & Mount, 1991) it can be hypothesized that these people are more likely to benefit from an SRL-course. Conscientiousness might provide the strongest positive relationship to SRL and learning, as this trait encompasses many tendencies which are part of SRL, such as planning, organizing, goal setting and persistence (e.g., Bidjerano & Dai, 2007; Chamorro-Premuzic & Furnham, 2003; Hoyle, 2010; Ruffing et al., 2015). It is therefore also expected that such people will expand their SRL-strategies through SRL-training. Apart from this, it can be hypothesized that openness and conscientiousness have the same effect on the increase of SRL in web-based and attendance-based training, as these traits do not include any characteristics that indicate a preference for a learning context. With regard to extraversion, no concrete hypothesis can be stated about its effect on SRL-intervention success. On the one hand, extraverts engage in social learning strategies in particular because they prefer interpersonal interactions (e.g., Bidjerano & Dai, 2007). On the other hand, one can imagine that these people may not be good at learning on their own and overestimate their skills as they are too optimistic. Indeed, negative or no correlations with academic achievement and reflective problem solving have been shown (e.g., Chamorro-Premuzic & Furnham, 2003; Matthews, 1997). Agreeableness is related to unfavorable learning strategies such as reproductive and surface learning (e.g., Vermetten et al., 2001), but also to favorable strategies such as elaboration, time-management and effort (e.g., Bidjerano & Dai, 2007; Eilam et al., 2009; Ruffing et al., 2015). Thus, the relationship to learning is also ambiguous. Nevertheless, agreeable people may benefit more from attendance-based courses as they meet others with sympathy and show cooperative behavior (e.g., Vermetten et al., 2001), which is advantageous when learning with others. Thus, these people may benefit more from attendance-based training

as they are in direct contact with other learners. Lastly, it can be hypothesized that neurotic individuals will not benefit from SRL-training because there is a strong negative relationship to the use of supportive learning strategies (Busato et al., 1999; Chamorro-Premuzic & Furnham, 2003; Klingsieck, 2013; McCrae & Löckenhoff, 2010).

Based on the presented theoretical assumptions and empirical findings, one can conclude that personality factors are related to learning and SRL. However, more research is needed on how the different personality factors affect SRL-training success. Therefore, a further aim of this dissertation is to examine the differential effects of personality factors on the gain of SRL. In particular, connections of conscientiousness and openness to experience with learning and components of SRL have more justifications than connections of agreeableness, extraversion and neuroticism, which clearly hinders learning. Thus, it is expected that conscientiousness and openness to experience support SRL-training success, whereas neuroticism hinders SRL-training success, agreeableness is expected to have an effect in attendance-based formats, and it is still open how extraversion affects the change of SRL through training.

## 4.2 Differences related to Motivation

In addition to personality traits, achievement motivation is a central prerequisite for learning and performance (e.g., Eccles & Wigfield, 2020; Elliot & McGregor, 2001; Spinath, 2010). An important motivational construct in achievement motivation literature is goal orientation, stating that human experience and behavior can be explained and predicted based on desired goals (Spinath, 2010). It is used to explain learning and performance in academic tasks (Vermetten et al., 2001) and has been shown to promote learning and achievement in school and university contexts (e.g. Spinath & Schöne, 2003; Steinmayr & Spinath, 2009; Wirthwein et al., 2013) and can also be associated with SRL (e.g. Liem, 2016; Vermetten et al., 2001). The literature traditionally distinguishes between learning- and performance goals (e.g., Dweck, 1986). A *learning-goal orientation* focuses on the development of competence and knowledge. People with this goal orientation want to improve their competences, concentrate on understanding the learning material and are convinced that they have to work hard to achieve their goal (Senko & Dawson, 2017; Vermetten et al., 2001). A *performance-goal orientation*, by contrast, focuses on the demonstration of competence. This original dichotomy of goal orientations was extended to a trichotomous framework in which performance goals were subdivided into *performance-approach* and *performance-avoidance* goals (Elliot & Harackiewicz, 1996). Students with a performance-approach goal orientation strive to demonstrate skills and knowledge to show that they are better than others, while students with a performance-avoidance goal orientation try to hide lack of competence. Recently, researchers also include *work avoidance*, which focuses on the goal to invest as little work and effort as possible (e.g., Spinath et al., 2012; Steinmayr et al., 2011). Even though it may appear that the four described goal orientations are in contrast to each other, different goals can be targeted simultaneously (Spinath et al., 2012). Goal orientations are typically measured across domains, understood as traits (Kriegbaum et al., 2018) and influence performance-related behavior across different situations (Steinmayr & Spinath, 2009).

As described above in relation to personality, it can be hypothesized that goal orientations also support or hinder the use of learning strategies. The basic assumption here is that goal orientations are substantially related to SRL-strategies and influence the effectiveness of SRL-training additionally due to their assisting function in such learning contexts. Numerous empirical studies with students in school and university contexts showed that differences in goal orientation were related to the use of different strategies in learning and achievement contexts, to learning success, but also to facets of SRL. It can be expected that learning-goal orientation is supportive in increasing SRL through training since people with this orientation apply favorable learning strategies (e.g., deep-learning strategies, cognitive and meta-cognitive strategies, help-seeking), self-regulation, show positive emotions and intrinsic motivation (e.g., Huang, 2012; Hulleman et al., 2010; Senko & Dawson, 2017; Vermetten et al., 2001), and make efforts to develop competence and knowledge. A performance-approach goal orientation may also be positively related to SRL and to the increase of SRL, but not as strongly as learning-goal orientation. In order to demonstrate competence, one has to be able to demonstrate at least something, which can also be reached by surface-learning strategies for short-term success, which has been found to be advantageous in contests (e.g., Spinath, 2010; Vermetten et al., 2001). The empirical picture for performance-approach goal orientation is more ambiguous. Meta-analyses (Hulleman, et al., 2010; Senko & Dawson 2017) show that this ambiguous picture comes from the different operationalizations of this goal orientation, which can either focus on outperforming others or demonstrating competence. When individuals focus on outperforming others, this goal orientation is related to more desirable factors such as better school performance, deep learning strategies and self-regulation whereas a focus on demonstrating competence is related to rather maladaptive strategies (e.g., self-handicapping, help-avoidance) (e.g., Hulleman et al., 2010, Senko, 2019; Senko & Dawson, 2017). Both, performance-avoidance orientation and work-avoidance already suggest negative relations to learning because of their definitions of lacking competence and effort. It has been shown that performance-avoidance orientation and work-avoidance are not supportive of using favorable learning strategies and they are negatively related to academic achievement (e.g., Dinger et al., 2013; Huang, 2012; Hulleman et al., 2010; Senko & Dawson, 2017). Thus, it is expected that these two orientations hinder the development of SRL.

Based on the presented theoretical assumptions and empirical findings, one can conclude that goal orientations are related to SRL. There is agreement that approach goals play a rather supportive role and avoidance goals are related negatively to learning and training success. However, more research is needed on how the different goal orientations affect SRL after SRL-training. Therefore, one aim of this dissertation is to examine the relationships between goal orientations and the gain of SRL to analyze differential training effects. In particular, links of learning-goal orientation and performance-approach orientations are positively related to SRL and therefore might have the strongest relation to SRL-training success, whereas performance-avoidance and work-avoidance are negatively related to SRL, which are therefore expected to hinder SRL-training to be effective. With regard to the different training formats, no specific hypotheses are formulated because the characteristics of goal orientations give no reasons to expect differential effects in different formats.



To shortly summarize, the above described theoretical constructs of personality, goal orientations, and SRL help explaining differences in individual learning. It is an open research question, however, how they affect SRL-training. Thus, this dissertation aims to answer how personality and motivational factors influence an individual's SRL-training effect.

## 5 Boosting Participation Rates in Web-Based Training with Minimal Interventions

As outlined, SRL can be fostered through training and learners have different support needs as SRL and thus SRL-training success can be influenced by certain characteristics, such as personality and motivation. Moreover, especially in a web-based context, learners may need more support as students are more likely to drop out compared to attendance-based classes (Levy, 2007; Nistor & Neubauer, 2010; Prenkaj et al., 2020; Qiu et al., 2019). Thus, besides the consideration of personal characteristics concerning SRL, the support needs of web-based learners should be taken into account. One central question is how web-based training participation can be further supported because dropout rates are rather high (e.g., Onah et al., 2014; Prenkaj et al., 2020). In this context, internal factors of the participant have been discussed to explain dropout from web-based courses, such as satisfaction with web-based courses, motivational and persistence levels, perceived course difficulty, lack of digital skills, less experience with academic studies, unrealistic expectations, academic locus of control, as well as demographic characteristics like age or more external factors related to the course (e.g., difficulty or perceived usefulness, ease of use, quality and tutor contact) (e.g., Levy, 2007; Lin, 2010; Nistor & Neubauer, 2010; Onah et al., 2014; Xenos et al., 2002).

These factors associated with dropout are mostly observable factors which became apparent during the course and were discussed to reflect a lack of personal motivation, which is a more recent problem in various contexts where web-based courses or interventions are conducted (e.g., El-Hmoudova, 2014; Hone & Said, 2016; Manthey et al., 2016; Onah et al., 2014; Prenkaj et al., 2020). Thus, it would be desirable to start with an intervention to boost an individual's motivation to participate and endure in a larger training program, which is not too complex and at an early stage *before* the actual course begins. In this regard, so called minimal interventions gain in importance in an educational context (Walton, 2014; Yeager & Walton, 2011). These interventions are considered to be efficient approaches to promote motivation and performance of students in school and university contexts and are defined as brief exercises that “target students’ thoughts, feelings, and beliefs in and about school” (Yeager & Walton, 2011, p. 268). Thus, these interventions serve as a promising approach to promote motivation, which results in a higher participation rate in educational courses. Therefore, in this dissertation, it is examined whether minimal interventions are effective in promoting the participation rate in a voluntary course at school. Hence, a minimal intervention is implemented before a web-based SRL-course, which is used as a sample case of an educational course because of its importance in educational psychology.

### 5.1 Principles of Successful Minimal Interventions

Minimal – also called wise or brief – interventions do not focus on academic content per se. Instead, they target the underlying psychological processes to change them in a positive direction with little effort resulting in, for example, higher academic achievement (Walton,

2014; Yeager & Walton, 2011). Moreover, despite their brevity, the effects may last over months and years as indicated by a review of studies conducted at school and university provided by Yeager and Walton (2011). The lasting effect is assumed to be mediated by self-reinforcing recursive processes even when the intervention recedes in time and becomes less focal (Walton & Cohen, 2011; Yeager & Walton, 2011). The intervention studies by Wilson and Linville (1982) and Blackwell et al. (2007) are examples of how students' attributions of poor grades or task performance can have long-term effects on their subsequent performance. Apart from that, Yeager and Walton (2011) describe successful brief interventions that target the weakening of stereotype threat resulting in, for example, minimizing the achievement gap between female and male students.

Some might think that these minimal interventions are magic – but they are not (Yeager & Walton, 2011). Yeager and Walton (2011) describe several factors that have to be considered when conducting these interventions. When aiming at reproducing the intended effect of an intervention, they point out that it is important to address the psychological experience students have during that intervention. For example, being presented with reasons for why doing schoolwork is necessary is not the same as thinking and generating those reasons oneself (e.g., Canning & Harackiewicz, 2015). The personal examination of reasons promotes personal interest, which leads to getting involved in a task, while the presentation of reasons can increase pressure. Moreover, one should be aware that the way an intervention is delivered (e.g., through a teacher versus a researcher) and the context of an intervention can influence its effect. The strength of an intervention in a classroom may be lower than in a laboratory setting because other factors may affect the intervention as well. For example, the teacher may adapt components of the intervention to match the curriculum. Therefore, it is challenging to conduct a laboratory intervention in the field with complete fidelity (e.g., Hulleman & Cordray, 2009). In addition, the meaning and thus the effect of an intervention may vary across contexts. Therefore, students should have the possibility of personalizing their responses so that the intervention targets the intended experience that is most relevant to the students (Yeager & Walton, 2011). For example, in a utility value intervention in a science class, students should give their own personal reasons for why it is important to study statistics. Moreover, any change of the intervention should be guided by theory.

In conclusion, the success principles are as follows: The intervention has to be based on a well-founded psychological theory, it has to be meaningful to the applied context, and it has to change the intended psychological process; the intervention can have long-term effects if it alters recursive processes and if the context provides adequate affordances (Walton, 2014). Thus, these factors have to be considered when aiming at successfully implementing interventions in different educational contexts.

## 5.2 Examples of Minimal Interventions

Minimal interventions in an educational context can focus on different aspects (see Walton, 2014; Yeager & Walton, 2011) such as the promotion of an incremental theory of intelligence (growth mind-set, for example: “When I train my brain with math-tasks, my brain will grow

like a muscle and I will get smarter.”), the strengthening of school values (utility value, for example: “Learning statistics at school helps me in my future psychology studies.”), the setting of goals (implementation intention, for example: “If I have read the last chapter of my textbook, then I start writing the review.”), on transition struggles (social belonging, for example: “Everyone initially feels alone when they enter high school.”), or the strengthening of important values (value affirmation, for example: “The relationship to my parents means so much to me because we always support each other.”). This dissertation focuses on two approaches in more detail – utility value and implementation intention – because their positive effects have already been shown at school (e.g., Gollwitzer, 2014; Hulleman & Harackiewicz, 2009).

Many *utility value* interventions are based on the expectancy-value model (Eccles & Wigfield, 2002), postulating that task-choices, performance, and persistence are influenced by expectancy for success and value of a given task. Expectancy for success is defined as individuals’ beliefs about how well they will perform a task. The second motivational construct, namely subjective task value, is defined as the quality of a specific task contributing to the probability that an individual will do the task. Four components of task-value can be differentiated: first, attainment value is related to the personal importance of doing well on the task, second, intrinsic value refers to the enjoyment of performing the task, third, utility value refers to the fit of a task to current and future goals and their relevance, and fourth, cost is related to negative consequences of doing the task such as effort or fear of failure (Eccles et al., 1983). Students who expect to perform well on a given task and value it are more likely to be motivated and persistent. Minimal interventions on components of task value have proven effective in the educational context. It is postulated that these interventions work most effectively for academic risk students (Hulleman & Harackiewicz, 2009). For example, Hulleman et al. (2017) based their intervention on a previous study by Hulleman and Harackiewicz (2009) and showed that their utility value intervention, which focused on making connections between science course material and life of the students, increased both, the interest and the performance of low-performing students at university. Studies that mainly focused on intrinsic value have so far shown an ambiguous picture (e.g., Ketelhut et al., 2010; Shachar & Fisher, 2004). Most of these studies lack a theoretical base that explains how the interventions would change students’ intrinsic value, operationalized as intrinsic motivation or interest (Rosenzweig & Wigfield, 2016). Acee and Weinstein (2010) targeted all components of task value in their intervention study with students of statistics. They found positive effects on students’ value of statistics, on their perceptions of statistics being useful for the future, on the frequency of accessing a website about statistics and on course performance, but the latter seemed to be related to a specific instructor. Nevertheless, it can be expected that it is easier to directly influence the utility value with extrinsic reasons for fulfilling a task than the intrinsic value and attainment value, because the utility value is more extrinsic in nature than the other components (Eccles & Wigfield, 2002; Gaspard et al.; 2015).

*Implementation intentions*, introduced by Gollwitzer (1993, 1999), focus on if-then planning with the aim of supporting individuals in their task to link anticipated situations to

goal-directed responses. Implementation intentions are an important strategy for effective self-regulation of goal striving (Gollwitzer, & Sheeran, 2006) and can thus be regarded as an important strategy of SRL. They combine situational cues with instrumental goal-directed responses, so that individuals know when, where, and how one wants to act to reach a goal. Therefore, an individual forming an implementation intention commits oneself to responding to a certain situation in a specific manner: “If situation Y is encountered, then I will perform the goal-directed response Z!” (Gollwitzer, 2014). This is suggested when individuals plan in advance and as soon as the critical situation occurs, the intended behavior is initiated automatically, which is an effective strategy to meet the actual goal (Gollwitzer, 1999). Forming if-then plans is more effective than forming a goal intention (“I want to reach X!”) since the former support the initiation, maintenance, withdrawal and further pursuit of goals, whereas a goal intention only specifies what a person intends to achieve (Gollwitzer & Sheeran, 2006). The if-component can either involve situational cues related to tasks or behavior, which one wants to perform, or anticipated obstacles, which could prevent an individual from doing something. Accordingly, the specified response in the then-component can also include behavior one wants to perform or the suppression of unwanted behavior.

The effectiveness of implementation intentions has been shown in various studies, not only in an educational context, but also in other life domains such as health concerns as indicated, for example, by the meta-analysis of Gollwitzer and Sheeran (2006). A recent study by Schippers et al. (2020) indicated that goal setting can improve academic performance of first-year university students. Here, the specificity of the strategies for achieving the objectives played a decisive role in the effectiveness of the intervention. Webb et al. (2007) showed that implementation intentions helped students to attend classes. Moreover, the implementation intention intervention had a greater effect for low or moderately conscientious students than for highly conscientious ones, and less open people were more likely to attend classes than people who are open to experience. Another study showed that students formulating a self-efficacy strengthening implementation intention performed better at a math test than students who only formed goal intentions (Bayer & Gollwitzer, 2007).

In summary, research has shown that minimal interventions are a promising approach to foster motivation and performance in an educational context. Utility value interventions are a promising approach to foster students’ school values. An example of a utility value formulation for fostering participation in an SRL-course could be a student saying, “Participating in the SRL-course is of high importance because in my future studies I have to be able to learn in a self-regulated way”. Furthermore, the effectiveness of implementation intentions has been shown in various contexts. An example of an implementation intention could be a student saying, “I will start with the SRL-course when I have finished my homework”. It is an open research question, however, whether minimal interventions are also effective in fostering participation in voluntary web-based courses in an educational context. It is expected that minimal interventions can boost an individual’s motivation to participate and endure in a training course. Therefore, the third central aim of this dissertation is to examine the usefulness of utility value and implementation intention interventions for fostering participation in

voluntary web-based courses. As an example, a voluntary web-based SRL-course is used in this thesis because it has already been pointed out that SRL is considered an important skill that should be promoted among students and moreover, SRL-training is often offered as a voluntary study-accompanying course.

Following on from the reviewed theoretical and empirical literature on SRL, its determinants, and the effectiveness of minimal interventions on training participation, there are three major subject areas and research gaps in particular that form the core of the present dissertation.

First, ample evidence indicates that SRL can be promoted by attendance- and web-based courses. However, if one considers both the increase in web-based formats and the lack of knowledge about how and whether these courses differ from attendance-based ones in the context of SRL, studies are needed to compare the effectiveness of both course formats. This research question is addressed in Study I.

Second, while previous studies on the effectiveness of SRL-training focus on global effects, less is known about differential training effects depending on individual characteristics of the participants. Personality and motivational factors are important individual difference variables in the context of learning and education, and thus, may affect how an individual benefits from an SRL program at university. This aspect of differential SRL-training effects is investigated in Study II.

Third, research on minimal interventions suggests that they can successfully foster motivation and performance in an educational context. It is an open research question, however, whether these interventions are also effective for boosting the participation rate in voluntary web-based courses in an educational context. Therefore, this aspect of the effectiveness of minimal interventions is examined using the example of a web-based SRL-course in Study III.

All these aspects are further delineated in the next chapter on the specification of this dissertation project.

## 6 Specification of this Dissertation Project

Based on the previous chapters, open research questions will be stated and the aims of this dissertation will be specified leading to the summary of the empirical findings and methodological approaches on each of the three studies that examined different aspects of SRL-training, determinants of SRL, and the promotion of training participation.

### 6.1 Aims, Research Questions, and Methodological Aspects

The present dissertation draws attention to the support of students' SRL and addresses three major questions. (1) How effective is a web-based course fostering SRL when compared to a regular attendance-based one? (2) Which students' personality and motivational characteristics can affect SRL and thus SRL-training success? And (3) can minimal interventions on utility value and implementation intention foster participation in a voluntary web-based SRL-course?

Concerning the *first question*, research has shown that SRL can be effectively promoted by attendance-based as well as web-based training in an educational context; yet, no study has compared the effectiveness of a web-based with a matched attendance-based training, which only differed in the presentation format. Thus, in Study I it was explored whether these two formats are equally effective in supporting SRL-strategy increase as well as the development of metacognitive declarative knowledge on SRL in a university context. Already existing and evaluated web-based SRL-training (Bellhäuser et al., 2016) was used, and on its basis, an attendance-based training was developed. The effectiveness of both training courses, which only differed in the presentation format, was tested in a pre-/posttest design with  $N = 162$  university students.

With regard to the *second question*, several personality traits as well as goal orientations have been shown to act as facilitators or suppressors of successful learning, and in particular, relations to SRL have been shown. However, less is known about differential training effects. Based on the assumption that personality traits and goal orientations are related to SRL, Study II takes a differential rather than a global perspective on SRL-training effects. Using the same data set as in Study I, the role of individual differences in students' personality and motivational factors on the increase of SRL through SRL-training were investigated.

Finally, and with respect to the *third question*, there is ample evidence of the effectiveness of minimal interventions in promoting motivation and performance in an educational context. Therefore, in Study III, two empirically tested brief interventions, namely utility value intervention and implementation intention intervention, were implemented to promote training participation in voluntary SRL-training in a school context. For this purpose, students from 17 schools were randomly assigned to different experimental conditions (utility value, implementation intention, a combination of both, and a control condition). The students performed the minimal interventions, and then training participation in the following SRL-training was compared.

The interplay of the three studies addressing the three research questions is displayed in Figure 2. Study I and II are embedded in a university context, while Study III is set at school.

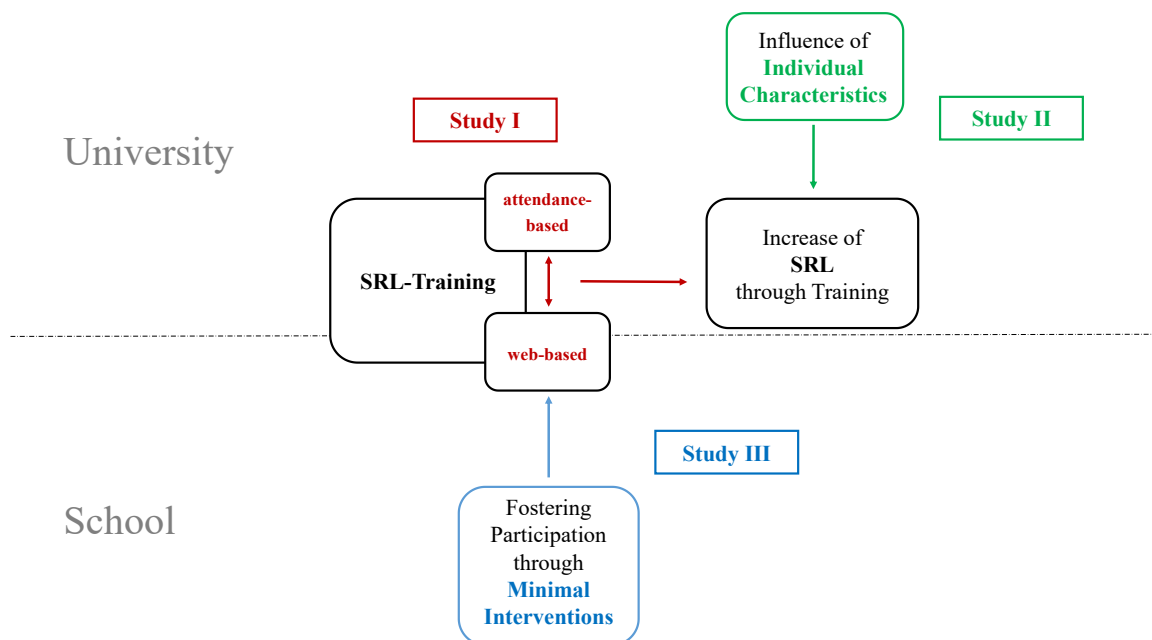


Figure 2. Interplay of the three studies within the framework of this dissertation. While Study I compared the effectiveness of the two SRL-training formats (attendance-based versus web-based), Study II explored whether individual characteristics (personality, motivation) influence the increase of SRL through training, and Study III examined whether the participation rate in SRL-training can be boosted by minimal interventions.

To answer the first and second research questions, data were collected from October 2015 until July 2016 within the scope of the Field of Focus 4 project *Promotion of students' self-regulated learning: Effectiveness of web-based courses compared to attendance-based courses* (original German title: Förderung des selbstregulierten Lernens von Studierenden: Effektivität von web-basierten Kursen im Vergleich zu Präsenzveranstaltungen). An experimental intervention study with three measurement points in a pre-/posttest design was conducted. Students were recruited from educational science and teacher education programs at Heidelberg University and were randomly assigned to the attendance-based or the web-based course format. The web-based SRL-training developed by Bellhäuser et al. (2016) was used for the web-based SRL-course. On this basis, a matched attendance-based training with the same structure and content as in the web-based program was developed. Thus, two parallelized training courses, which only differed in the presentation format, were implemented for this research project. The SRL-training was based on the process model by Schmitz and Wiese (2006) and consisted of three 90-minute units capturing preaction, action, and postaction phases and were released with an interval of one week. A complete description of the training contents can be found in Appendix A. After the first attendance-based introductory session, students



were randomly assigned to either the web-based or the attendance-based condition and were asked to fill out the pretest (t1), in which background variables, SRL-strategies and declarative metacognitive knowledge on SRL, and goal orientations were assessed. After five weeks, when SRL-training was completed, the students took the first posttest (t2), in which SRL-strategies and declarative metacognitive knowledge on SRL were assessed. Then, the implementation phase started, in which the students had to work on a transfer task, which was required to pass the course successfully. After four weeks, all students presented their work in a round-table discussion during an attendance-based session. At the end of the semester, all students met for a final session where they had the opportunity to give feedback on their experience with the course formats. Then, the second posttest (t3) was administered, in which again SRL-strategies and knowledge as well as big five personality factors were assessed. All self-assessment and objective instruments were presented via the online platform *SoSciSurvey*.

To answer the third research question, data were collected from August 2018 until June 2019 within the scope of the project *Self-Regulation Training for the Abitur in Rheinland-Pfalz* (original German title: *Selbstregulation Trainieren für das Abitur in Rheinland-Pfalz*; STAR). An experimental intervention study with three measurement points during one school year in a pre-/posttest design was conducted. Participants were recruited from German high schools. In total, 17 schools and 647 students agreed to participate in the study. At the beginning of the school year 2018, research assistants visited each school to guide the students through the introduction of the web-based SRL-training and the pretest. Students were randomly assigned to one of the different intervention conditions: Utility value (U), implementation intention (I), a combination of U and I (UI), and control condition (C), or to a waiting control group, which will not be part of this dissertation. The instructions for the minimal interventions can be found along with the data set in the public repository: <https://osf.io/693am>. At pretest (t1), background variables, expectancy-value motivation and grades were collected with web-based questionnaires, presented on *moodle*, an online learning platform. In addition, students' log files related to SRL-training were assessed throughout the school year. The training was accessible immediately after the pretest until the first posttest (t2). This posttest and a second posttest (t3, before winter break), however, are not part of this dissertation because they do not contribute to answering the third research question about the effectiveness of minimal interventions to promote training participation.

Table 1 gives an overview of the measures and assessment points that are relevant for this dissertation. Study I, II, and III are displayed in one table for simplicity, although Study III refers to a different data set.

Table 1

*Applied measures and assessment points in the three different studies I, II, and III*

SRL-Training	Theory phase		Implementation phase
	t1	t2	t3
Students Background Variables	I, II, III		
<sup>a</sup> Self-Regulated Learning	I, II	I, II	I, II
<sup>b</sup> Declarative Metacognitive Knowledge on SRL	I	I	I
<sup>c</sup> Evaluation of SRL-Training			I
<sup>d</sup> Big Five Personality Factors			II
<sup>e</sup> Goal Orientations	II		
<sup>f</sup> Expectancy-Value Motivation	III		
Training Participation		III	

*Note.* Study I - Study III are shown in one table for simplicity, although Study III refers to a different data set; t1 = pretests, t2 = first posttests, t3 = second posttests; I, II, III measures are only considered in I = Study I, II = Study II or III = Study III; <sup>a</sup>Items from survey of self-regulated learning at university (Fragebogen zur Erhebung des selbstregulierten Lernens an der Universit t; SRL@U; Bellhäuser et al., 2015) and learning strategies in studies (Lernstrategien im Studium; LIST; Wild & Schiefele, 1994); <sup>b</sup>Knowledge Test (Butz et al., 2016); <sup>c</sup>Usefulness of SRL for studying, satisfaction with the course, competence increases in aspects of SRL, overall learning increase (van der Beek et al., 2019); <sup>d</sup>Short version of the big five personality inventory (Kurzversion des Big Five Personality Inventory; BFI-K; Rammstedt & John, 2005); <sup>e</sup>Scales for measuring learning and achievement motivation - student version (Skalen zur Erfassung von Lern- und Leistungsmotivation – Studentenversion; SELLMO-ST; Spinath et al., 2012); <sup>f</sup>Expectancy, Utility Value, Interest, Cost Scales (following Hulleman et al., 2017).

## 7 Summary of Empirical Findings

In the following section, the empirical findings of the three papers that are at the core of this dissertation will be summarized. As the original papers can be found in the Appendices (A, B, and C) in full length, the description of these manuscripts will focus on the essential aspects of study aims, methodologies and results.

### 7.1 Study I: New Ways in Fostering Self-Regulated Learning at University: How Effective are Web-Based Courses when Compared to Regular Attendance-Based Courses?

In order to contribute to the first major research question of this dissertation, the study of van der Beek et al. (2019) aimed at exploring the effectiveness of a web-based course format in fostering SRL compared to a regular attendance-based format at university. For comparison, already evaluated web-based SRL-training (Bellhäuser et al., 2016) and parallelized attendance-based training were used, which differed only in their formats. As the web-based SRL-training was already evaluated and the focus of this study lies on the comparison of the two training formats, the training's content will not be presented here in detail (for details refer to Appendix A). Three of the four evaluation levels of Kirkpatrick (1979) were implemented for evaluation: satisfaction, learning, and behavior levels. The training concept was based on the process model by Schmitz and Wiese (2006), consisting of preaction, action, and postaction phases.

Concerning the training evaluation, it was expected that students in both course formats would be equally satisfied with the courses and rate SRL as useful (research question 1). At the learning and behavior levels, the evaluation of the main research question (research question 2) was realized: It was expected that students in both course formats showed improvements in their SRL-strategies and declarative metacognitive knowledge on SRL during the semester and that they did not differ in their SRL-strategies and declarative metacognitive knowledge at posttests. Furthermore, it was expected that students in both course formats reported a perceived increase in SRL-competence at the end of the semester and did not differ in their evaluation.

The  $N = 162$  participants of this study were students with an average age of 23.70 years ( $SD = 3.13$ ,  $range = 18-44$ ), recruited from educational science and teacher education programs, and randomly assigned to two course formats: attendance-based and web-based. Three assessment points were scheduled for one semester, i.e., six months. The pretest (t1) was conducted before the actual course program started. At t1, declarative metacognitive knowledge on SRL (Butz et al., 2016) and SRL-strategies (Bellhäuser et al., 2015; Wild & Schiefele, 1994) were assessed. The first posttest (t2) was conducted after the training units five weeks later and again, declarative metacognitive knowledge on SRL and SRL-strategies were assessed. The second posttest (t3) was conducted after the implementation phase at the end of the semester. Declarative metacognitive knowledge on SRL, SRL-strategies as well as students' evaluations were assessed retrospectively with questions about the SRL-course.

Data were analyzed with MANOVAs and repeated-measures MANOVAs. Furthermore, pairwise tests with Bonferroni corrections were computed for comparisons of the measurement points.

As expected, the results showed that the students were very satisfied with both course formats, SRL was considered useful for studying (research question 1), and the subjective and objective increases in learning were high (research question 2). Furthermore, findings revealed that SRL could be fostered in the web-based course as effectively as in the attendance-based course. In more detail, the results show that declarative metacognitive knowledge on SRL increased along with the theory phase of the training (t2) in both course formats, while SRL-strategies increased along with the implementation phase (t3), again independent of the course format.

This paper is of high relevance providing important evidence that it is possible to promote SRL among university students in different educational formats. In this respect, it is important to note that when employing a training program, in addition to a theoretical phase, an implementation phase is crucial. In future research, however, the training's influence on the more objective result level (Kirkpatrick, 1979) should be taken into consideration. For example, students could be compared with respect to performance tests or grades.

### 7.2 Study II: Promotion of Self-Regulated Learning at University: Importance of Students' Individual Characteristics for the Success of SRL-Training

In order to contribute to the second major research question of this dissertation, the aim of the study by van der Beek et al. (submitted) was to analyze the influence of individual characteristics on SRL-training success. Based on previous research, there is evidence that SRL is related to personality and motivational traits. The question, however, whether particular students benefit more than others from SRL-training has not been answered yet. It was expected that students' big five personality factors (research question 1) and moreover, goal orientations (research question 2) would influence SRL-training success differentially.

As this study follows on from Study I, the same sample as well as the same SRL-training were part of the present study. Motivation was measured at pretest (t1), personality was measured at the second posttest (t3) and SRL was measured at pre- and posttests (t1, t2, t3).

Hierarchical regression analyses revealed that the personality traits of conscientiousness, agreeableness and openness for experience significantly predicted gain of SRL from pre- to posttests, whereas other personality traits or motivational factors were unrelated to the gain of SRL. Findings further indicate differential effects of personality traits for the different training phases and course formats. With respect to the training phases (theory versus implementation), results showed that conscientiousness significantly influenced SRL increase in both phases, whereas agreeableness in particular seems to be of importance in the theory phase (t2) and openness for experience for the implementation phase (t3). Furthermore, regarding the formats (attendance- versus web-based), in the attendance-based group, higher levels of conscientiousness, agreeableness, and openness to experience were associated with a higher

increase in SRL-strategies, while in the web-based group only conscientiousness was a significant predictor in both phases.

The study contributes significantly to previous research by showing that students can be trained in SRL, but the extent seems to be affected by personality traits. Therefore, besides the global evaluation of training effects, the inclusion of differential analyses in the evaluation of interventions is recommended. Moreover, to ensure that all students have the opportunity to benefit from the training equally, it would be desirable to know with which individual characteristics students enter a training, so that teachers could implement a tailored training, adapted to their learners' needs.

### 7.3 Study III: Do Minimal Interventions Increase the Participation Rate in Voluntary Online Training at High School?

Related to the third guiding question of this dissertation, the aim of the paper of van der Beek et al. (2020) was to analyze whether minimal interventions could increase the participation rate in a voluntary online SRL-training at high school. Minimal interventions on utility value (U) and implementation intention (I) are promising approaches to increase the use of voluntary training. It was therefore expected that minimal interventions on utility value and implementation intention would increase participation in the SRL-training and moreover, that students with low expectation of success would benefit more from the utility value intervention than students with high expectation of success (research question 1). Furthermore, to complement this variable-centered approach with a person-centered approach, this study also addressed the question of whether differences in training participation could be explained by specific profiles of students' motivation (research question 2).

For the analyses, data of  $N = 269$  students, randomly assigned to the U, I, a combination of U-I or a control-condition, were used. In the pretest motivation and grades were assessed. In addition, students' log files related to SRL-training (to operationalize participation) were assessed throughout the school year.

Regression analyses showed that the minimal interventions on U and I had no effect on training participation. Positive predictors, however, were expectancy for success and mean grade score. In addition, latent profile-analyses showed a three-class model with the profiles "motivated", "balanced", and "unmotivated". Motivated students participated in the training significantly more often ( $M = 1.38$ ,  $SD = .19$ ) than students with other profiles (balanced:  $M = .90$ ,  $SD = .14$ ; not motivated:  $M = .55$ ,  $SD = .22$ ;  $p < .01$ ).

The present study gives reason to evaluate critically in which contexts minimal interventions are successful, as the minimal interventions in this study unexpectedly did not have an effect on training participation. In future research, however, it should be ensured that students indeed set themselves the goal of participating in the training. Apart from that, other components of task value (e.g. attainment and intrinsic value) could be targeted in the intervention in order to foster participation rate. This study contributes to previous research by

## 7 Summary of Empirical Findings

showing that minimal interventions are not effective per se because they seem to be context dependent, which is relevant for the practical implementation.

## 8 General Discussion

The central aim of this dissertation was to extend current scientific knowledge about self-regulated learning in educational contexts. To this end, three empirical studies were conducted in university and school environments, which addressed key research gaps regarding the comparability of attendance- and web-based SRL-training formats (Study I), the role of the individual characteristics of the participants for the success of SRL-training (Study II), and the effects of minimal interventions to increase the participation rates in subsequent SRL-training (Study III).

In the following sections, the key findings of these studies will be discussed and strengths and limitations will be analyzed. Then implications will be presented to derive an outlook on future directions before closing with a general conclusion and contribution of this dissertation.

### 8.1 Summary and Integration of Research Findings

In the following, the research findings of the three major research questions will be discussed.

#### 8.1.1 (Almost) No Differences between Web- and Attendance-Based SRL-Training

While ample evidence exists on the effectiveness of web-based SRL-training (e.g., Bellhäuser et al., 2016; Núñez et al., 2011) on the one hand and attendance-based training (e.g., Dignath & Büttner, 2008; Dörrenbächer & Perels, 2016a) on the other hand, valid empirical comparisons of such formats are rare. Therefore, the first aim of this dissertation was to examine whether a web-based course was as effective as an attendance-based course in fostering SRL. For evaluation, Kirkpatrick's model (1979) was implemented, which postulates that training programs should be evaluated based on four levels: reaction, learning, behavior, and results. Findings of Study I indicate that students' reactions towards both training formats were positive as all students were satisfied with both formats and rated SRL as useful with no substantial differences between web- and attendance-based training. Students in both formats gained an equal amount of declarative metacognitive knowledge about SRL from pretest to the first posttest, which is an indication of a positive evaluation on the learning level. Furthermore, the evaluation of the behavior level was also positive since results showed an increase of SRL in the preaction, action, and postaction phases. Again, there was no difference between the SRL of students in both formats from the first posttest to the second posttest, with the exception of SRL for the postaction phase, which also increased from pre- to posttest, suggesting that the theory phase already supported the students' reflection skills. Although the different effects of the two training phases were initially unexpected, it is not surprising that these results underline that effective training needs both: a theoretical and an implementation phase. Indeed, research suggests that trainees need opportunities to use new learning content for a successful transfer (e.g., Burke & Hutchins, 2007; Kauffeld, et al., 2012; Leutner & Leopold 2003). Furthermore,

the results of Study I are in line with the assumption that content and teaching methods within the teaching medium (attendance-based versus web-based) and not the learning environment itself influence the learning process as long as the same types of cognitive processes are fostered in different environments (Clark et al., 2016; Mayer, 2017). To sum up, the results of Study I lead to the conclusion that it is possible to equally enhance SRL in university students in web-based and attendance-based training formats. However, the results of Study II indicate that, in addition to the global effectiveness of training, individual characteristics interact differentially with the format of training (web-based and attendance-based) and its phases (theory and implementation). Therefore, there are almost no differences between the training formats. The differential findings will be discussed in further detail in the following section.

### 8.1.2 Individual Differences for the Success of SRL-Training: Personality Matters

The second major aim of this dissertation was to analyze the influence of personality characteristics as conceptualized in the big five personality model (McCrae & Costa, 1987), and moreover the influence of achievement motivation as conceptualized in goal orientations (Dweck, 1986; Steinmayr & Spinath, 2009) on SRL-training success because they play an important role in learning situations (e.g., Richardson et al., 2012) and their impact was not investigated before. Since Study I on the global effectiveness of the intervention program showed that students reported an increase in their SRL-knowledge after the theory phase and a significant improvement in their SRL-strategies after the implementation phase, Study II used the same data and also considered the two training phases and the two training formats separately.

As can be expected based on theoretical assumptions and empirical evidence (e.g., Bidjerano & Dai, 2007; Ljubin-Golub et al., 2019; Vermetten et al., 2001), data suggest that the personality traits of conscientiousness, openness to experience, and agreeableness are related to the increase in SRL through training. Contrary to theory and previous research findings (e.g., Senko & Dawson, 2017), goal orientations, however, were unrelated to differential increases in SRL.

The results support the assumption that conscientiousness encompasses many characteristics that are part of SRL and suggest that this trait is supportive in both phases of training – theory and implementation – as well as in both training formats – web-based and attendance-based. For the attendance-based format, besides conscientiousness, particularly agreeableness and openness to experience are of further importance. Here, the findings have to be further specified, in so far that agreeableness was related to SRL-increase assessed after the theory phase, and openness was significantly related to SRL-increase after the implementation phase. In the attendance-based course during the theory phase, students attended the course together with other students. Therefore, it is not surprising that agreeableness is related to an increase in SRL after this phase, given the theoretical background that agreeable people get along well with others (McCrae & Löckenhoff, 2010) which seems to promote learning for such people. So far, research results on the relationship between agreeableness and SRL have been ambiguous, as relationships have been reported both with positive aspects of SRL (e.g.,



Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016b; Eilam et al., 2009; Ljubin-Golub et al., 2019; Vermetten et al., 2001) and with more negative learning aspects (Busato et al., 1999; Kokkinos et al., 2015; Vermetten et al., 2001). The findings of Study II, however, speak in favor of a positive relationship between agreeableness and an increase in SRL through training.

During the implementation phase, students had to work on a transfer task, which required SRL. So the students had to be somehow open to implement the strategies they had learned in theory. The results of Study II are consistent with the research results, which continuously show that openness to experience is positively related to SRL-related learning strategies (Bidjerano & Dai, 2007; Chamorro-Premuzic et al., 2008; Kokkinos et al., 2015; Ljubin-Golub et al., 2019; Ruffing et al., 2015; Trapnell & Campbell, 1999; Vermetten et al., 2001).

For the other two personality factors, extraversion and neuroticism, no significant relations to SRL-increase were found. Concerning neuroticism, it is surprising that the results did not show a significant negative relationship since the negative relation between neuroticism and SRL is empirically well documented. For extraversion, the empirical picture is ambiguous. In future research, sub-facets of personality traits and SRL could be considered because although correlations with a global SRL-factor have been shown, these two personality traits correlated only with a limited number of sub-facets of SRL (e.g., Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016b).

As already mentioned, goal orientations had no incremental effect on SRL-increase beyond personality traits. This was against the expectations and earlier findings. For example, Steinmayr and Spinath (2007) even suggested integrating trait conceptions of motivation in the nomological network of personality since their research indicates a predominance of motivational concepts over the personality concept of the big five. Therefore, in additional analyses the influence of goal orientations on SRL-increase was examined independent of the personality variables to exclude the possibility that personality masks a possible effect of goal orientations on SRL-increase. But still, goal orientations did not affect SRL-training success. Apart from that, Richardson et al. (2012) emphasize that especially motivational subcomponents of SRL are necessary to be a successful learner. Thus, it is also conceivable that the effect of learning goal orientation is covered by SRL. As SRL t1 predicted SRL t2 and SRL t3 significantly, learning goal orientation had no chance to further influence the increase of SRL.

Study II did not further differentiate within the goal orientation scales. However, as indicated by meta-analyses (e.g., Hulleman et al., 2010; Senko & Dawson, 2017), the theoretical framework of goal orientations, and especially performance-approach goals (Senko & Dawson, 2017) should be further differentiated. That means, performance-approach goals could theoretically be further divided into two subscales, namely competence demonstration and peer comparison. Empirically, it has been shown that the competence part of performance-approach goals is negatively related to performance as opposed to the peer comparison part, which is positively related to performance (Senko & Dawson, 2017).

According to the other goal orientations, mostly consistent results are reported for their global scales (Senko & Dawson, 2017). Hulleman et al. (2010), for example, reported stronger effects with performance for the global scale of learning goal orientation compared to the

subscales, indicating that the global learning goal scale does not need to be further differentiated.

In summary, although there was no empirical evidence for all hypotheses, the results of Study II indicate that SRL-training can have differential effects, and particularly emphasize the important role of the personality factors of conscientiousness, agreeableness, and openness to experience.

### 8.1.3 No Effect of Minimal Interventions on the Promotion of Training Participation

Inspired by the increasing research on minimal interventions in the educational context, the third major question of this dissertation addressed two promising minimal interventions – utility value and implementation intention – for promoting training participation. Unexpectedly and in contrast to most previous research on these intervention approaches (e.g., Gollwitzer & Sheeran, 2006; Hulleman & Harackiewicz, 2009; Hulleman et al., 2017), these minimal interventions did not affect training participation. Moreover, it was expected that the utility value intervention would be even more effective for low performing students. Theory suggests that the source of information on utility value influences its effectiveness. That means, examples given by a peer group of students should be more effective than examples given by an authority like a teacher. In addition, it should be even more effective if individuals first receive examples from their peers and then generate examples of utility value for themselves because they experience that their peers are also capable of making these connections (Canning & Harackiewicz; 2015). Since Canning et al. (2019) also failed to show that their utility value intervention is especially effective for low performers, they discussed that the reason might lie in the fact that low performers doubted their preparedness for the class, lost confidence in their performance and cared less about doing well, which, in turn, led to decreased interest and perceived utility value. Another reason could be the introduction to the SRL-training, in which only a short overview of the training was given. Maybe, too little information was provided so that students did not see the relevance of SRL compared to, for example, the relevance of science courses, which are already known to the students, and for which the effects of utility value interventions were usually shown (e.g., Hulleman & Harackiewicz, 2009). Apart from this, most studies were conducted within a compulsory class. Hence, students had no choice whether they want to participate. Although the recommendation was followed to allow students to generate their own utility value examples, the results indicate that context factors like voluntary or mandatory courses play an important role for the effectiveness of utility value. When students have to participate, they might think more deeply about the utility of a course. Apart from that, the time when the training was presented to students may not have been optimal. Since students had to prepare for their final exams, they may have experienced work overload rather than support for their learning. However, the results indicate that further research is needed.

Contrary to expectations, the implementation intentions were not effective either. The reasons for this can be manifold. First, students had to specify when they wanted to start with the training, and second, they had to form the intention of how to deal with the obstacles that

arose. Thus, the students did not form the actual intention to participate; but goal setting is decisive for implementation intentions (Gollwitzer & Sheeran, 2006). In addition, implementation intentions may depend on moderators, such as stability of intention, peer and school norms, plan reminders, motivation type or personal characteristics such as conscientiousness (Prestwich & Kellar, 2010; Sheeran et al., 2005; Webb et al., 2007). For example, it was shown that an implementation intention intervention was more effective for students with low or moderate conscientiousness than for students with high conscientiousness (Webb et al., 2007). Apart from this, Sheeran et al. (2005) showed that when people had weak goal intentions, their implementation intention had no impact on performance and that goal activation influenced the impact of the implementation intention. These findings underline that implementation intentions are more effective for people with strong goal intentions, which, however, cannot be tested in this dissertation. Hence, prospective studies could address this issue more thoroughly.

Concerning motivation profiles, the fact that motivation, namely high values in the expectation of success, utility value and interest, and low values in cost, positively influences performance enriches the evidence for the expectancy-value model (Eccles & Wigfield, 2002). However, minimal interventions did not affect these factors strong enough so that it would lead to an increase in participation rate. But it was not tested whether minimal interventions had an effect on motivation. Thus, in future studies the effect of minimal interventions on motivation should be examined. Apart from that, previous studies have operationalized the effectiveness of utility value interventions with achievement indicators (e.g., grades) whereas in Study III the focus was on the behavioral indicator of participation rate.

The results of Study III indicate that the implementation of minimal interventions on utility value and implementation intention in a school context for voluntary courses is more complex than expected. Thus, further research is needed to investigate which factors are responsible for this and how these factors should be adjusted for the success of such interventions. A deeper understanding of in which contexts, for which people, and with which essential requirements minimal interventions work is relevant not only for theory but also for the practical implications.

## 8.2 Strengths and Limitations

A major strength of this dissertation is that all studies were conducted in real and relevant educational settings, such as school and university contexts. In particular, this dissertation focuses on university students and students in their last year at school, as these students face a critical transition by entering the more autonomous learning environment and thus need support in their abilities to learn in a self-regulated way. This acquired autonomy can lead to learning problems and students often show deficits in their knowledge about SRL and their ability to learn in a self-regulated way (Peverly et al., 2003; Randi & Corno, 2000; Stark & Mandl, 2005; Wei et al., 2005). This dissertation shows how students can be supported in their SRL with different training formats. The sample of Study I and II came from a German university and the sample of Study III was drawn from 17 different German schools. The results are not only

interesting for researchers in the educational field, but also of practical importance for teachers and students at school and university. This is particularly important in view of the current situation in these educational contexts, which have changed significantly in 2020. Due to the coronavirus pandemic, stakeholders in schools and universities had to adapt their teaching and learning quickly. Web-based teaching and learning at home became an everyday reality, and students were more than ever asked to regulate their learning in a self-regulated way (e.g., Fischer et al., 2020; Möller, 2020).

In this regard, a major strength of this dissertation is the fact that by implementing the web-based training on SRL, not only SRL, but also students' digital competences were addressed in passing. Both skills, SRL and digital competence are crucial not only for the current demands, but for life-long learning in a world with increasing changes, where individuals constantly face new developments (e.g., van Laar et al., 2017). These changes require an enhanced use of digital information and the ability to act self-controlled and independently. Thus, the applied web-based SRL-training already prepares pupils and students for the upcoming requirements in our society.

Another strength is that all studies were conducted as experimental designs with multiple measurement points and all participants were randomly assigned to the intervention conditions (attendance-based or web-based group; U, I, UI, or C group). This and the fact that the studies were conducted under real conditions underlines that all studies are of high ecological validity.

Furthermore, a multi-method approach was applied in this dissertation by combining several self-assessment tools and objective measurements such as a knowledge test or log files. Log files have the advantage of showing real performance data in the actual situation.

To add another strength, all studies used different data analysis methods, including variable-centered methods such as ANOVAs, MANOVAs, MANOVAs with repeated measurements, hierarchical regression analyses, and person-centered analysis methods such as latent profile-analysis.

Apart from that, this dissertation is based on many self-assessment criteria such as SRL, personality, motivation, and grades. For personality and motivation, established, valid and reliable instruments were used like the big five personality inventory (BFI-K; Rammstedt & John, 2005), scales for measuring learning and achievement motivation (SELLMO-ST; Spinath, et al., 2012), and expectancy, utility value, interest, cost scales (following Hulleman et al., 2017). SRL-strategies were also assessed with items from reliable instruments (LIST; Wild & Schiefele, 1994; and SRL@U; Bellhäuser et al., 2015). Self-assessments are the most common way to measure SRL, which is on the one hand reasonable since some internal processes are only accessible to the person themselves. On the other hand, such self-assessments have several limitations (Maag Merki et al., 2013; Winne & Perry, 2000). Students could have answered in a socially desirable way, and there could be problems of retention and generalization. To overcome this and to measure SRL in a more objective way, an additional knowledge test on SRL was conducted. Nevertheless, it would be interesting to collect more behavioral data for more reliable results. Moreover, the SRL self-assessment items were based on a quantitative approach, relying on *the more, the better* comparisons. This approach of item phrasing has been discussed in the context of SRL because learners have to remember past

learning situations, thus, their evaluation depends on recalled and potentially biased situations. Furthermore, it is questionable whether the more frequent use of more learning strategies is better than the use of less, but appropriate learning strategies (e.g., Wirth & Leutner, 2008). In addition, the use of qualitative standards is a promising approach as it improves test validity (e.g., Maag Merki et al., 2013; Wirth & Leutner, 2008). An example of a qualitative approach would be to present learners with a description of a learning task with different learning approaches of varying strategic quality. The learners have to evaluate them concerning the fit between task and learning approach. As an indication of how good the learners' assessments are, they are compared with experts' assessments that serve as a standard. This qualitative approach is defined as an optimal view compared to the quantitative maximum view.

In this dissertation, SRL was measured at three measurement points. Thus, students' ratings refer to subjective assessments in a certain period of time (example item: "I regularly check to see if I am still following my goals"). This common way of assessing SRL, however, misses information of how learners make small-grained adaptations over time in authentic learning situations (McCardle & Hadwin, 2015). Thus, in prospective studies, it would be desirable to assess the actual learning process in a given learning situation and measuring SRL when it occurs. Such an approach using the more fine-tuned ecological momentary assessments (Shiffman et al., 2008) or so-called online measurements would also allow studying situational and contextual influence on SRL since SRL is sensitive to context and may vary from task to task (McCardle & Hadwin, 2015; Rovers, 2019; Wirth & Leutner, 2008). Qualitative think-aloud protocols asking students to verbalize their thoughts while learning (e.g., Greene et al., 2011), observations of the learner, log files (e.g., Rovers et al., 2019), or trace data (McCardle & Hadwin, 2015) are examples of such online assessments. So-called offline measures are collected either before or after task performance (Wirth & Leutner, 2008). Although the terminology of online and offline could be misleading, this distinction refers to the timing of measurement, not to the mode of administration. Therefore, offline measurements can be presented in a web- or computer-based way. Wirth and Leutner (2008) argue for computer-based assessments in terms of online approaches because they could adapt to changes in the task and cognitive conditions. Thus, with respect to the methodological aspects that could be addressed in future studies, on the one hand, qualitative techniques and on the other hand, momentary assessments would be suitable to complement the global offline quantitative measurement of SRL. However, these methods are often time-consuming to implement and to evaluate. Apart from that, it is possible that momentary assessment itself is an intervention which promotes learning because it serves as a reminder to implement learning strategies such as diaries (see Schmitz & Wiese, 2006). Thus, its influencing effect has to be considered.

There are several reasons why a web-based self-report SRL questionnaire, which is part of quantitative offline standards, was used in this dissertation. First, it was the aim to analyze whether SRL-skills change on average over time, and second, this is understandable against the background of the study by Bellhäuser et al. (2016), in which the web-based SRL-training was developed and which also uses this approach for evaluation. As several measurement points were implemented, the overall increase in SRL-strategies was assessed. Moreover, this approach is well suited for large sample sizes. For example, Rovers et al. (2019) showed that

offline measurement methods provide relatively accurate insights into the global level of self-regulatory competence of students, which was one of the research aims. It has to be pointed out, however, that even inaccurate self-reports of SRL can still provide important information because learners' perceptions are central when it comes to SRL and learners use their own perception to regulate their learning by goal setting, monitoring and adapting learning processes (McCardle & Hadwin, 2015).

A limitation of this dissertation is that it did not include grades or performance-tests before and after SRL-training, which, however, would be advantageous to find out whether the applied SRL-training has an effect beyond knowledge increase and self-reported strategies. Thus, in future research, more criteria that are objective should be included to measure the influence of SRL on performance. The applied knowledge test can be considered as an objective measurement. It indicated that the students improved their factual knowledge about SRL after training (see learning level; Kirkpatrick, 1979) but it did not measure subsequent performance at university. Therefore, it would be desirable to also integrate assessments of the behavior level with, for example, the implementation of the described online measures during the learning situation in future studies. Additionally, future research should include the result level, for example, by using grades and performance tests, in order to analyze the link between SRL-training and actual performance, which has been questioned (e.g., Spörer & Brunstein, 2006). Such evidence is central for training validity. For example, in relation to Study I, final grades could be collected for analysis at the result level: did students who participated in the SRL-training receive higher grades than students who did not participate? Nevertheless, several contextual factors may also influence the output of the institution at the result level (Kauffeld et al., 2012; Kirkpatrick, 1979). It is therefore difficult to analyze the sole influence of training.

Moreover, with regard to the third research question, how participation rate in a voluntary training can be fostered, this thesis took the venture of transferring an already established intervention on utility value to a new context, namely, voluntary training compared to compulsory education in STEM fields. Implementation intentions have already proven effective in various life domains (Gollwitzer & Sheeran, 2006), which also include voluntary acts. However, in this dissertation, the utility value and implementation intention interventions were not effective in fostering participation rate. Thus, in future research, the effectiveness of utility value interventions should be analyzed in other domains outside the obligatory STEM classes and with different dependent variables to get insight in their general effectiveness. Moreover, it should be guaranteed that the students indeed set goals, which is crucial for the effectiveness of implementation intentions (Gollwitzer & Sheeran, 2006). This thesis omitted to ask the students directly whether they had set themselves goals for participation in the training. Since participation in the SRL-course was voluntary, it cannot be guaranteed that it was the aim of the students to participate in the training at all. Therefore, students in prospective studies should be asked directly about their goals regarding participation in SRL-training.

The minimal interventions were presented in a web-based way, which can be regarded as a strength. For example, Paunesku et al. (2015) criticized that most interventions were tested in a single context and with great researcher involvement than would be possible in a large-scale implementation, leading to difficulties in studying their impact on educational outcomes. Web-

based interventions have the advantage that they are independent of extensive participation by researchers or teacher training and open up access for a large number of students. Especially in the current situation, where web-based teaching and learning is becoming an everyday business due to the coronavirus pandemic, the advantages of time and space flexibility are becoming more and more apparent.

### 8.3 Implications

This section gives an overview of theoretical and practical implications derived from the three studies of this dissertation. Implications for further research will be discussed in the next section (8.4).

With regard to *theoretical* implications, many SRL-models – like the model of Schmitz and Wiese (2006) – focus on concrete processes. Increasingly there is more research, like this dissertation, which shows that individual (e.g., personality) and contextual (e.g., school, university) factors also seem to play a systematic role for SRL and SRL-increase. Therefore, it would be desirable to expand existing models by these factors. This would also provide a sound basis for the conceptualization of training to promote SRL.

Moreover, the findings of this dissertation also offer implications for *practice*. Study I demonstrated that SRL is trainable in different course formats. Students in the web-based course as well as students in the regular attendance-based course benefitted from the content-independent SRL-training. Such SRL-training offers the opportunity to improve cross-curricular competence that not only provides students with subject-specific support (e.g., Wagner et al., 2010), but that also enables students to apply SRL-strategies in different academic requirements. As described above, content-independent training has proven effective to promote SRL in students (e.g., Dörrenbächer & Perels, 2016a; Hofer & Yu, 2003). Due to these promising findings, teachers can offer such training to their students, independent of their study field. It would be particularly useful to employ it directly before the start of studies, for example in preparing summer schools or at the beginning of the first semester, as many students begin at university with a lack of SRL-skills (e.g., Peverly et al., 2003; Randi & Corno, 2000; Stark & Mandl, 2005). Since students are less exposed to external regulation in school as part of the preparation for their graduation, it is recommended that such training should be presented to this group as well. However, Study III has shown that participation in SRL-training – despite minimal intervention – can be low if participation in the training is voluntary even when participants are motivated. However, it is still open how participation can best be promoted.

Apart from that, the results of Study I show that SRL-training should encompass two training phases, which target different SRL-aspects: the theory phase promotes SRL-knowledge, while the implementation phase, in which learners can practice the theoretically learned competences, promotes SRL-skills. Therefore, it is important to consider these phases during the planning and designing of SRL-training in order to promote and use these SRL-increases in knowledge and skills in an optimal way.

Furthermore, and with respect to the results of Study II, an individual's SRL-training success seems to be partially dependent on personal characteristics like personality. This result

emphasizes the importance of analyzing differential effects in addition to global effects to determine which groups of learners benefit or do not particularly benefit from an intervention. Finding differential effects gives implications for the design of interventions and suggests that learners would benefit from adaptive SRL-interventions, but tailored interventions are not easily realized in terms of personality. From an ethical perspective, personality assessments at school or university are not justifiable. Nonetheless, teachers could try to stimulate personal characteristics in their students that have proven to be supportive, such as offering an external regulation at the beginning of the training in terms of the dates on which the units must be completed in order to trigger components of conscientiousness, as this characteristic has proven to be a strong predictor of SRL. It could also be recommended to form learning groups to stimulate aspects of agreeableness and to encourage students to apply what they have learned, and to engage them in something new, which would promote components of openness to experience.

Moreover, derived from the findings of Study III, minimal interventions did not have an effect on training participation, but students' initial motivation played a significant role as expectancy for success predicted participation, and second, research indicates that motivation is a predictor of SRL-training's success (e.g., Dörrenbächer & Perels, 2016b). In addition, and in line with this, latent profile-analyses showed that motivated students participated in the training more often than the unmotivated or balanced group. Therefore, in prospective studies it should be examined which activating teaching methods could be implemented to further enhance student motivation and how (minimal) interventions should be designed to stimulate student motivation to participate in voluntary training.

### 8.4 Future Directions

This dissertation contributes to the field of self-regulated learning research and raises points for future research. Concerning the SRL-model by Schmitz and Wiese (2006) used in this dissertation, it would be interesting to analyze the effects of training on the different SRL subcomponents (e.g., goal setting in the preaction phase, monitoring in the action phase, self-reflection in the postaction phase) in order to obtain a more fine-grained and integral picture. In this way, it could be analyzed whether all components of SRL are targeted by the training as postulated. According to Schmitz and Wiese (2006), learning behavior can be assessed with more trait-like instruments, but also with instruments that capture time-varying behavioral aspects and are more sensitive to changes like momentary assessment instruments. In prospective studies, standardized learning diaries could be administered, which have to be filled in directly before (for the preaction phase), during (for the action phase) and after (for the postaction phase) a learning task (e.g., Schmitz & Wiese, 2006). Although this method depends more on the motivation of the learners, as they have to fill in the diary over a certain period of time, the data give a more accurate insight into the form of behavioral change that can be analyzed with time series analysis (Perels et al., 2020; Schmitz & Wiese, 2006). In addition, the effect of the training on the processes at the micro level of the students can be evaluated with the help of diaries, which would inform which specific strategies are best or most



stimulated by the training and are employed in different learning situations (see Bembenutty, 2011; Rovers et al., 2019). The approach of diary assessments was successfully implemented by studies based on Schmitz and Wiese's process-model (e.g., Perels et al., 2007; Schmitz & Wiese, 2006).

In terms of personality, prospective studies could focus on the fine-grained relationships between sub-facets of personality traits and subcomponents of SRL, as research indicates that the relationships are diverse (see Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016b).

Based on the discussion about the different findings depending on the definition of performance-goals (e.g., Hulleman et al., 2010; Senko & Dawson, 2017), future studies could analyze whether the relationship to SRL varies when the influence of items for outperformance and items for demonstration of competence are examined separately.

It would further be of interest to expand the person-centered approach (see Study III) by including profiles of SRL, achievement, personality and goal orientation that might influence students' development of SRL. As a person-centered approach, latent profile-analyses could help to identify heterogeneity between individuals that may remain unobserved by traditional variable-centered analyses (Hickendorff et al., 2018). This approach could help to identify patterns of these variables which, when combined, could act as promoters or suppressors of SRL.

Furthermore, and in view of the current situation in which not only students and teachers but also employees of different fields are confronted with the demands of working from home due to the coronavirus pandemic, SRL-skills have gained in importance (e.g., Fischer et al., 2020; Huber & Helm, 2020; Iglhaut, 2020; Rigotti et al., 2020). Instead of being together with others at school or university, students now sit at home in front of their mobile devices and have to work on tasks in a self-regulated way. By working from home, people need to eliminate distractions and structure their own days even more in order to be efficient. This results in new urgencies and application areas. Therefore, research should focus not only on students but also – due to the digital change and work from home – on SRL-training for employees of different age groups.

## 9 General Conclusion

The aim of this dissertation was to find effective ways to promote self-regulated learning in the educational contexts of school and university. Building on recent conceptual and empirical advances, it strived to close research gaps in three major areas. The first open research question targeted the effectiveness of a web-based course for the promotion of SRL compared to an attendance-based one. The second question related to individual characteristics as potential facilitators or suppressors of the effectiveness of SRL-training. And third, it was investigated whether participation in a voluntary SRL-course can be promoted by minimal interventions. The dissertation contributes to the currently rising field of self-regulation research in educational contexts from a theoretical, methodological, as well as a practical perspective. The findings underline that SRL can be effectively promoted in web-based and attendance-based courses. It is, however, important that SRL-training includes a theoretical as well as a practical phase in which the students can implement, practice, and thus strengthen the theoretically learned skills. Moreover, the success of such training can also depend on personal characteristics like personality. There is strong evidence that conscientiousness acts as a facilitator of SRL, regardless of the training's format (web-based or attendance-based) or the training's phase (theory or implementation). Furthermore, there is evidence that openness to experience and agreeableness can act as facilitators of SRL-gain in attendance based – but not in web-based – formats. In this regard, agreeable students profit more from a theory phase, whereas open students profit more from an implementation phase. Apart from that, an important finding of this dissertation is that the promotion of participation on voluntary SRL-training seems to be context dependent. Although, the effectiveness of minimal interventions on utility value and implementation intention are well investigated, their implementation and combination with voluntary SRL-training did not prove effective.

By contributing to answer research questions in the field of self-regulated learning research, this thesis detected new and important questions that have to be answered in future research. Moreover, this dissertation offers answers not only to researchers but also to practitioners such as teachers, who work with students. They may now trust more in web-based learning scenarios that will arise more often in a century in which digitalization plays a key role in almost every life domain. Teachers may be primed for the importance of personality differences and their interaction with SRL-training success as well as better understand that some students are better or worse self-regulated learners and which learning formats are more or less suitable for different groups of students.

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## Appendix A - 1<sup>st</sup> Paper (Study I)

Study I: New ways in fostering self-regulated learning at university: How effective are web-based courses when compared to regular attendance-based courses?

*Note:* This version of the article does not fully correspond to the article published in *Zeitschrift für Pädagogische Psychologie* at <https://doi.org/10.1024/1010-0652/a000254>. This is not the original version of the article and can therefore not be used for citation. Please do not distribute or quote this article without the author's consent.

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## Deutsche Version

Titel: Vermittlung von Selbstreguliertem Lernen im Studium: Wie wirksam sind E-Learning Veranstaltungen im Vergleich zu Präsenz-Seminaren?

### Zusammenfassung

Die Fähigkeit zum selbstregulierten Lernen ist eine wichtige Voraussetzung für akademischen Erfolg. Gleichzeitig gibt es Hinweise darauf, dass viele Studentinnen und Studenten deutliche Defizite im Bereich des selbstregulierten Lernens aufweisen. Die Förderung der Selbstregulationskompetenz durch geeignete Trainingsmaßnahmen stellt somit einen wichtigen Aspekt der universitären Lehre dar. Bislang wurde die Wirksamkeit von Seminaren zum selbstregulierten Lernen insbesondere für Präsenzveranstaltungen gezeigt. Gegenwärtig gewinnt die Implementation von E-Learning Formaten in der universitären Lehre zunehmend an Bedeutung. Ein Vergleich mit Präsenzveranstaltungen zur Vermittlung des selbstregulierten Lernens steht bislang noch aus. In einer randomisierten Interventionsstudie ( $N=186$  Studentinnen und Studenten) wurde untersucht, ob Studentinnen und Studenten in einer web-basierten Intervention gleichermaßen profitieren wie Studentinnen und Studenten in einer Präsenzveranstaltung. Zur Evaluation wurde Kirkpatrick's Modell herangezogen. Die Ergebnisse zeigen, dass die Zufriedenheit der Studentinnen und Studenten mit beiden Kursen sehr hoch ist, selbstreguliertes Lernen als sehr hilfreich für das Studium angesehen wird und die Studentinnen und Studenten ihre Selbstregulationsstrategien und Wissen über selbstreguliertes Lernen verbessern. Die Ergebnisse weisen darauf hin, dass selbstreguliertes Lernen in Präsenz- sowie in E-Learning-Kursen gleichermaßen effektiv gefördert werden kann.

Schlüsselwörter: Selbstreguliertes Lernen, Studentinnen und Studenten, Universität, E-Learning, Evaluation

English Version

Abstract

Self-regulated learning is essential for studying successfully at university. However, students often show deficits in their ability to learn in a self-regulated way. Consequently, it has become crucial to foster students' self-regulated learning at university. The effectiveness of such courses has primarily been investigated in regular class contexts that require physical attendance. However, web-based course formats are currently gaining in importance. Web-based courses have several advantages (e.g., that students can decide when and where they want to study). The question of whether a web-based course is as effective as an attendance-based one has yet to be answered.

In a randomized intervention study ( $N=186$  university students) with two different treatments (attendance-based and web-based courses), it was investigated whether students in the web-based format profited to the same extent as students in the attendance-based course. Kirkpatrick's model was implemented for evaluation. The results showed that the students were very satisfied with both course formats, self-regulated learning was considered useful for studying, and the subjective and objective increases in learning were high. Furthermore, the results showed that self-regulated learning can be fostered in the web-based course as effectively as in the attendance-based course.

Keywords: self-regulated learning, students, university, e-learning, evaluation

## 1 Introduction

Self-regulated learning (SRL) is an essential condition for studying successfully at university (e.g., Bellhäuser, Lössch, Winter & Schmitz, 2016; Kitsantas, Winsler & Huie, 2008; Schunk & Ertmer, 2000). However, students often show deficits in their knowledge about SRL and their ability to learn in a self-regulated way (Peverly, Brobst, Graham & Shaw, 2003; Randi & Corno, 2000; Stark & Mandl, 2005). Consequently, it has become crucial to foster SRL in university students. Courses for fostering self-regulation competence have been shown to be effective, as has been indicated by both self-reported and objective measures of the learning process (e.g., Benz, 2010; Dörrenbächer & Perels, 2016; Masui & De Corte, 2005). The effectiveness of these courses at universities has primarily been investigated within regular class contexts that require physical attendance. However, web-based course formats are becoming more important (Benz, 2010; Waheed, Kaur & Kumar, 2016). They offer many properties that make them attractive, for example, that physical attendance is not required and that students can choose their preferred study times. Web-based course formats allow for higher levels of autonomy and self-determination because they enable students to learn the contents of a course at any time and from anywhere (e.g., Shachar & Neumann, 2003). The question of whether web-based course formats are as effective as regular attendance-based courses has yet to find a clear answer. Therefore, the aim of this study is to compare the effectiveness of a web-based course format with that of an attendance-based course format.

## 2 Process model of SRL

Several popular SRL models (e.g., Boekaerts, 1999; Schmitz & Wiese, 2006; Zimmermann & Schunk, 2011) have postulated that a learner's motivation, cognition, and metacognition are crucial for successful learning. This study refers to Schmitz and Wiese's (2006) SRL model, which is an adaptation of Zimmerman's (2000) three-phase cyclical SRL model, but specified for a concrete situation, namely learning, and in which SRL is exclusively defined as a process of learning states. Its phase structure can serve as the basis for the training structure, which can be divided according to the phases. Moreover, several other effective training programs have been based on this model (e.g., Bellhäuser et al., 2016; Perels, Otto, Landmann, Hertel & Schmitz, 2007). In line with Zimmerman (2000), Schmitz and Wiese (2006) described SRL as a process that comprises a cyclical sequence of three phases: the preaction, action, and postaction phases. The preaction phase is defined by preparing to learn. The learner defines goals that facilitate the evaluation of the learning outcome in the future process. Goal-setting is influenced by situational demands and the given task. Motivation is another key concept of self-regulated learning (Perels et al., 2007; Schmitz & Wiese, 2006). On the basis of these components of the preaction phase, the learner chooses strategies and plans his actions in order to achieve his goals. In the action phase, the main learning takes place. The learner implements his chosen strategies and controls his actions. Self-monitoring, understood as the observation of one's actions (Zimmerman, 2000), is therefore important during the action phase. With self-monitoring, the learner's actual performance can be

checked, and it can influence self-regulation (Schmitz & Wiese, 2006). The postaction phase is defined by the reflection and evaluation of the learning process and learning outcomes. Based on this, consequences for further learning can be derived, and in due course, strategies or goals can be adapted for the following learning cycle. This can be further influenced by the attribution of the learning outcomes and the frame of reference (Abramson, Dykman & Needles, 1991; Rheinberg & Fries, 2010). All variables in one phase are both affected by previous learning phases and predictive of the subsequent learning process (Perels et al., 2007). Therefore, the postaction phase of one learning cycle influences the preaction phase of the next cycle (for a detailed description, see Schmitz & Wiese, 2006).

### 3 SRL trainings

Research has shown that students in various age groups can be successfully trained in SRL and that the acquired skills are associated with improved academic achievement. Most of these interventions were conducted in a school context and required physical attendance (e.g., Dignath & Büttner, 2008; Ferreira & Simão, 2012; Perels, Gürtler & Schmitz, 2005; Randi & Corno, 2000; Reid & Borkowski, 1987; Werth et al., 2012; Zimmerman, 1990). Nonetheless, research has shown that adults can also be trained in SRL. For example, Benz (2010) conducted a meta-analysis that revealed that 19-37-year-old learners indeed profited from SRL interventions. Another meta-analysis (Hattie, Biggs & Purdie, 1996), which also included samples of university students, showed that interventions focusing on SRL skills (e.g., time management, motivation) were successful in enhancing learning. Nevertheless, the samples of university students showed smaller performance increases than the younger age groups. The authors assumed a ceiling effect. However, the university students benefitted more from a positive attitude toward learning. Another study (Zhu, Au & Yates, 2016) showed that university students' SRL and self-control, which were assessed at the beginning of a blended-learning course, predicted students' learning outcomes at the end of the course. The influence of the students' self-control was mediated through their use of self-regulated learning and online course participation. The authors concluded that students have to be able to use self-regulated learning strategies in order to learn more effectively, especially in online learning environments. Therefore, they recommended that teachers support their students in building these strategies, for example, through SRL training. Moreover, a study by Masui and De Corte (2005) emphasized that training programs that included both instructional conditions (for imparting knowledge) and practice conditions (for applying the content that was learned) are effective in helping students improve their SRL skills.

#### 3.1 Web-based interventions

Nowadays, due to digitalization, new learning formats such as web-based learning arise far more often than only in work-related contexts (Bundesministerium für Arbeit und Soziales, 2017; Kattoua, Al-Lozi & Alrowwad, 2016; Mayer, 2017).



This educational trend can also be observed in the university context (e.g., Matuga, 2009; Waheed et al., 2016). Web-based courses for students have many advantages (e.g., Kattoua et al., 2016; Nedeva & Dimova, 2010). For example, the format allows flexibility with regard to where and when the learning occurs and can be adapted to users' abilities (e.g., DeWolfe Waddill, 2006; Fariborzi & Bakar, 2010; Nedeva & Dimova, 2010). Moreover, students become familiar with a learning format that is commonly used in work-related contexts. Students are supported by the fact that they get to learn in an environment with a high degree of freedom, preparing them for their study programs and future professional careers. However, literature (e.g., Margaryan, Bianco & Littlejohn, 2014) shows that in particular massive open online courses (MOOCs), a special form of a web-based course, which is offered to a large amount of students and not only to a selected group within a university course, lack instructional quality. The authors analyzed 76 MOOCs with the course scan questionnaire, which includes a set of principles of instruction (e.g., problem-centred, activation, application). The results showed that most courses scored low.

Mayer (2017) describes twelve different principles that can be used in order to design e-learning materials to facilitate academic learning. In particular, implementing the multimedia-principle in e-learning, meaning that words (spoken or printed) and pictures (static or dynamic) should be presented together rather than alone, yields in better student learning (Mayer, 2003; 2017). Videos or animations with accompanying narration or onscreen text and computer-based interactive games including spoken or printed texts are common examples of using multimedia in e-learning (Mayer, 2017). Furthermore, on the basis of cognitive theory of multimedia learning the author describes how to create effective multimedia instructional messages because not any combination of words and pictures is equally effective. He states three instructional goals with corresponding research-based techniques: reduce extraneous processing (e.g., redundancy) manage essential processing (e.g., segmenting), and foster generative processing (e.g., personalization). In earlier research Mayer (2003) already showed that four instructional design methods (multimedia, coherence, spatial contiguity, personalization) have equal effects in book-based and computer-based environments. He concluded that instructional design methods that are effective in one media environment also promote learning in other environments as long as the same kinds of cognitive processing are promoted and the method is not unique to one media. Clark, Tanner-Smith and Killingsworth (2016) also emphasize in their review about the medium of digital games and learning the important role of the design of an intervention. They conclude that it is not only the environment, but the design within the medium that determines the efficacy of a learning environment.

Mayer (2017) presents a research agenda that requests to further examine using multimedia in e-learning in regard to, for example, long-term effects, replication of material with new learners and more realistic learning environments in order to, on the one hand, share results with instructional designers and, on the other hand, to add to theories of learning.

Web-based courses fostering SRL have thus far received positive evaluations (e.g., Bellhäuser et al., 2016; Cranwell et al., 2014; Feng & Chen, 2014; Kauffmann, Ge, Xie & Chen, 2008; Tsai, Shen & Tsai, 2011; Hu, 2007). The web-based course developed by

Bellhäuser et al. (2016) was based on Schmitz and Wiese's (2006) model. It meets the multimedia criteria presented by Mayer (2017; e.g., videos and animations with spoken texts) and by Margaryan et al. (2014; e.g., application) and was tested in an authentic learning environment. In a randomized controlled evaluation study with 211 university students, they found that training had significant effects on SRL knowledge, SRL behavior, and self-efficacy. Moreover, the participants gave high ratings to the usefulness of the SRL strategies and the quality of the web-based training program. Bellhäuser et al. (2016), who also used the web-based training program from this study reported that the students were very satisfied with the program.

However, the question of whether a web-based course is as effective at fostering SRL as an attendance-based course has yet to find a clear answer. So far, researchers have tried to examine whether web-based or distance education courses are as effective as attendance-based ones by using different criteria (e.g., attitude and achievement outcomes). However, the research findings have been ambiguous. Allen, Bourhis, Burell and Mabry's (2002) meta-analysis included studies that compared students' satisfaction in traditional face-to-face courses versus distance education courses, which included three channels of communication (writing, audio, and video). The findings indicated that students showed a slight preference for a traditional classroom environment. However, the authors stated that satisfaction provided only one possible source of evaluation and should be complemented by other sources of evaluations. Shachar and Neumann (2003) concentrated on an objective dimension of effectiveness. In their meta-analysis, they explored the question of whether there is a difference in students' final academic performance in distance education programs compared with traditional face-to-face programs. They used learning outcome data from 86 studies and showed that distance learning outperformed classroom instruction because in 66 percent of the studies, the final academic performance grades of students in distance education programs were higher than those enrolled in traditional programs. In another meta-analysis, the effectiveness of web-based instruction and classroom instruction for teaching declarative and procedural knowledge as well as reactions to the courses were examined (Sitzmann, Kraiger, Stewart & Wisher, 2006). Participants of the 96 studies were college students or employees who acquired knowledge or skills in workplace training programs. It was shown that web-based instruction was more effective than classroom instruction for teaching declarative knowledge but equally effective for teaching procedural knowledge, and participants were equally satisfied with both delivery media.

In another meta-analysis, Bernard et al. (2004) compared classroom instruction and distance learning regarding achievement, attitude, and retention. They found great variability in effect sizes on all measures, indicating that distance education can surpass classroom instruction and that it can be less effective concerning these measures. Moreover, they criticized the quality of the literature because it lacked design features. The biggest problem that arose from comparing two learning formats was found in the lack of ecological validity (Matuga, 2009). The literature comparing the two formats often lacked a detailed description of the methodology and the contents of the formats (e.g., Bernard et al., 2004). Therefore, to

contribute to this research gap, we compared the web-based course developed by Bellhäuser et al. (2016) with an attendance-based course.

#### 4 Research questions and hypotheses

The aim of the present study was to analyze the effectiveness of a web-based course in comparison with an attendance-based course – differing only in the format – to provide new insights into the effectiveness of web-based courses. For this purpose, the web-based course fostering SRL developed by Bellhäuser et al. (2016) was used because it had already been approved and positively evaluated. For comparison, a parallelized attendance-based course was implemented. For the evaluation, Kirkpatrick’s well-established model served as the framework (Kirkpatrick, 1979), which differentiates between four levels: reaction, learning, behavior, and results. The reaction level measures the acceptance of the training. At the learning level, the increase in participants’ learning is measured; at the behavior level, the extent to which the participants adapted their behavior on the basis of the course is evaluated; and at the result level, the impact of the course on the participants’ institution becomes visible. In this study, an evaluation of the reaction, learning, and behavior levels was realized. It is expected that both course formats would be evaluated positively. Because the two courses differed only in their format, and research (e.g., Sitzmann et al., 2006) has shown that attendance-based and web-based formats are both effective in teaching declarative and in particular procedural knowledge, no differences in their general effectiveness were expected. Thus, the current study postulated the following research questions and hypotheses:

Research question 1: How do students rate the two course formats?

Hypothesis 1: Students in both course formats are satisfied with the courses and rate SRL as useful. Students’ ratings of the two courses are equally positive.

Research question 2: Is the web-based course format as effective as the attendance-based course format?

Hypothesis 2a: Students in both course formats show improvements in their SRL strategies and declarative metacognitive knowledge on SRL over the semester. They do not differ in their SRL strategies and declarative metacognitive knowledge at posttests.

Hypothesis 2b: Students in both course formats report a perceived increase in SRL competence at the end of the semester and do not differ in their evaluation.

#### 5 Methods

##### 5.1 Design

A randomized intervention study was conducted. It was announced that students could register for a course with the title “Self-Regulated Learning”. Students were randomly assigned to two course formats: attendance-based and web-based. Because the effectiveness

of the web-based format had previously been tested against a control group with no intervention, this study investigated only two different training conditions here. Three assessment points were scheduled. The pretest (t1) was conducted before the actual course program started. The first posttest (t2) was conducted after the training units and the second posttest (t3) was conducted after the implementation phase at the end of the semester. Students' background variables, their course evaluation, and their self-regulatory skills were assessed, and a declarative metacognitive knowledge test was implemented. All data were collected with online questionnaires.

## 5.2 Participants

Participants were recruited from educational science and teacher education programs at a German university. 186 students took part in the pretest session, after which they were randomly assigned to either the attendance-based group ( $n = 91$ ) or the web-based group ( $n = 95$ ). 184 participants took part in the posttest assessment (attendance-based group:  $n = 90$ , web-based group:  $n = 94$ ), and 171 participants took part in the second posttest (attendance-based group:  $n = 81$ , web-based group:  $n = 90$ ).

Due to incomplete data, however, some participants had to be excluded, leaving a final  $N$  of 162 for the analyses (12.90% dropout). Attrition analyses revealed that the excluded individuals did not differ from the participants in the final sample concerning the effects of the demographic variables (gender, study time, GPA) and the pretest variables (SRL preaction, action, and postaction phases and declarative metacognitive knowledge) on SRL (Wilks'  $\lambda = .94$ ,  $p = .51$ ).

In the final sample of  $N = 162$  participants ( $n = 38$  male,  $n = 121$  female;  $n = 3$  unspecified; mean age: 23.70 years,  $SD = 3.13$ ,  $Range = 18-44$ ), the attendance-based group consisted of  $n = 77$  students ( $n = 16$  male,  $n = 60$  female,  $n = 1$  unspecified; mean age: 24.01 years,  $SD = 3.61$ ,  $Range = 18-44$ ), and the web-based group consisted of  $n = 85$  students ( $n = 22$  male,  $n = 61$  female,  $n = 2$  unspecified; mean age: 23.41 years,  $SD = 2.62$ ,  $Range = 19-34$ ). Their GPA was 2.23 ( $SD = 0.62$ ,  $Range = 1.0-3.8$ ) in the whole sample (attendance-based group: 2.29 ( $SD = 0.66$ ,  $Range = 1.0-3.8$ ), web-based group: 2.18 ( $SD = 0.58$ ,  $Range = 1.0-3.2$ )). Participants had studied on average for 7.07 semesters ( $SD = 3.79$ ,  $Range = 1-20$ ) in the whole sample (attendance-based group: 7.16 semesters ( $SD = 3.88$ ,  $Range = 1-17$ ), web-based group: 6.99 semesters ( $SD = 3.72$ ,  $Range = 1-20$ )). A MANOVA was computed to analyze differences in demographic and dependent variables between the groups (randomization check). The alpha level was set to .20 in order to test  $H_0$  and thereby minimize the Type II error rate (Bortz, 1999). The multivariate effect (Wilks'  $\lambda = .95$ ,  $p = .73$ ) was not significant. However, there were significant effects of the SRL postaction phase ( $F(1,93) = 2.17$ ,  $p = .15$ ) and gender ( $F(1,93) = 1.97$ ,  $p = .16$ ), but these effects were not interpreted because the multivariate effect was not significant.

### 5.3 Procedure

The students who enrolled in the SRL course were invited to attend the first meeting in the lecture hall where they received an overview of the course requirements and modalities. Participation in our study was voluntary. After this meeting, the students were randomly assigned to the different courses. They were informed via e-mail about their assignment and asked to complete the pretest. All tests were conducted online. After five weeks, when SRL training was completed, the students took the first posttest and started working on a transfer task, which was required to pass the course. After four weeks, the students presented their work in a round-table discussion during an attendance-based session. At the end of the semester, the second posttest was administered, and the students met for the final session where they had the opportunity to give feedback on their experience with the course formats.

### 5.4 Course program

In this study, the web-based training developed and evaluated by Bellhäuser et al. (2016), aimed at supporting students' SRL at university. The training concept was based on the process model by Schmitz and Wiese (2006), consisting of preaction, action, and postaction phases. Each 90-minute unit was released with an interval of one week. Participants acquire cognitive, metacognitive, and motivational learning strategies. The course was provided in an online learning platform (moodle), and the content was transmitted through different media, for example, videos, power point presentations, interactive exercises, and discussion forums. An attendance-based course that followed the same theoretical concept was implemented. The number of units, their duration, structure, and contents, as well as the teaching and learning methods were all identical. The only difference was in the format: web-based versus attendance-based. For example, the students in the web-based course had the opportunity to discuss questions with other students in a discussion forum or ask questions via e-mail, whereas students in the attendance-based course could discuss their questions in the classroom. Both groups had access to the course material after the materials were first released.

*Unit 1 (Introduction, self-regulation model, goal-setting, time-management).* The first unit is about the *preaction phase* and provides an overview of the course and its relevance. An introduction to the process model (Schmitz & Wiese, 2006) illustrated that all learning phases are relevant for successful learning. A further component of this unit is goal-setting (Doran, 1981; Kozlowski & Bell, 2006; Locke & Latham, 1990). Then the students come to understand and apply the SMART technique (Doran, 1981). This technique describes how effective goals are defined and divided into the following categories: specific, measurable, assignable, realistic, and time-related. The final aspects of this unit are planning and time-management. The participants identify time thieves and get to know a technique for effective time-management: the ALPEN-technique (Seiwert, 2004). This technique can be used to draw a timetable that involves the tasks with their durations, buffer time, and a subsequent check.

*Unit 2 (procrastination, distractions, volition, learning strategies).* The second unit deals with the *action phase*. The main focus lies in distractions that occur during the learning process

and the learning strategies. The unit begins with a video that introduces procrastination (Tice & Baumeister, 1997). The participants reflect on their own procrastination and develop strategies to avoid it. The next section discusses distractions. In order to show the consequences of distractions, participants are asked to do the word color stroop task with and without loud noises. The comparison of the test results shows that participants perform better in the condition without noise. Afterwards, they are given more facts about two types of distractions: inner and outer distractions. Participants then receive tips on how to deal with distractions (e.g., turn off mobile phone). The third section of this unit deals with volition (Schmitz & Wiese, 2006; Kuhl & Fuhrmann, 1998) by illustrating that people can actively influence their volition. The last section deals with cognitive, metacognitive, and resource-oriented learning strategies (Bellhäuser et al., 2016; Pintrich, Smith, Garcia & McKeachie, 1991; Schmitz & Wiese, 2006; Wild & Schiefele, 1994).

*Unit 3 (attribution, frame of reference, reflection, motivation).* The third unit is about the *postaction phase* and emphasizes the handling of success, failure, reflection, and motivation. The unit begins with the theory of attribution (Abramson et al., 1991; Peterson & Barret, 1987; Weiner, 1985). In this section, the students are sensitized to different attribution styles and their resulting consequences. For example, in terms of success (e.g., doing well on an exam), the internal attribution style influences future success and motivation in the most adaptive way. The next part is about the frame of reference (Rheinberg & Fries, 2010) that serves as a standard of comparison. It is explained that the individual frame of reference has the best effect on motivation. The next section deals with reflection. The participants formulate three goals: a short-term, a middle-term, and a long-term goal. They are asked to reflect on the short-term and middle-term goals during the next week, focusing on why they have or have not reached their goals. Finally, motivation is addressed as an important factor that influences the whole learning process (Perels et al., 2007; Ryan & Deci, 2000).

The training program was followed by a three-week implementation phase, which required self-regulation skills because the students had to self-structure and work individually on a given task. The students had to choose one aspect of SRL and write a paper about the theoretical concept in APA style and prepare a presentation of their work. For this, they had to conduct a literature review about their chosen SRL aspect and about the formatting style. In this phase, they had to apply the strategies they learned, such as goal-setting, motivation, time management, and reflection on their work. Then, in an attendance-based session, the students had to present their work to their fellow students.

## 5.5 Instruments

Data were assessed via a multimethod approach by employing several self-assessment and objective instruments.

### 5.5.1 Evaluation scales

Students' evaluations were assessed retrospectively with questions about the SRL course at t3. Students were asked for their opinions about the usefulness of SRL for studying (five-point Likert scale; 1 = not useful at all to 5 = very useful) and about their satisfaction with the course (1 = not satisfied at all to 5 = very satisfied). Additionally, they had to indicate the extent to which they thought they profited from the course regarding the eleven SRL aspects that were part of the course (e.g., "How much competence did you build in the SRL course regarding the following aspects: For comparison, please refer to the beginning of the course. ... time-management?"; 1 = no increase at all, 5 = a large increase). They were also asked about their perceptions of the overall increase in their learning (1 = very low, 5 = very high).

### 5.5.2 Knowledge test

Declarative metacognitive knowledge on SRL was measured with a knowledge test (Butz et al., 2016) at t1, t2, and t3. The questions covered the contents taught in the course and the components of SRL. The test consisted of 14 multiple-choice items with three possible answers – one correct answer and two distractors (e.g., "Please assign the following self-regulation aspect to one component. Reflection: cognitive / metacognitive / motivational component"). Questions are worth 1 point for each correct answer, so a score between 0 and 14 points could be reached. The test showed a good range for difficulty ( $P_{it1} = 0.03-0.71$ ,  $P_{it2} = 0.12-0.77$ ,  $P_{it3} = 0.14-0.71$ ), and the discriminatory power was satisfactory ( $D_{it1} = .09-.67$ ;  $D_{it2} = .06-.83$ ;  $D_{it3} = .10-.87$ ).

### 5.5.3 Self-regulated learning

Self-regulated learning was assessed at t1, t2, and t3 with twelve items from questionnaires for assessing SRL and learning-strategy application (Bellhäuser, Roth & Schmitz, 2015; Wild & Schiefele, 1994), representing the three phases of Schmitz and Wiese's (2006) SRL model. The participants were asked to indicate their agreement on a six-point Likert scale ranging from 1 (not true) to 6 (true). The instrument consists of three scales (preaction, action, postaction phases), which were captured with four items each. The preaction phase scale (Cronbach's  $\alpha_{t1} = 0.77$ , Cronbach's  $\alpha_{t2} = 0.75$ , Cronbach's  $\alpha_{t3} = 0.73$ ; e.g., "I check regularly to see if I am still following my goals"), the action phase scale (Cronbach's  $\alpha_{t1} = 0.65$ , Cronbach's  $\alpha_{t2} = 0.60$ , Cronbach's  $\alpha_{t3} = 0.62$ , e.g., "I lack the patience for tasks I would have to do for a long time"), and the postaction phase scale (Cronbach's  $\alpha_{t1} = 0.75$ , Cronbach's  $\alpha_{t2} = 0.77$ , Cronbach's  $\alpha_{t3} = 0.77$ , e.g., "In the evenings, I think about what

worked out well and what I want to do differently tomorrow”) showed acceptable to good internal consistencies.

## 6 Results

Data were analyzed with MANOVAs and repeated-measures MANOVAs. Furthermore, pairwise tests with Bonferroni corrections were computed for comparisons of the measurement points. Means ( $M$ ), standard deviations ( $SD$ ), and intercorrelations between all measures are presented in Table 1. For the evaluation, Kirkpatrick’s model served as the framework (Kirkpatrick, 1979).

insert Table 1 here

### 6.1 Reaction level: Course evaluations

In order to answer research question one and to measure the impact on the reaction level (Kirkpatrick, 1979), the students rated their satisfaction with their course and the usefulness of SRL for studying. All students’ ( $N = 146$ ) average rating of their satisfaction was 3.93 ( $SD = 0.76$ ;  $n_{\text{attendance-based group}} = 70$ ,  $M = 3.90$ ,  $SD = 0.82$ ;  $n_{\text{web-based group}} = 76$ ,  $M = 3.96$ ,  $SD = 0.70$ ), and the usefulness of SRL for studying was rated 4.22 ( $SD = 0.75$ ;  $M_{\text{attendance-based group}} = 4.21$ ,  $SD = 0.74$ ;  $M_{\text{web-based group}} = 4.22$ ,  $SD = 0.76$ ). A MANOVA revealed no differences between the groups (Wilks’  $\lambda = .95$ ,  $p = .94$ ). The alpha level was set to .20 because  $H_0$  was tested to minimize the Type II error rate (Bortz, 1999).

### 6.2 Learning and behavior levels: Training effectiveness

A repeated-measures MANOVA was conducted to test whether participants gained knowledge and whether their SRL strategies improved over the semester (research question 2). The SRL preaction, action, and postaction phase scales as well as declarative metacognitive knowledge on SRL were included as dependent variables. There was a significant main effect of time, indicating changes across the entire sample for the dependent variables ( $F(8, 136) = 25.89$ ,  $p = .00$ ,  $\eta^2 = .60$ ). The same was true for the univariate effects of every single dependent SRL variable (see Table 2). To analyze the time x treatment interaction effect, the alpha level was set to .20 because  $H_0$  was tested to minimize the Type II error rate (Bortz, 1999). The overall MANOVA was not significant, indicating that the two groups benefitted from the training equally ( $F(8, 136) = .78$ ,  $p = .63$ ,  $\eta^2 = .04$ ). The pairwise tests with a Bonferroni correction for the main effect of time revealed a nonsignificant effect of t1-t2 for the SRL preaction phase ( $p = .79$ ) and a significant effect of t2-t3 ( $p < .001$ ). The same was true for the SRL action phase, in which the effect of t1-t2 was not significant either ( $p = 1.00$ ), but the effect of t2-t3 was significant ( $p < .001$ ). For the SRL postaction phase, the effects of t1-t2 and



t2-t3 were both significant ( $p < .001$ ,  $p < .001$ ). For declarative metacognitive knowledge on SRL, the tests showed a different picture insofar as the effect of t1-t2 was significant ( $p < .001$ ), but the effect of t2-t3 was not significant ( $p = .79$ ).

insert Table 2 here

Furthermore, the students were asked about their perceptions of the development of their SRL competence and knowledge and rated the overall increase in their learning at t3 (Table 3). All aspects were rated with a mean value between three and four. Reflection was the aspect with the largest increase in both groups, and social learning had the smallest increase. They also gave high ratings to the overall increase in their learning. To analyze whether the groups differed in their evaluations, a MANOVA was computed and was not significant (Wilks'  $\lambda = .95$ ,  $p = .94$ ). Again, the alpha level was set to .20 because  $H_0$  was tested to minimize the Type II error rate (Bortz, 1999).

insert Table 3 here

## 7 Discussion

The present study explored the effectiveness of a web-based course format in fostering SRL in comparison with a regular attendance-based format at university. For comparison, a web-based training and a parallelized attendance-based training were used, which differed only in their formats.

### 7.1 Training evaluation

The students gave high ratings for usefulness and were very satisfied with the courses (research question 1). This is an important finding because, although a positive reaction does not ensure learning or transfer, participants' attitudes can influence the success of a course (e.g., Arthur, Bennett, Edens & Bell, 2003; Bergmann & Sonntag, 2006; Burke & Hutchins, 2007; Grossman & Salas, 2011). For example, satisfaction with the training can influence participants' motivation to learn, which is a condition for learning success. Moreover, participants who believe that a training is useful are more likely to apply the skills they learned in it (Burke & Hutchins, 2007; Grossman & Salas, 2011). Therefore, if the findings at the reaction level are negative instead, the recommendation would be to modify the training program (Bergmann & Sonntag, 2006).

At the learning and behavior levels, the evaluation of the main research question (research question 2) was realized, namely, the comparison of the web-based and attendance-based

training formats. In order to analyze the effectiveness of both formats, a repeated-measures MANOVA was computed for the pre-posttest comparison. The MANOVA showed a significant main effect of time, indicating positive changes in the SRL preaction, action, and postaction phases and knowledge about SRL from pre- to posttest. Unexpected was that the pairwise tests showed for t1-t2 that only the improvement in the postaction phase was significant, indicating that the training program supported students' reflection skills. Then, regarding t2-t3, the students significantly improved their SRL strategies in the preaction, action, and postaction phases. This finding indicates that the implementation phase, in which the students had to work on a task for which they were asked to apply what they had learned, is crucial for enhancing SRL strategies in all phases. In the implementation phase, the students might have paid more attention to and applied their learning strategies not only during their actual learning but also in preparing and reflecting on their learning, leading to an improvement in strategies in all phases. As opposed to strategy improvement, the significant increase in knowledge took place from t1-t2. This is not surprising because training on the content-related input ended just before t2. Thus, an increase in declarative knowledge comes along with factual input, whereas procedural knowledge and skill development require application to develop. Therefore, one can conclude that leaving room for the application of the trained strategies is crucial for actually building the trained competences. Thus, an implementation phase is crucial for success in training.

Research on training has confirmed that trainees need opportunities to use new learning for a successful transfer (e.g., Burke & Hutchins, 2007; Kauffeld, Lorenzo & Weisweiler, 2012). Leutner and Leopold (2003) demonstrated that strategy training was more successful for the group that had to apply the strategies they had learned than the group that only received training. Learning by itself (i.e., an increase in declarative knowledge) is not enough for training to be considered effective because real success requires changes in performance (Grossman & Salas, 2011). Hence, not only knowledge acquisition but also the application of the material should be included in training programs (Leutner & Leopold, 2003). This is in line with Kirkpatrick's evaluation levels: that is, the behavior level is situated above the learning level.

Furthermore, as expected, the time x treatment interaction effects were not significant, indicating that the students in the two courses showed equal gains in SRL strategies in the preaction, action, and postaction phases as well as declarative metacognitive knowledge about SRL over the semester, even under conservative testing with an alpha level of .20. The students' retrospective evaluation at t3 showed that they also perceived that they gained competence and knowledge in SRL because they gave high ratings to the development of all SRL aspects. The comparison of the groups showed no differences between the groups. The result of the objective metacognitive knowledge test confirmed that not only did the students think they gained knowledge, but they objectively did.

Because web-based courses are increasingly employed, it is important to examine whether this educational medium is effective for teaching knowledge and skills (Sitzmann et al., 2006). The findings of our study suggest that the web-based course as well as the attendance-based course format can be implemented at university in order to support SRL with comparable

effectiveness. However, it is important to acknowledge that, like face-to-face instruction, web-based instruction still requires resources in terms of preparation and supervision, and delivery media such as laptops are cost-intensive. Therefore, it should be weighed carefully whether a web-based course or an attendance-based course should be implemented. For example, web-based courses could be offered to students who are not able to attend an attendance-based course. Apart from this, a web-based course to foster SRL could be offered in addition to the regular course program. It could be part of a summer school or offered to students in the introductory phase because SRL is an essential component to learn successfully (e.g., Hattie et al., 1996), and it should therefore be trained as early as possible.

## 7.2 Strengths, limitations, and future research

A strength of the present study is its (quasi-)experimental design. All participants were randomly assigned to the attendance-based or web-based group. Moreover, the study was conducted in a real setting. Another strength of the study is the implementation of a multi-method assessment by combining several self-assessment instruments and an objective measure. Although self-assessments are still the most common way to assess SRL, it is important to mention that it would be desirable to administer more objective measures because self-reports have several limitations (Maag Merki, Ramseier & Karlen, 2013). The literature has shown that SRL and academic achievement are positively related, but this relation has also been discussed critically (e.g., Valle et al., 2008). Therefore, it is advantageous to collect real performance data (e.g., grades). In doing so, we were also able to analyze whether the intervention had a positive impact on academic performance. Apart from this, situational-judgment tests (SJTs) are promising for overcoming the methodological limitations of self-reports (Maag Merki et al., 2013). Because SJTs measure the quality of learning strategies, they are able to overcome the limitation of the assessment of quantity applied with self-reports, which are based on the underlying assumption that carrying out more strategies is better (Wirth & Leutner, 2008). SJTs should be integrated into future research because a combination of many types of tests will provide a more realistic picture.

Apart from this, the study used a sample size that was drawn from only one university, and 75 percent of the sample was female. Because this is typical in educational studies, this sample can be considered representative of this field. The study by Bellhäuser et al. (2016) was conducted in mathematically oriented fields of study, and 78 percent of the sample consisted of men. Because the intervention showed similar effects, this indicates that the intervention has similar effects in samples consisting of more men and from different disciplines. However, the current results should be replicated in future studies with larger samples from more universities.

Apart from this, the web-based course had no adaptive features, which means that the students were not able to decide what they wanted to learn, only where and when in a certain time slot of a certain week. In further development, more sophisticated pedagogical approaches should be taken into consideration. For example, when students enter the course with a high prior knowledge or skill level in certain aspects, they should have the opportunity

to skip selected contents. Their level of knowledge could be tested with a prior knowledge assessment so that each student can join an individual course program and thereby obtain a starting point from which to approach the course material (Rowe & Rafferty, 2013). This would be an advantage over conventional teaching at university.

Another point concerns the lengths of the sections of both course formats, which were designed for 90-minute sessions. The students who participated in the web-based training program of Bellhäuser et al. (2016) stated that they needed on average 90 minutes for each unit. However, students in the web-based format were free to choose their own study time and pace. Thus, they could divide the sections to study them in parts or repeat certain contents according to their preferences. The students in the attendance-based format could not choose the course time, but, because they had access to the material after the lesson, they also had the chance to repeat the material. Thus, future studies should investigate how much time the students spent learning in order to analyze whether study time influences the outcome variables. It is also possible, however, for students in an attendance-based course to be inattentive or to be focusing on different contents on their smartphones or laptops. For example, in the study by Zhu et al. (2016), the time spent online and the number and length of online contributions were assessed, and the effect of SRL on learning outcomes was in fact mediated by online course participation. Similar effects were found in the study by Imhof and Vollmeyer (2009) who examined the effects of a blended-learning course on SRL. It was shown that the frequency of the use of the electronic learning material was positively correlated with the final grade.

Apart from this, a modification regarding the evaluation of the behavior level and the implementation of the evaluation of the result level could be taken into consideration. The evaluation of the behavior and result levels was more difficult to obtain than the reaction and learning levels because changes in the actual performance and the training's impact on the participants' institution should be visible (Kauffeld et al., 2012; Kirkpatrick, 1979). In this study, the behavior level was gauged at three measurement points. In future research, however, it would be desirable to use an instrument that measures the extent to which participants adapted their behavior while they were actually learning. For example, in weekly reports or in a daily learning diary, the implementation of the strategies could be assessed in a student's learning environment (Schmitz & Wiese, 2006; Zhu et al., 2016). Regarding the result level, in further studies, cohorts with and without SRL training could be compared with respect to performance tests or final grades. It can be expected that the effect on the institutional level in terms of final grades would not be directly measurable after training. However, the evaluation on this level is the most challenging because several contextual factors can influence the institution's output (Kauffeld et al., 2012; Kirkpatrick, 1979). Kirkpatrick (1979) recommended that the reaction, learning, and behavior levels should be evaluated first.

In spite of the described potential improvements, this study met the requirements introduced by Matuga (2009) and Bernard et al. (2004) by showing ecological validity and providing a detailed description of the methodology and content of the formats. Moreover, in this study, delivery media and the instructional methods were not confounded, which was criticized by Clark (1994) because the two courses differed only in their format. The results

of this study are also in line with Mayer's (2017) statement saying that instructional design methods that are effective in one media environment also promote learning in other environments if the same kinds of cognitive processing are promoted and the method is not unique to one media.

This is the first study to compare an attendance-based course and a web-based course in a real setting showing that the two course formats were equally effective. The study has high relevance because it addressed an important aspect of successful learning in the university context, and the results lead us to the conclusion that it is possible to enhance SRL in university students in different training formats. In this respect, it is important to note that when employing a training program, not only a theory but also an implementation phase is crucial. This study indicates that learners need opportunities to apply the material they learned in order to actually develop the ability to apply the strategies. Although it was challenging to conduct this field study, it revealed important findings and provides implications for supporting SRL in a university setting.

8 Literature

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## Tables

Table 1

*Means (M), standard deviations (SD), and intercorrelations between all measures at t1*

	Descriptives		1	2	3	4	5	6
	<i>M</i>	<i>SD</i>						
1 Study time	7.07	3.79	-	-.33**	-.04	-.11	.00	.25**
2 GPA	2.21	.62		-	-.23**	-.05	-.14	-.26**
3 SRL Pre	3.76	1.14			-	.48**	.37**	.14
4 SRL Act	4.25	.94				-	.48**	-.01
5 SRL Post	3.99	1.03					-	.01
6 SRL knowledge	6.70	2.34						-

*Note.*  $N = 162$ , \*\* $p < .01$ .

Table 2

*Effects of treatment: ANOVAs for the pre-posttests, comparing the web-based group vs. the attendance-based group*

	<i>M</i> <sub>attendance-based group</sub> ( <i>SD</i> )		<i>M</i> <sub>web-based group</sub> ( <i>SD</i> )		group		time		time x treatment			
	<i>t1</i>	<i>t2</i>	<i>t3</i>	<i>t1</i>	<i>t2</i>	<i>t3</i>	<i>F</i> ( <i>df</i> )	$\eta^2$	<i>F</i> ( <i>df</i> )	$\eta^2$		
SRL preaction phase	3.76 (1.17)	3.80 (.94)	4.17 (.94)	3.82 (1.11)	3.94 (1.02)	4.17 (.94)	<i>F</i> (1,143)=.07	.00	<i>F</i> (2,286)=12.22**	.08	<i>F</i> (2,286)=1.42	.01
SRL action phase	4.29 (.89)	4.28 (.73)	4.58 (.81)	4.28 (.95)	4.31 (.89)	4.53 (.78)	<i>F</i> (1,143)=.00	.00	<i>F</i> (2,286)=10.57**	.07	<i>F</i> (2,286)=.18	.00
SRL postaction phase	3.90 (1.06)	4.18 (.95)	4.47 (.95)	4.06 (.99)	4.33 (.90)	4.67 (.95)	<i>F</i> (1,143)=1.68	.01	<i>F</i> (2,286)=30.61**	.18	<i>F</i> (2,286)=.08	.00
SRL knowledge	6.42 (2.65)	9.23 (1.79)	9.46 (1.92)	7.05 (1.91)	9.32 (1.71)	9.46 (1.68)	<i>F</i> (1,143)=1.17	.00	<i>F</i> (2,286)=106.36**	.43	<i>F</i> (2,286)=1.36	.01

*Note.* Alpha level was set to .20 because  $H_0$  was tested, \* $p < .20$ , \*\* $p < .01$

$n_{attendance-based\ group} = 69$ ,  $n_{web-based\ group} = 76$ .

Table 3

*Students' perceptions of competence increases in aspects of SRL*

Aspect	<i>M (SD)</i>	<i>M (SD)</i> <sub>attendance-based group</sub>	<i>M (SD)</i> <sub>web-based group</sub>
Goal-setting	3.64 (.98)	3.54 (1.06)	3.72 (.90)
Time-management	3.66 (.97)	3.53 (1.05)	3.78 (.88)
Procrastination	3.45 (1.12)	3.47 (1.11)	3.43 (1.14)
Handling distractions	3.33 (1.19)	3.23 (1.22)	3.42 (1.17)
Self-instruction	3.44 (.99)	3.40 (1.04)	3.47 (.95)
Cognitive learning strategies	3.45 (.94)	3.34 (.93)	3.54 (.94)
Metacognitive learning strategies	3.53 (.88)	3.46 (.93)	3.59 (.94)
Social learning	3.25 (1.06)	3.14 (1.04)	3.34 (1.08)
Reflection	3.75 (.84)	3.69 (.84)	3.82 (.83)
Handling success and failure	3.36 (1.13)	3.24 (1.22)	3.46 (1.04)
Motivation	3.64 (1.06)	3.46 (1.22)	3.80 (.99)
Subjective learning increase (overall)	3.39 (.76)	3.34 (.83)	3.43 (.68)

*Note.*  $N = 146$ , response format: five-point Likert scale (1 = no increase at all, 5 = large increase).

## Appendix B - 2<sup>nd</sup> Paper (Study II)

Study II: Promotion of self-regulated learning at university: Importance of students' individual characteristics for success of SRL-training

*Note:* This is the submitted version of the article.

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## Deutsche Version

Titel: Förderung des Selbstregulierten Lernens an der Universität: Bedeutung individueller Eigenschaften von Studierenden für den Erfolg eines SRL-Trainings

### Zusammenfassung

Manche Studierende weisen eine geringe Kompetenz im selbstregulierten Lernen (SRL) auf, was nicht unproblematisch ist, da SRL für den Erfolg im Studium von Relevanz ist. Aus diesem Grund kommt der Förderung des SRL von Studierenden eine bedeutsame Aufgabe zu. Die Frage, ob bestimmte Studierendengruppen mehr von einem SRL-Training profitieren als andere, wurde bisher nicht beantwortet. Es gibt Hinweise darauf, dass Persönlichkeits- und motivationale Eigenschaften mit SRL zusammenhängen. Das Ziel dieser Interventionsstudie mit 162 Studierenden ist daher zu untersuchen, inwiefern diese individuellen Charakteristiken (Persönlichkeit und Motivation) den Zuwachs von SRL durch ein Training – bestehend aus zwei Phasen (Theorie und Anwendung) und zwei Formaten (web-basiert und präsenz-basiert) – innerhalb eines Semesters beeinflussen. Gesamthaft konnten die Ergebnisse zeigen, dass sich SRL bei Studierenden erfolgreich fördern lässt, jedoch das Ausmaß des Trainingserfolgs dabei von individuellen Persönlichkeitseigenschaften, nicht aber von Motivation, beeinflusst wird. Hierarchische Regressionsanalysen zeigten, dass die Persönlichkeitsvariablen Gewissenhaftigkeit, Verträglichkeit und Offenheit für Erfahrung den Zuwachs an SRL signifikant vorhersagen konnten. Dabei ist Gewissenhaftigkeit für beide Trainingsformate und beide Trainingsphasen bedeutsam, wohingegen Verträglichkeit für die Theoriephase im Präsenzformat und Offenheit für Erfahrung für die Anwendungsphase ebenfalls im Präsenzformat bedeutsam ist. Für zukünftige Studien wird der Einbezug differentieller Analysen bei der Evaluation von Interventionen empfohlen.

Schlagwörter: Motivation, Persönlichkeit, Selbstreguliertes Lernen, Training

English Version

Title: Promotion of Self-Regulated Learning at University: Importance of Students' Individual Characteristics for SRL-Training Success

Abstract

Some university students show little self-regulated learning competencies (SRL), which is a problem because SRL is highly relevant for learning success. Thus, fostering students' SRL in university education is important. While there is evidence that SRL is related to personality and motivational traits, the question whether particular students profit more than others from SRL-training has not been answered yet. Therefore, in a study with 162 university students it was investigated how personal characteristics (personality, motivation) influence students' gain in SRL through training, including two phases (theory and application) and presented in two formats (web-based and attendance-based). Data on students' SRL was collected throughout the semester. Hierarchical regression analyses revealed that personality, but not motivation, predicted gain of SRL over one semester. More precisely, conscientiousness, agreeableness and openness for experience significantly predicted increases in SRL with varying importance for the two different phases of the training and the training format. Conscientiousness influenced both theory and implementation phases in both formats, agreeableness was related to the theory phase in the attendance-based format, and openness was related to the implementation phase in the attendance-based format. Overall, findings suggest that SRL can be trained in students, but the extent seems to be affected by personality traits. Therefore, the addition of differential analyses in the evaluation of interventions is recommended.

Keywords: motivation, personality, self-regulated learning, training



## 1 Einführung

Selbstreguliertes Lernen (SRL), bzw. „Prozesse, durch die Lernende selbst Kognitionen, Affekte und Verhaltensweisen aktivieren und aufrechterhalten, die systematisch auf das Erreichen persönlicher Ziele ausgerichtet sind“ (Zimmerman & Schunk, 2011, S. 1), ist eine essenzielle Komponente für erfolgreiches Studieren an der Universität (z.B. Autoren1; Kitsantas, Winsler & Huie, 2008; Schunk & Ertmer, 2000). Jedoch bekunden einige Studierende Mühe mit der Selbstregulation ihres Lernens (z.B. Peverly, Brobst, Graham & Shaw, 2003; Deing, 2019). Forschung zu SRL-Trainings hat gezeigt, dass studienbegleitende Kurse SRL erfolgreich fördern können (z.B. Autoren12; Broadbent, Panadero & Fuller-Tyszkiewicz, 2020; Dörrenbächer & Perels, 2016). In der Regel wird ein Kurs in der Erwartung angeboten, dass alle Teilnehmerinnen und Teilnehmer in gleicher Weise profitieren. Unterschiedliche Umstände können jedoch den Erfolg einer Intervention und damit den Lernerfolg der Studierenden beeinflussen (z.B. Schober et al., 2015). Die Kenntnis sowohl fördernder als auch hemmender Faktoren des individuellen Trainingserfolgs würde die Möglichkeit bieten, Interventionen zumindest teilweise an die speziellen Bedürfnisse der Lernenden anzupassen. So betonen Eckert, Seifried und Spinath (2015) die Bedeutung individueller Merkmale: 50% der interindividuellen Unterschiede in schulischen Leistungen können durch Unterschiede in kognitiven und motivationalen Eigenschaften der Studierenden erklärt werden. Adaptives, individuelles Testen und Training, das die individuellen Merkmale der Lernenden berücksichtigt, wird als ein wertvoller Ansatz im Bereich der Pädagogischen Psychologie diskutiert (z.B. Deing; 2019; Eckert et al., 2015; Gold, 2018). Das Ziel dabei ist, Lernende mit unterschiedlichen Kompetenzen und Eigenschaften zu unterstützen, um ihren Lernerfolg zu maximieren.

Individuelle Merkmale könnten auch bei SRL-Trainings eine Rolle spielen; jedoch ist dem bisher kaum nachgegangen worden. Daher ist das Ziel der vorliegenden Studie zu untersuchen, welche individuellen Charakteristiken den SRL-Trainingserfolg beeinflussen können und welche sowohl in Forschung als auch in Praxis stärker beachtet werden sollten. Hierzu wird ein SRL-Training verwendet, das bereits sowohl präsenz-basiert als auch web-basiert durchgeführt und als wirksam evaluiert wurde (Autoren12), um zu untersuchen, ob bestimmte Studierendengruppen besonders von dem Training und einzelnen Elementen profitieren. Insbesondere für Lehrende ist es vorteilhaft die Voraussetzungen ihrer Studierenden zu kennen, um eine adaptive Lernumgebung zu schaffen (z.B. Eckert et al., 2015; Kokkinos, Kargiotidis & Markos, 2015).

### 1.1 Prozessmodell des Selbstregulierten Lernens

Viele bekannte SRL-Modelle postulieren, dass Motivation, Kognition sowie Metakognition wichtige Bestandteile erfolgreichen Lernens sind (z.B. Boekaerts, 1999; Zimmerman & Schunk, 2011). Ein im deutschsprachigen Raum bewährtes Modell ist das Prozessmodell von Schmitz und Wiese (2006), eine inhaltliche Erweiterung des Zimmerman Modells (2000). Es dient als konzeptueller Rahmen dieser Studie. Das Modell von Schmitz und

Wiese (2006) bezieht sich auf eine konkrete Lernsituation und nimmt an, dass SRL in drei Phasen abläuft: Die *präaktionale* Phase ist durch die Lernvorbereitung bestimmt. Hier werden Handlungen und Lernstrategien geplant und Ziele zur Evaluation des Lernergebnisses definiert. Motivation ist nicht nur in dieser Phase bedeutsam, sondern auch in der *aktionalen* Phase, in der das eigentliche Lernen stattfindet. Geplante Handlungen werden eingesetzt, kontrolliert und beobachtet. In der *postaktionalen* Phase wird der Lernprozess bewertet und gegebenenfalls angepasst. Diese Phase kennzeichnet die Reflexion und Evaluation des Lernprozesses und -ergebnisses, aus der Konsequenzen für zukünftiges Lernen abgeleitet werden. Deshalb kann die postaktionale Phase die präaktionale Phase eines nächsten Lernzyklus beeinflussen (Schmitz & Wiese, 2006). Ein Training, das alle SRL-Phasen mit den dazugehörigen SRL-Strategien abdeckt, sollte zu optimaler Leistung und Motivation führen und die Evaluation der Lernstrategien der Studierenden erleichtern (Cleary et al., 2008; Dignath & Büttner, 2008).

## 1.2 Differenzielle Effekte von Trainings

Bisher wurde bei der Evaluation von SRL-Trainings vorherrschend die durchschnittliche Veränderung einer Trainingsgruppe betrachtet, ohne den Einfluss persönlicher Eigenschaften der Lernenden ausreichend zu berücksichtigen. Individuelle Charakteristika können jedoch die Lernsituation beeinflussen, was zu unterschiedlichen Lernerfahrungen führt. Somit können Personen unterschiedlich von derselben Intervention profitieren. Individuelle Unterschiede und ihren Beitrag zu differentiellen Trainingseffekten zu verstehen und zu untersuchen, hat mehrere Vorteile (z.B. Lapka, Wagner, Schober, Gradinger & Spiel, 2011). Zum einen ergänzt dies das Wissen über die relevanten individuellen Merkmale im Kontext von SRL. Zweitens ist die Identifizierung und Differenzierung von globalen und differentiellen Trainingseffekten möglich. Drittens ist das Wissen darum wichtig für weitere Handlungsentscheidungen, da Fehlinterpretationen vermieden werden können, wie das Einstellen vermeintlich ineffektiver Trainings. Darüber hinaus kann die Wirksamkeit eines Trainings durch einen adaptiven oder individuell angepassten Ansatz erhöht werden. Um die Funktionsweise eines SRL-Trainings und Unterschiede zwischen den Lernenden besser zu verstehen und zu erkennen, sollte analysiert werden, wie individuelle Merkmale den Erfolg des SRL-Trainings beeinflussen. So zeigen einige Untersuchungen, dass Personen mit unterschiedlichen SRL-Kompetenzen unterschiedlich stark von SRL-Trainings profitieren. Dörrenbächer und Perels (2016) konnten beispielsweise differentielle Effekte ihrer SRL-Intervention bei Studierenden nachweisen. Vor allem Studierende mit niedrigen oder hohen SRL-Kompetenzen profitierten nur wenig von der Intervention. In einer anderen Studie zu differentiellen Trainingseffekten hingegen profitierten vorwiegend Probanden mit niedrigen SRL-Kompetenzen von dem eingesetzten SRL-Training (González-Pienda, Fernández, Bernardo, Núñez & Rosário, 2014). Schmidt, Perels und Schmitz (2010) kombinierten in ihrer Untersuchung zur Effektivität eines SRL-Trainings bei Schülerinnen und Schülern unterschiedliche Methoden, um individuelle und gruppenbezogene Daten zu vergleichen und fanden beispielsweise, dass Motivation die Planungskomponente eher beeinflusste als die Interventionsgruppe.

Ergebnisse über differentielle Trainingseffekte liefern bedeutsame Informationen über die Gestaltung und Konzeption von SRL-Interventionen. So führt Wissen über potenzielle Defizite dazu, dass man diese im Training gezielt berücksichtigt und dadurch optimaler Weise ausgleichen kann. Beispielsweise haben Stoeger, Fleischmann und Obergriesser (2015) ein adaptives SRL-Training für Grundschüler mit unterschiedlichen Fähigkeitsniveaus entwickelt. Inwieweit andere individuelle Unterschiede neben SRL-Ausgangsniveau die Effektivität eines SRL-Trainings beeinflussen, ist bisher wenig erforscht (z.B. Dörrenbächer & Perels, 2016; Lapka et al., 2011).

Der Passung zwischen Person und Umgebung (*Person-Environment-Fit*; PE-Fit) wird auch für den Lernerfolg im Hochschulkontext eine Bedeutung zugeschrieben (vgl. Pawlowska, Westerman, Bergman & Huelsman, 2014). Forschung im Lehr-/Lernkontext hat gezeigt, dass Persönlichkeit die Effektivität von Interventionen, aber auch die Interaktion von Persönlichkeit und Lernumgebung (*classroom environment*) die Leistung von Schülerinnen und Schülern beeinflussen kann (z.B. Pawlowska et al., 2014; Schniederjans & Kim, 2005). Diese Annahme und empirischen Belege sollen in der vorliegenden Studie auf den Kontext von Lernen und SRL übertragen werden. Der differentielle Einfluss bestimmter vorhandener persönlicher Merkmale in einer Intervention wird auch als *aptitude-treatment interaction* (ATI) bezeichnet (z.B. Preacher & Sterba, 2019). Dabei werden Persönlichkeitseigenschaften und motivationale Faktoren als zwei zentrale persönliche Merkmale einbezogen, da diesen im Kontext von Lernen und SRL wiederholt eine große Bedeutung zukommt (Bidjerano & Dai, 2007; McCrae & Löckenhoff, 2010; Vermetten, Lodewijks & Vermunt, 2001). Persönlichkeit und Motivationen hängen einerseits mit SRL-Kompetenzen zusammen (z.B. Bidjerano & Dai, 2007; Vermetten et al., 2001), Studien zeigen aber auch wiederholt, dass sie das Lernen – unabhängig vom konkreten Inhalt – auf vielfache Art erleichtern (z.B. Richardson, Abraham & Bond, 2012; Pawlowska et al., 2014). Ausgehend von PE-Fit und ATI, könnte das Erlernen von SRL-Strategien durch eine entsprechende Intervention, je nach individueller Merkmalsausprägung und Lernumgebung (web-basiert versus präsenz-basiert) begünstigt oder gehemmt werden (z.B. Schniederjans & Kim, 2005). Im Folgenden werden empirische Studien und konzeptuelle Überlegungen beschrieben, inwiefern individuelle Unterschiede in diesen Bereichen mit SRL und der Effektivität von SRL-Trainings zusammenhängen könnten.

### 1.3 SRL und Persönlichkeit

Persönlichkeit beschreibt individuelle Unterschiede zwischen Personen, die zeitlich und über Situationen hinweg relativ stabil bleiben, und Kognition, Verhalten und Emotionen erklären (Hogan, Hogan & Roberts, 1996). Das Big Five Persönlichkeitsmodell umfasst die Traits Gewissenhaftigkeit (G), Offenheit für Erfahrung (O), Verträglichkeit (V), Extraversion (E) und Neurotizismus (N) (McCrae & Costa, 1987). Persönlichkeit kann grundlegend die Anwendung von Lernstrategien begünstigen oder beeinträchtigen und ist daher eine zentrale Variable für Lernen (Heinström, 2000; Kokkinos et al., 2015). Darüber hinaus gibt es Hinweise, dass SRL mit Persönlichkeitsmerkmalen der Big Five substantiell zusammenhängt (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016). Individuelle

Persönlichkeitsunterschiede der Studierenden könnten daher den Erfolg eines Trainings, insbesondere eines welches SRL-Strategien vermittelt, beeinflussen. Im Folgenden werden Forschungsbefunde präsentiert, wie Persönlichkeit mit Lernen und darüber hinaus mit SRL zusammenhängt und Hypothesen über den differentiellen Einfluss der Persönlichkeitseigenschaften auf den SRL-Trainingserfolg abgeleitet.

*Gewissenhafte* Personen tendieren dazu, ihr Verhalten im Sinne ihrer gesetzten Ziele zu kontrollieren (McCrae & Löckenhoff, 2010). G hängt stark mit akademischer Leistung sowie akademischer Motivation zusammen (Komarraju, Karau & Schmeck, 2009; Ljubin-Golub, Petričević & Rován, 2019; Richardson, Abramson & Bond, 2012; Spengler, e, Martin & Brunner, 2013). Gewissenhaft Studierende zeigen hohe Persistenz, Selbstdisziplin, Selbstkontrolle, Motivation, Anstrengungsregulation, geringe akademische Prokrastination, wenden bevorzugt Zeitmanagement-Strategien an, sind perfektionistisch und zeigen ein hohes Maß an kognitiven Strategien wie Metakognition, Elaboration sowie kritisches Denken und sind gut organisiert (Bidjerano & Dai, 2007; Chamorro-Premuzic, Ahmetoglu & Furnham, 2008; Chamorro-Premuzic & Furnham, 2003; Eilam, Zeidner & Aharon, 2009; Kokkinos et al., 2015; Ljubin-Golub et al., 2019; McCrae & Costa, 1987; McCrae & Löckenhoff, 2010; Ruffing, Hahn, Spinath, Brünken, & Karbach, 2015; Stoeber, Otto & Dalbert, 2009). Dieser Befund lässt darauf schließen, dass gewissenhafte Personen in Lernsituationen erfolgreicher und effektiver sind (Spengler et al., 2013) und deshalb tendenziell von Interventionen zur Steigerung von Lernstrategien mehr profitieren als weniger gewissenhafte Personen. Dass G auch mit Interventionserfolg zusammenhängt, konnte empirisch auch in anderen Kontexten gezeigt werden (z.B. Senf & Liao, 2013). Zudem zeigten sich direkte positive Zusammenhänge zwischen G und SRL (z.B. Dörrenbächer & Perels, 2016; McCrae & Löckenhoff, 2010; McLellan & Jackson, 2017; Vermetten et al., 2001).

Personen, die *offen für Erfahrung* sind, machen gerne neue Erfahrungen, sind neugierig und haben viele Interessen (McCrae & Löckenhoff, 2010). O geht, ähnlich wie G, mit Zeitmanagement-Strategien, Anstrengungsregulation, Tiefen-, kognitiven sowie metakognitiven Lernstrategien, guter Urteilsfähigkeit über die eigene Leistung, Elaboration und Reflexion einher. Offene Personen tendieren dazu, das Lernen zu genießen und nicht zu prokrastinieren (Bidjerano & Dai, 2007; Chamorro-Premuzic et al., 2008; Kokkinos et al., 2015; Ljubin-Golub et al., 2019; Ruffing et al., 2015; Vermetten et al., 2001). O hängt zudem mit Erfolg in Leistungstests zusammen, was damit erklärt wird, dass offene Personen Lernstrategien verwenden, die mit einer Leistungssteigerung einhergehen (Spengler et al., 2013). Insgesamt zeigen sich also substantielle, positive Zusammenhänge zwischen O und Aspekten erfolgreichen Lernens und SRL.

*Verträglichkeit* beschreibt die Tendenz, anderen mit Sympathie zu begegnen und selbstlos zu handeln (McCrae & Löckenhoff, 2010). Die Forschungsbefunde für V sind uneindeutig, da positive Zusammenhänge sowohl mit Anstrengung, Metakognition, Elaboration, kritischem Denken, Zeitmanagement, SRL und niedriger akademischer Prokrastination zu finden sind (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016; Eilam et al., 2009; Ljubin-Golub et al., 2019; Vermetten et al., 2001), aber auch mit eher ungünstigen Strategien wie oberflächlichem bzw. reproduktivem Lernen (Busato, Prins, Elshout & Hamaker, 1999;

Kokkinos et al., 2015; Vermetten et al., 2001). Verträgliche Studierende bevorzugen interaktive Lehre, Gruppendiskussionen und kleine Lerngruppen (Chamorro-Premuzic, Furnham & Lewis, 2007). Die Forschung deutet auf eine inkonsistente Befundlage zum Zusammenhang zwischen V und Lernen sowie SRL hin.

*Extravertierte* Personen favorisieren intensive und häufige zwischenmenschliche Interaktionen, sind energisch und optimistisch (McCrae & Löckenhoff, 2010). Empirische Zusammenhänge zwischen E und Lernstrategien zeigen ebenfalls uneindeutige Ergebnisse. Einige Studien berichten positive Zusammenhänge zwischen E und SRL, sozialen Lernstrategien (u.a. Suche nach Unterstützung, Lernen in Peergruppen) und dem Setzen von Subzielen (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016; Kokkinos et al., 2015; Ljubin-Golub et al., 2019). Andererseits finden sich negative Zusammenhänge mit akademischer Leistung, was darauf zurückzuführen sein könnte, dass extravertierte Studierende sich leichter ablenken lassen (Richardson et al., 2012), und sie schneiden schlechter dabei ab, Probleme reflektiert zu lösen (z.B. Matthews, 1997). Insgesamt sind auch bei dieser Persönlichkeitseigenschaft Zusammenhänge mit SRL und Lernen uneindeutig.

Personen mit einem hohen Grad an *Neurotizismus* tendieren dazu, vielfältige Formen emotionalen Leidens zu empfinden und sind leicht reizbar (McCrae & Löckenhoff, 2010). Der negative Zusammenhang zwischen N und SRL ist empirisch gut dokumentiert (vgl. Bidjerano & Dai, 2007). So korreliert N eher mit geringerer akademischer Leistung und Selbstkontrolle, Prokrastination, ungerichtetem Lernen, und führt somit beispielsweise zu Problemen bei der Verarbeitung des Studienmaterials (Busato et al., 1999; Chamorro-Premuzic & Furnham, 2003; Klingsieck, 2013; McCrae & Löckenhoff, 2010). Demnach wirkt sich N in Lernsituationen und in entsprechenden Interventionen eher negativ aus.

Die bisherige Forschung legt nahe, dass Persönlichkeitsfaktoren Lernen beeinflussen können, dass konzeptuelle Überschneidungen zwischen den Operationalisierungen von SRL und Persönlichkeit zu finden sind und empirisch Zusammenhänge bei Schülerinnen und Schülern sowie Studierenden nachgewiesen werden konnten (vgl. Bidjerano & Dai, 2007; Ljubin-Golub et al., 2019). Davon ausgehend kann vermutet werden, dass individuelle Persönlichkeitsunterschiede mit unterschiedlichen Trainingserfolgen nach SRL-Interventionen einhergehen. Zusätzlich deuten Untersuchungen mit Profilanalysen und kanonischen Korrelationsanalysen darauf hin, dass die Kombination verschiedener Persönlichkeitsausprägungen mit günstigen SRL-Profilen verbunden ist (Dörrenbächer & Perels, 2016). Zum Beispiel zeigen Studierende mit ausgeprägtem SRL einen niedrigen Grad an N, eine hohe O, hohe E, hohe V sowie hohe G, insgesamt die wohl am adaptivsten angepasste Persönlichkeitsstruktur (Dörrenbächer & Perels, 2016). Die Ergebnisse von Bidjerano und Dai (2007) legen ebenfalls nahe, dass Personen mit einer bestimmten Kombination aus Persönlichkeitseigenschaften bessere selbstregulierte Lerner sind. Hier war u.a. die Kombination aus G und O mit hohen SRL-Werten assoziiert. Dabei könnte SRL als Mediator zwischen Persönlichkeitsfaktoren und Lernen wirken. In der Studie von Bidjerano und Dai (2007) medierte beispielsweise die SRL-Strategie Anstrengungsregulation den Zusammenhang zwischen G und V mit akademischer Leistung. Auch Ljubin-Golub et al. (2019) konnten einen mediiierenden Effekt von motivationaler Regulation zwischen den

Persönlichkeitsfaktoren G, V und O und (verringertes) akademischer Prokrastination nachweisen. Des Weiteren waren G, O, E sowie V positiv mit der Anwendung von motivationalen Regulationsstrategien, einem Kernprozess von SRL, assoziiert, wohingegen sich für N wie erwartet negative Zusammenhänge zeigten. Davon abgesehen konnten beispielsweise Schniederjans und Kim (2005) zeigen, dass G, O, N und V positiven und E negativen Einfluss in einer web-basierten Lernumgebung hatten. Jedoch ist mehr Forschung notwendig, um Zusammenhänge mit unterschiedlichen Lernumgebungen (web-basiert und Präsenz-basiert) zu untersuchen.

#### 1.4 SRL und Motivation

Neben Persönlichkeitseigenschaften ist Motivation eine zentrale Voraussetzung für Lernen und Leistung (z.B. Eccles & Wigfield, 2020; Kriegbaum, Becker & Spinath, 2018; Spinath, 2010; Richardson et al., 2012). Ein zentrales motivationales Konstrukt in der Leistungsmotivationsforschung ist die Zielorientierung und die damit einhergehende Kanalisierung von Ressourcen, da diese Lernen und Leistung im Schul- und Hochschulkontext fördern (z.B. Spinath & Schöne, 2003; Steinmayr & Spinath, 2009; Wirthwein, Sparfeldt, Pinquart, Wegerer & Steinmayr, 2013) und ebenfalls mit SRL in Verbindung gebracht werden kann (z.B. Liem, 2016; Vermetten et al., 2001). Wie auch anderes Verhalten sind Lern- und Leistungsverhalten auf verschiedene Ziele ausgerichtet. Klassischerweise werden in der Literatur Lern- und Leistungsziele unterschieden (z.B. Dweck, 1986). Eine *Lernzielorientierung* (LZ) fokussiert die Entwicklung von Kompetenz und Wissen. Studierende mit dieser Zielorientierung möchten ihre Kompetenzen verbessern, konzentrieren sich darauf, den Lerninhalt zu verstehen und sind überzeugt, dass sie sich für ihr Ziel anstrengen müssen (Senko & Dawson, 2017; Vermetten et al., 2001). Hier steht der Lernprozess im Vordergrund. Bei Leistungszielen wird in aktueller Forschung weiter zwischen Annäherungs-Leistungszielen (ALZ) und Vermeidungs-Leistungszielen (VLZ) unterschieden (z.B. Elliot & Moller, 2003). Studierende mit einer *Annäherungs-Leistungszielorientierung* möchten Können und Wissen demonstrieren, um zu zeigen, dass sie besser sind als andere, während Studierende mit einer *Vermeidungs-Leistungszielorientierung* bemüht sind, vermeintlich mangelnde Kompetenzen zu verbergen. Darüber hinaus beschreiben Forscher als vierte Zielorientierungsdimension die *Arbeitsvermeidung* (AV), die das Ziel beschreibt, eine geringstmögliche Anstrengung zu investieren (Spinath, Stiensmeier-Pelster, Schöne & Dickhäuser, 2012). Die vier beschriebenen Zielorientierungen sind nicht gegensätzlich, es können verschiedene Ziele gleichzeitig anvisiert werden (Spinath et al., 2012).

Eine Vielzahl empirischer Untersuchungen mit Schülerinnen und Schülern sowie Studierenden zeigt, dass Unterschiede in Zielorientierungen offenbar mit der Nutzung unterschiedlicher Strategien in Lern- und Leistungskontexten, mit Lernerfolg, aber auch mit Facetten von SRL einhergehen. Beispielsweise sind lernzielorientierte Studierende eher intrinsisch motiviert, nutzen Tiefenlernstrategien und kognitive sowie metakognitive Lernstrategien, was zu einer Verbesserung der Selbstregulation sowie der akademischen Leistung führen kann (Baneshi, Samadieh & Ejei, 2015; Dinger, Dickhäuser, Spinath &

Steinmayr, 2013; Mouratidis, Vansteenkiste, Michou & Lens, 2013; Senko & Dawson, 2017; Vermetten et al., 2001). Insgesamt ist eine LZ mit positiven leistungsbezogenen motivationalen Variablen sowie mit effektivem Lernverhalten wie Selbstregulationsstrategien und Lernstrategien korreliert (z.B. Metaanalysen von Hulleman, Schrage, Bodmann & Harackiewicz, 2010; Wirthwein et al., 2013). Des Weiteren gibt es Hinweise darauf, dass eine LZ über Persönlichkeit (G und O) und Intelligenz hinweg akademische Leistung vorhersagen kann (Steinmayr et al., 2011).

Die Befunde zum Zusammenhang zwischen ALZ mit Lernen und Leistung sind uneindeutig (Elliot & Moller, 2003; Senko & Dawson, 2017). Ähnlich wie bei der LZ haben Forschergruppen gezeigt, dass ALZ positiv mit akademischer Leistung zusammenhängen kann (z.B. Dinger et al., 2013; Harackiewicz, Barron, Tauer & Elliot, 2002; Wirthwein et al., 2013). Hier finden sich jedoch je nach Fokus der ALZ unterschiedliche Zusammenhänge (vgl. Senko, 2019). Wenn der Fokus darauf liegt, andere zu übertreffen, hängt dies mit wünschenswerteren Faktoren zusammen, wie besserer schulischer Leistung, Tiefenlernstrategien und Selbstregulation, als wenn der Fokus darauf liegt, Kompetenz zu zeigen (z. B. Senko, 2019; Senko & Dawson, 2017). Jedoch scheint eine ALZ auch mit Oberflächenlernen zusammenzuhängen (vgl. Vermetten et al., 2001). LZ kann hingegen auch nicht nur mit Tiefenlernstrategien, sondern auch mit Oberflächenlernen zusammenhängen (z. B. Senko, 2019). Mouratidis et al. (2013) haben in ihrer querschnittlichen Untersuchung mit Schülerinnen und Schülern herausgefunden, dass der Zusammenhang von eher effektiven Lernstrategien wie kritisches Denken, metakognitive Selbstregulation und Anstrengungsregulation mit ALZ schwächer ausfällt als mit LZ. Liem (2016) konnte in seiner Studie ebenfalls zeigen, dass eine LZ stärker als eine ALZ mit SRL bei High-School Schülerinnen und Schülern assoziiert war. Lernzielorientierte Schülerinnen und Schüler scheinen eher nach Unterstützung zu suchen als leistungszielorientierte (Butler & Neuman, 1995). Chatzismatiou, Dermizaki, Efkliides und Leondari (2015) hingegen fanden in ihrer Studie direkte positive Effekte von Leistungszielen auf kognitive und metakognitive SRL-Strategien im Bereich Mathematik, wohingegen für Lernziele nur indirekte, jedoch stärkere Effekte gefunden wurden. Es lässt sich aufgrund der Literatur folgern, dass LZ sowie ALZ positiv mit Lernen und Leistung zusammenhängen. Die Effekte für LZ fallen jedoch insgesamt positiver aus, da hier Voraussetzungen für langfristig gute Leistung gegeben ist, wohingegen ALZ langfristig weniger positive Effekte hat, was in der Verwendung von ineffektiveren Lernstrategien (z.B. Oberflächenlernen) liegen könnte (Elliot & McGregor, 1999; Mouratidis et al., 2013; Wirthwein et al., 2013).

Im Gegensatz zu LZ und ALZ gilt eine VLZ als ineffektive Form der Regulation (Elliot & Moller, 2003; Mouratidis et al., 2013). Studierende mit einer VLZ nutzen eher Oberflächenlernstrategien (Diseth & Kobbeltvedt, 2010). Des Weiteren hängt eine VLZ negativ mit intrinsischer Motivation, Anstrengung, Zeitmanagement, organisiertem Lernen und akademischer Leistung zusammen (Dinger et al., 2013; Diseth & Kobbeltvedt, 2010; Liem, 2016; Spinath et al., 2012).

Wie vermutet konnte in bisherigen Studien ein durchweg negativer Zusammenhang zwischen AV und Lernen und Leistung gezeigt werden (z.B. Dupeyrat & Mariné, 2005; Spinath et al., 2012; Harackiewicz et al., 2002; Steinmayr & Spinath, 2009). Steinmayr und Spinath

(2009) konnten in ihrer querschnittlichen Untersuchung beispielsweise zeigen, dass AV den positiven Einfluss von Intelligenz auf Schulerfolg abschwächt. Im Gegensatz zu anderen Zielorientierungen zielt AV nicht auf Leistung und Kompetenz ab.

Zusammenfassend lässt sich festhalten, dass wiederholt Zusammenhänge zwischen Zielorientierungen und Aspekten gezeigt werden konnten, die Lernsituationen begünstigen und mit SRL einhergehen, wie kognitive Lernstrategien, Zeitmanagement, intrinsische Motivation und akademische Leistung. Jedoch legen viele Studien, die diese Zusammenhänge untersuchen, ein korrelatives Untersuchungsdesign zugrunde (z.B. Dinger et al., 2013.; Mouratidis et al., 2013; Steinmayr & Spinath, 2009). Es gibt bisher kaum Untersuchungen, die den Einfluss von Zielorientierungen längsschnittlich (z.B. Harackiewicz et al., 2002) und keine, die den Einfluss auf die Verbesserung von SRL durch Interventionen untersuchen.

## 2 Studienziele und Hypothesen

Aufgrund der vorgestellten Befunde und der Überlegungen zum Zusammenhang von Persönlichkeitsfaktoren und Lernzielorientierungen mit dem Verhalten in Lernsituationen sowie SRL-Attributen, untersucht diese Studie die Bedeutung der Big Five (Forschungsfrage 1) und darüber hinaus die Bedeutung der Zielorientierungen (Forschungsfrage 2) für differentielle Trainingseffekte von Studierenden in einer SRL-Intervention mit zwei Formaten (web-basiert und präsenz-basiert). Vermutet wird, dass (Hypothese 1) G und (Hypothese 2) O den Trainingserfolg positiv beeinflussen. G und O beinhalten Aspekte, die sich nicht nur konzeptuell mit SRL überschneiden, sondern auch darauf schließen lassen, dass Studierende in Interventionen zu SRL erfolgreicher abschließen. Ferner wird vermutet, dass (Hypothese 3) N den Trainingserfolg negativ beeinflusst, da N Aspekte enthält, die Lernen hemmen. Zudem wird angenommen, dass (Hypothese 4) V den Trainingserfolg besonders im präsenz-basierten Kurs positiv beeinflusst. Denn hier stehen Studierende im direkten Austausch mit anderen, was die Bedeutung von V für den Lernerfolg hervorhebt, da verträgliche Personen darum bemüht sind, mit anderen zu kooperieren, wie beispielsweise ihren Kommilitoninnen und Kommilitonen und Dozierenden (z.B. Vermetten et al., 2001). Dies könnte zu mehr Unterstützung und somit Lernerfolg führen (Spengler et al., 2013). Der Zusammenhang von E mit differentiellen SRL-Trainingseffekten wird aufgrund der inkonsistenten Befundlage explorativ untersucht. In Bezug auf die Zielorientierungen wird angenommen, dass (Hypothese 5) LZ und (Hypothese 6) ALZ den Trainingserfolg positiv beeinflussen, da beide Aspekte enthalten, die sich förderlich auf Lernsituationen auswirken. Im Gegensatz dazu wird postuliert, dass (Hypothese 7) VLZ und (Hypothese 8) AV den Trainingserfolg negativ beeinflussen, da sie Aspekte enthalten, die für das Lernen hinderlich sind.



### 3 Methode

#### 3.1 Design

Die Daten stammen aus einer randomisierten Interventionsstudie mit drei Befragungszeitpunkten, in der 186 Studierende zwei Kursformaten zufällig zugeteilt wurden: Präsenz-basiert (P) oder web-basiert (W). Der Prätest (t1) wurde vor Beginn des Kursprogramms, der erste Posttest (t2) nach Durchführung der inhaltsbezogenen, theoretischen Lektionen und der zweite Posttest (t3) nach der Anwendungsphase am Ende des Semesters durchgeführt. Die Daten wurden anhand von Online-Fragebögen erhoben.

#### 3.2 Stichprobe

Die Probanden wurden von lehramtsbezogenen Studiengängen und dem Bachelorstudiengang Bildungswissenschaft einer deutschen Universität rekrutiert. Es wurde ein Kurs zum SRL angeboten. 186 Studierende nahmen an der ersten Präsenzsitzung teil. Danach wurden sie zufällig der P-Gruppe ( $n=91$ ) oder der W-Gruppe ( $n=95$ ) zugeteilt. 184 Studierende nahmen an der Erhebung zu t2 (P-Gruppe:  $n=90$ , W-Gruppe:  $n=94$ ) und 171 Teilnehmer am Posttest (t3) teil (P-Gruppe:  $n=81$ , W-Gruppe:  $n=90$ ). Insgesamt wurden  $N=162$  Probanden in die Analysen eingeschlossen, 12.9% wurden aufgrund unvollständiger Daten ausgeschlossen. Dropouts unterschieden sich nicht von Personen der finalen Stichprobe bezüglich demographischer Variablen (Geschlecht, Studiendauer, Abiturnote) oder Prätestvariablen SRL aktional, aktional, postaktional und deklaratives metakognitives Wissen SRL (Wilks'  $\lambda=.94$ ,  $p=.51$ ). Innerhalb der finalen Stichprobe  $N=162$  ( $n=38$  Männer,  $n=121$  Frauen;  $n=3$  Personen ohne Angabe zum Geschlecht; Durchschnittsalter: 23.70 Jahre,  $SD=3.13$ ,  $Range=18-44$ ) bestand die P-Gruppe aus  $n=77$  Studierenden und die W-Gruppe aus  $n=85$  Studierenden. Die durchschnittliche Abiturnote war 2.23 ( $SD=.62$ ,  $range=1-3.8$ ) und die Studierenden befanden sich im Durchschnitt im 7.07 Hochschulsemester ( $SD=3.79$ ,  $range=1-20$ ). Der Randomisierungsscheck zeigte keine Gruppenunterschiede zu t1 (Wilks'  $\lambda=.96$ ,  $p=.65$ ).

#### 3.3 Prozedur

Studierende, die sich für den SRL-Kurs angemeldet hatten, wurden zum Eröffnungstermin im Hörsaal eingeladen. Hier bekamen sie einen Überblick über Anforderungen und Modalitäten des Kurses. Die Teilnahme an der Studie war freiwillig. Nach dem ersten Termin wurden die Studierenden den beiden Kursformaten (W oder P) randomisiert zugeordnet. Sie wurden per E-Mail über ihre Zuordnung informiert und gebeten, an der ersten Befragung teilzunehmen (t1). Nach fünf Wochen, als der inhaltliche Teil des SRL-Trainings abgeschlossen war, nahmen die Studierenden an der zweiten Befragung teil (t2) und begannen mit der Bearbeitung einer Transferaufgabe, die Voraussetzung für das Bestehen des Kurses war. Nach vier weiteren Wochen präsentierten die Studierenden ihre Ergebnisse in einer Round-Table Diskussion während einer Präsenzveranstaltung. Am Semesterende wurde die dritte Erhebung (t3)

durchgeführt. Die Studierenden hatten in einer letzten Präsenzsitzung die Möglichkeit, ein Feedback zu geben.

### 3.4 Kursprogramm

Für diese Studie wurde ein Training eingesetzt, das darauf abzielt, Studierende in ihrem SRL zu unterstützen. Das Kurskonzept basiert auf dem Prozessmodell von Schmitz und Wiese (2006). Insgesamt wurden fünf 90-minütige Lektionen nacheinander in einem Intervall von einer Woche freigeschaltet. Der Kurs wurde einmal als P-Format und einmal als W-Format über eine Online-Plattform (Moodle) angeboten. Anzahl der Lektionen, ihre Dauer, Struktur, Inhalte sowie die Lehr- und Lernmethoden waren identisch. Der einzige Unterschied lag im Format: W oder P. Zum Beispiel hatten die Studierenden im W-Kurs die Möglichkeit, Fragen mit anderen Studierenden im Diskussionsforum zu diskutieren oder Fragen per E-Mail zu stellen, während Studierende der P-Gruppe ihre Fragen im Seminar diskutieren konnten. Beide Gruppen hatten Zugang zum Kursmaterial, nachdem dieses das erste Mal freigeschaltet wurde. Eine detaillierte Beschreibung des Kursprogramms kann Autoren<sup>2</sup> entnommen werden. Die Effektivität des Trainings wurde bereits gezeigt (Autoren<sup>1,2</sup>).

### 3.5 Instrumente

Es wurden Items zur Erhebung des SRL und der Anwendung von Lernstrategien (Autoren 1; Wild & Schiefele, 1994), der Lern- und Leistungsmotivation (SELLMO-ST; Spinath et al., 2012), der Persönlichkeitsvariablen (BFI-K; Rammstedt & John, 2005) sowie Fragen zur Demographie (Geschlecht, Alter, Abiturnote, Studiendauer) eingesetzt.

#### 3.5.1 Selbstreguliertes Lernen

SRL wurde zu t1, t2 und t3 mit zwölf Items von Instrumenten erhoben, die SRL sowie die Anwendung von Lernstrategien (Autoren<sup>1</sup>; Wild & Schiefele, 1994) messen und die drei Phasen des SRL-Modells von Schmitz und Wiese (2006) repräsentieren. Probanden sollten ihre Zustimmung auf einer sechsstufigen Skala von 1 (nicht wahr) bis 6 (wahr) angeben. Das Instrument besteht aus drei Skalen mit jeweils vier Items. Die drei Skalen *Präaktionale Phase* (Cronbach's  $\alpha=.77/.75/.73$ ; z.B. "Ich kontrolliere regelmäßig, ob ich noch meine Ziele verfolge."), *Aktionale Phase* (Cronbach's  $\alpha=.65/.60/.62$ , z.B. "Mir fehlt einfach die Geduld für Arbeiten, an denen ich lange dranbleiben müsste."), und *Postaktionale Phase* (Cronbach's  $\alpha=.75/.77/.77$ , z.B. "Abends denke ich darüber nach, was heute beim Lernen gut gewesen ist und was ich morgen anders machen möchte.") zeigten akzeptable bis gute interne Konsistenzen über die drei Messzeitpunkte. In Mplus (Version 7.3, Muthén & Muthén, 2014) wurde faktorenanalytisch überprüft, ob ein drei-Faktorenmodell mit SRL-Präaktional-, Aktional- und Postaktionalphasen die Daten besser beschreibt als ein Modell 2. Ordnung mit einem übergeordneten SRL-Faktor. Beide Modelle zeigen einen gleich guten Modellfit

( $\chi^2(45)=73.337, p<.01; CFI=.952, RMSEA=.054$ ). Deshalb wird das Ein-Faktoren-Modell für die Hauptanalysen herangezogen.

### 3.5.2 Zielorientierungen

Zielorientierungen der Studierenden wurden zu t1 mit den Skalen zur Erfassung der Lern- und Leistungsmotivation (SELLMO-ST; Spinath et al., 2012) erhoben. Antwortkategorien reichten von 1 (stimme überhaupt nicht zu) bis 5 (stimme voll zu). Die Skalen messen LZ (8 Items, z.B. "An der Univer geht es mir darum, so viel wie möglich zu lernen.", Cronbach's  $\alpha=.86$ ), ALZ (7 Items, z.B. "An der Universit t geht es mir darum, dass andere denken, dass ich klug bin.", Cronbach's  $\alpha=.81$ ), VLZ (8 Items, z.B. "An der Universit t geht es mir darum, keine falschen Antworten auf Fragen der Dozenten zu geben.", Cronbach's  $\alpha=.93$ ) sowie AV (8 Items, z.B. "An der Univer geht es mir darum, mit wenig Arbeit durch diesen Kurs zu kommen.", Cronbach's  $\alpha=.91$ ).

### 3.5.3 Persönlichkeit

Persönlichkeit wurde zu t3 mit einer Kurzversion des Big Five Inventory gemessen (BFI-K; Rammstedt & John, 2005). Der BFI-K besteht aus den Skalen E (8 Items, Cronbach's  $\alpha=.81$ , z.B., "Ich bin unterhalte mich gern."), O (10 Items, Cronbach's  $\alpha=.81$ , z.B., "Ich bin vielseitig interessiert."), G (9 Items, Cronbach's  $\alpha=.85$ , z.B., "Ich arbeite zuv sig und gewissenhaft."), V (10 Items, Cronbach's  $\alpha=.73$  z.B., "Ich bin hilfsbereit und selbstlos anderen."), und N (10 Items, Cronbach's  $\alpha=.83$ , z.B., "Ich mache mir viele Sorgen."). Die Probanden wurden gebeten, ihre Zustimmung auf einer stufigen Skala von 1 (nicht zutreffend) bis 5 (zutreffend) anzugeben.

## 3.6 Datenauswertung

Es wurden für beide Kursformate jeweils zwei hierarchische Regressionsanalysen in SPSS (Version 25) durchgeführt mit jeweils SRL t2 und SRL t3 als abhängige Variable und Persönlichkeitsfaktoren und Lern- und Leistungszielorientierungen als unabhängige Variablen. Eine vorangegangene Studie zur globalen Effektivität des Interventionsprogramms zeigte, dass Studierende nach der Theoriephase (t2) einen Anstieg ihres SRL-Wissens verzeichneten und nach der Anwendungsphase (t3) eine signifikante Verbesserung ihrer SRL-Strategien berichteten (Autoren2). Deshalb betrachtet die vorliegende Studie die beiden Messzeitpunkte ebenfalls getrennt voneinander. Zuerst wurde jeweils ein Baseline-Modell (Modelle 1) mit Kontrollvariablen (SRL t1, Abiturnote, Studiendauer) spezifiziert. Im nächsten Modell (Modelle 2) wurden die Persönlichkeitsvariablen (G, E, V, N, O) simultan eingefügt. Im jeweils dritten Modell wurden die Zielorientierungsvariablen (LZ, ALZ, VLZ, AV) gleichzeitig eingefügt.

## 4 Ergebnisse

Mittelwerte ( $M$ ), Standardabweichungen ( $SD$ ), und Interkorrelationen aller Studienvariablen sind in Tabelle 1 dargestellt. Bei Persönlichkeit korrelieren G und O und bei den Zielorientierungen LZ und AV mit SRL zu t1, t2, und t3. Zusätzlich korrelieren V und ALZ mit SRL t2.

In allen Baseline-Modellen (s. Tabellen 2, 3, 4, 5) war SRL t1 ein signifikant positiver Prädiktor für SRL t2 und SRL t3.<sup>1</sup>

Tabelle 1 hier einfügen

### 4.1 P-Gruppe: Einfluss auf SRL t2 (Theoriephase)

Die Hinzunahme der Persönlichkeitsfaktoren als Prädiktoren von SRL t2 (Modell 2) ging mit einer substantiellen  $\Delta R^2 = .10, p < .01$  einher. SRL t1 blieb signifikanter Prädiktor ( $\beta = .59, p < .001$ ). Zusätzlich waren G ( $\beta = .25, p = .01$ ) sowie V ( $\beta = .22, p = .01$ ) signifikante Prädiktoren für SRL t2. Die Hinzunahme der Zielorientierungen in Modell 3 führte zu keiner weiteren substantiellen Veränderung der Varianzaufklärung ( $\Delta R^2 = .03, p = .40$ ), keine der Zielorientierungen war bedeutsam mit SRL t2 assoziiert. Der Einfluss von V reduzierte sich, SRL t1 ( $\beta = .57, p < .001$ ) und G ( $\beta = .25, p = .02$ ) hingegen blieben signifikante Prädiktoren für SRL t2, V hingegen nicht.

### 4.3 W-Gruppe: Einfluss auf SRL t2 (Theoriephase)

Die Hinzunahme der Persönlichkeitsfaktoren als Prädiktoren von SRL t2 (Modell 2) ging mit einer substantiellen  $\Delta R^2 = .11, p = .01$  einher. SRL t1 blieb signifikanter Prädiktor ( $\beta = .49, p < .001$ ). Zusätzlich war G ( $\beta = .40, p < .001$ ) signifikant mit SRL t2 assoziiert. Die Hinzunahme der Zielorientierungen in Modell 3 führte zu keiner weiteren substantiellen  $\Delta R^2 = .04, p = .25$  der Varianzaufklärung. Keine der Zielorientierungen hatte eine signifikante Vorhersagekraft für SRL t2. SRL t1 ( $\beta = .44, p < .001$ ) und G ( $\beta = .44, p < .001$ ) blieben signifikante Prädiktoren.

Tabellen 2 und 3 hier einfügen

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<sup>1</sup> Bonferroni-Korrektur wurde in den hierarchischen Regressionsanalysen eingesetzt, um für Alphafehler-Kumulierung zu kontrollieren. Da dieses die Ergebnisse nicht verändert, werden die Originalergebnisse berichtet.

#### 4.4 P-Gruppe: Einfluss auf SRL t3 (Anwendungsphase)

In Modell 2 ging die Hinzunahme der fünf Persönlichkeitsfaktoren als Prädiktoren von SRL t3 ebenfalls mit einer substantiellen Erhöhung der Varianz einher ( $\Delta R^2=.23$ ,  $p<.001$ ). SRL t1 blieb signifikanter Prädiktor ( $\beta=.35$ ,  $p<.001$ ). Zusätzlich waren G ( $\beta=.39$ ,  $p<.001$ ) sowie O ( $\beta=.27$ ,  $p<.001$ ) signifikante Prädiktoren für SRL t3. Die Hinzunahme der Zielorientierungen (Modell 3) führte auch hier zu keiner weiteren substantiellen Veränderung der Varianz ( $\Delta R^2=.24$ ,  $p=.47$ ), keine der Zielorientierungsvariablen war signifikant mit SRL t3 assoziiert. SRL t1 ( $\beta=.38$ ,  $p<.001$ ), G ( $\beta=.40$ ,  $p<.001$ ) sowie O ( $\beta=.28$ ,  $p=.02$ ) blieben signifikante Prädiktoren.

#### 4.5 W-Gruppe: Einfluss auf SRL t3 (Anwendungsphase)

In Modell 2 ging die Hinzunahme der fünf Persönlichkeitsfaktoren als Prädiktoren von SRL t3 ebenfalls mit einer substantiellen Erhöhung der Varianz einher ( $\Delta R^2=.17$ ,  $p<.001$ ). SRL t1 blieb signifikanter Prädiktor ( $\beta=.41$ ,  $p<.001$ ). Zusätzlich war wieder ausschließlich G ( $\beta=.48$ ,  $p<.001$ ) signifikanter Prädiktor für SRL t3. Die Hinzunahme der Zielorientierungen (Modell 3) führte auch hier zu keiner weiteren substantiellen Veränderung der Varianz ( $\Delta R^2=.01$ ,  $p=.84$ ), keine Zielorientierung war bedeutsam für SRL t3. SRL t1 ( $\beta=.40$ ,  $p<.001$ ) sowie G ( $\beta=.51$ ,  $p<.001$ ) blieben signifikante Prädiktoren.

Tabellen 4 und 5 hier einfügen

## 5 Diskussion

Die vorliegende Studie adressierte die Bedeutung individueller Eigenschaften für Interventionsprogramme und ging der Frage nach, welche Studierenden besonders von einem SRL-Trainingsprogramm mit zwei Darbietungsformaten (W und P) profitieren. Hierbei wurde angenommen, dass Persönlichkeitseigenschaften (Forschungsfrage 1) und darüber hinaus Lern- und Leistungsmotivation (Forschungsfrage 2) von Studierenden den differentiellen SRL-Trainingserfolg beeinflussen können.

In den hierarchischen Regressionsanalysen erwies sich G wie erwartet als stärkster Prädiktor für SRL-Zuwachs. Zusätzlich konnten sich folgende Überlegungen bestätigen: V zeigte sich im P-Format als signifikanter Prädiktor, und zwar für die Theoriephase (SRL t2). O war ebenfalls im P-Format und zwar mit SRL t3, also der Anwendungsphase, bedeutsam assoziiert. Somit konnten Hypothesen 1 sowie 2 und 4 (teilweise) bestätigt werden. N (Hypothese 3) und E (explorative Analyse) hatten hingegen keinen signifikanten Einfluss auf SRL. Darüber hinaus hatten die Zielorientierungen ebenfalls keinen signifikanten Einfluss, womit keine Belege für Hypothesen 5, 6, 7 und 8 gefunden werden konnten. Ebenso zeigte sich kein signifikanter Einfluss der Kontrollvariablen Studiendauer und Abiturnote. Die

Studienergebnisse stellen somit vor allem die Bedeutung von G, O und V für den Lernerfolg in SRL-Interventionen, vor allem im Präsenzformat, heraus.

Die Ergebnisse legen nahe, dass G für das gesamte SRL-Training, also in beiden Phasen und für beide Formate, bedeutsam ist. G beinhaltet viele Aspekte, die sich als lernförderlich erweisen und bereits Attribute von SRL beschreiben. So zeigen beispielsweise gewissenhafte Personen hohe Persistenz, Anstrengungsregulation und setzen sich Ziele (z.B. Bidjerano & Dai, 2007). Die Ergebnisse stehen außerdem in Einklang mit anderen Untersuchungen, die Zusammenhänge zu SRL und Lernerfolg zeigten (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016; Spengler et al., 2013). Darüber hinaus konnten in dieser Studie nun Assoziationen zum SRL-Zuwachs gezeigt werden.

O beinhaltet ebenfalls Attribute von SRL, die in Lernsituationen förderlich sind. So wenden offene Personen z.B. metakognitive Lern- und Zeitmanagement-Strategien an (Bidjerano & Dai, 2007). O schien insbesondere in der Anwendungsphase des SRL-Trainings, bei der die Studierenden aufgefordert waren, das vermittelte Wissen anzuwenden und Strategien auszuprobieren, einen positiven Effekt zu haben. Dies ist nicht verwunderlich vor dem Hintergrund, dass in dieser Phase Eigenschaften, wie die Bereitschaft, vermittelte Inhalte auszuprobieren, eigene Strategien zu überarbeiten und zu verbessern, unterstützend wirken.

In Bezug auf V waren die bisherigen Befunde uneindeutig. Die Bedeutsamkeit von V hat sich in der vorliegenden Studie insbesondere in der Theoriephase des P-Formats gezeigt. Für V konnten einerseits bisher Zusammenhänge mit SRL-Strategien (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016; Eilam et al., 2009; Ljubin-Golub et al., 2019; Vermetten et al., 2001) gefunden werden, andererseits auch mit weniger förderlichen Lernstrategien wie reproduktivem Lernen (Busato et al., 1999; Vermetten et al., 2001). Unsere Ergebnisse bekräftigen, dass V insbesondere dann einen positiven Einfluss hat, wenn Studierende in Interaktion mit anderen stehen (Chamorro-Premuzic et al., 2007). Dies war im SRL-Training in der ersten Phase des Präsenzformats, in der auch hauptsächlich das Theoriewissen vermittelt wurde, der Fall. In dieser Phase sind also Eigenschaften vorteilhaft, die für das Zusammenarbeiten und den Wissensaufbau förderlich sind. Verträgliche Studierende sind kooperationsbereit, wollen dem Dozierenden gefallen und arbeiten gut mit (z.B. Spengler et al., 2013; Vermetten et al., 2001). Lernstrategien, die eine Anwendung und somit längerfristiges Behalten unterstützen, waren zu diesem Zeitpunkt noch nicht notwendig. Unsere Ergebnisse stehen außerdem im Einklang mit den Befunden der vorangegangenen Studie von Autoren<sup>2</sup>, in der die Theoriephase des Trainings zu einer Verbesserung des deklarativen Wissens über SRL und die Anwendungsphase zu einer Verbesserung der SRL-Strategien führte. Frühere Arbeiten zeigen, dass SRL dabei vor allem als Mediator zwischen den Persönlichkeitsfaktoren und Lernen wirkt (Bidjerano & Dai, 2007; Ljubin-Golub et al., 2019).

Für E und N konnten keine Zusammenhänge mit dem SRL-Trainingserfolg nachgewiesen werden. Auch auf korrelativer Ebene finden sich keine substantiellen Zusammenhänge zwischen E und N mit den SRL-Gesamtwerten. Bisherige Forschungsbefunde für E im Kontext von SRL und Lernen im Allgemeinen sind uneindeutig, weshalb unser Befund nicht ganz überraschend ist. Für N hingegen konnten bisher negative Zusammenhänge zu Lernen und SRL gezeigt werden (z.B. Dörrenbächer & Perels, 2016; Matthews & Zeidner, 2004). In der

vorliegenden Studie wurde SRL als globaler Faktor herangezogen. Andere Studien (z.B. Bidjerano & Dai, 2007; Dörrenbächer & Perels, 2016) fokussierten auch Zusammenhänge zwischen Persönlichkeitsfaktoren und Unterfacetten von SRL und es ergaben sich andere korrelative Muster als mit einem Globalwert. Um herauszufinden, ob sich für einzelne SRL-Phasen andere Assoziationen mit den Persönlichkeitsvariablen zeigen, wurde in zusätzlichen Analysen der Einfluss auf den SRL-Zuwachs getrennt für die drei SRL-Phasen betrachtet. Hier ergab sich jedoch ein ähnliches Bild wie für den SRL-Gesamtscore (G, V und O als bedeutsame Prädiktoren), was für die Robustheit der Befunde spricht.

Die zweite Forschungsfrage adressierte die inkrementelle Validität von Lern- und Leistungsmotivation gegenüber Persönlichkeit für den SRL-Trainingserfolg. Entgegen unserer Erwartung konnte für LZ und ALZ kein signifikant positiver Einfluss nachgewiesen werden (Hypothesen 4 und 5). Auch, wenn wir, den vorherrschenden Befunden vorangegangener Untersuchungen gefolgt, von einem positiven Einfluss ausgegangen sind, ist das Ergebnis nicht ganz überraschend, da sich in der Literatur bisher kein einheitliches Muster gezeigt hat (z.B. Stoeger et al., 2015). In Metaanalysen (z.B. Linnenbrink-Garcia, Tyson & Patall, 2008; Wirthwein et al., 2013) wird beispielsweise berichtet, dass der Zusammenhang bzw. Einfluss einer ALZ auf Lernen und Leistung im Schul- und Hochschulkontext positiv, negativ oder auch nicht besteht. Auch für die Hypothesen 6 und 7 zur Bedeutung von VLZ und AV für SRL-Trainingserfolg konnten keine Belege gefunden werden. Entgegen der konstanten Befundlage in der Literatur (z.B. Steinmayr & Spinath, 2009) ließen sich in dieser Studie keine negativen Einflüsse dieser beiden Zielorientierungen nachweisen. Betrachtet man allerdings die Interkorrelationen, zeigt sich ein Muster, das in Einklang mit anderen Studien zu Zusammenhängen mit Lernen und Leistung steht (z.B. Bidjerano & Dai, 2007; Liem, 2016; Steinmayr & Spinath, 2009; Vermetten et al., 2001): signifikant schwach positive bzw. negative Korrelation von LZ, ALZ und AV mit SRL t2. Dies weist zumindest darauf hin, dass Zielorientierungen mit SRL zusammenhängen, aber weniger mit SRL-Trainingserfolg. Steinmayr et al. (2011) fanden ebenfalls entgegen ihrer Erwartung keinen Einfluss von VLZ und AV auf akademische Leistung, wenn sie für Persönlichkeit kontrollierten. Sie stellten deshalb die Vermutung auf, dass bis auf LZ die Aspekte der Zielorientierungen, die akademische Leistung vorhersagen, bereits in den Big Five enthalten seien und deshalb keine zusätzliche Vorhersagekraft hätten. Um auszuschließen, dass Persönlichkeit den Effekt der Zielorientierungen auf den SRL-Zuwachs verschwinden lässt, wurde in dieser Studie der Einfluss der Zielorientierungen auf SRL-Trainingserfolg ohne Persönlichkeitsvariablen untersucht. Auch hier zeigten sich keine substantiellen Zusammenhänge zwischen Zielorientierungen und SRL-Zuwachs.

Davon abgesehen, könnte der Grund, weshalb keine signifikanten Ergebnisse gefunden wurden, in der Tatsache liegen, dass Studierende eventuell nur am Kurs teilnahmen, um Leistungspunkte zu erwerben. Die Daten sind zwar normalverteilt und die deskriptiven Statistiken vergleichbar mit denen anderer Studien (z.B. Dinger et al., 2013; Steinmayr et al.; 2011), jedoch lässt sich nicht ganz ausschließen, dass die Studierenden sozial erwünscht geantwortet haben.

Obwohl nicht für alle Hypothesen Belege gefunden werden konnten, bekräftigen die Ergebnisse unserer Studie zum signifikanten Einfluss von G, V sowie O auf den SRL-Trainingserfolg, dass SRL-Trainings differentielle Effekte aufweisen können. Die vorliegende Studie konnte diese Zusammenhänge nicht nur cross-sektional, sondern in einem längsschnittlichen Untersuchungsdesign über ein Semester hinweg zeigen. Es lässt sich folgern, dass unterschiedliche Interventionseffekte und -erfolge von den Voraussetzungen der Teilnehmerinnen und Teilnehmer abhängen (PE-Fit).

Infolgedessen sollten Interventionen nicht nur hinsichtlich ihrer globalen Effektivität analysiert werden. Darüber hinaus sollte ein ATI-Ansatz verfolgt werden, indem individuelle Charakteristika der Teilnehmerinnen und Teilnehmer bei der Analyse und Bewertung von Trainingseffekten einbezogen werden, um Fehlinterpretationen des Trainingserfolgs zu vermeiden (z.B. Lapka et al., 2011). Personen-zentrierte Analysen oder ein mixed-methods-Ansatz stellen geeignete Analysen für Feldforschung dar, da im Gegensatz zu Laborstudien die Ergebnisse nicht immer einfach zu interpretieren sind (z.B. Dörrenbächer & Perels, 2016; Lapka et al., 2011).

Damit alle Studierenden von Interventionen gleichermaßen profitieren können, ist es für Lehrende von Vorteil, die Voraussetzungen ihrer Studierenden zu kennen, um eine adaptive Lernumgebung zu schaffen (z.B. Kokkinos et al., 2015; Ljubin-Golub et al., 2019). Auch wenn teilweise für den Einsatz von Persönlichkeitstests argumentiert wird (z.B. Pawloska et al., 2014), lehnt diese Studie Persönlichkeitsdiagnostik für die Entwicklung eines adaptiven Trainings eher ab. Es ist nicht nur aus praktischen, sondern auch aus ethisch-moralischen Gründen an Universitäten nicht ohne großen Aufwand umsetzbar, Studierende vor einem SRL-Training einen Persönlichkeitstest durchlaufen zu lassen. Um dennoch die Ergebnisse dieser Studie zu nutzen, könnte eine Alternative zu adaptiven Trainings darin bestehen, die Aspekte der bedeutsamen Persönlichkeitsfaktoren im Rahmen des Trainings gezielt anzusprechen und situativ zu stimulieren. Um Aspekte von G zu fördern, könnte das Training noch stärker strukturiert werden und beispielsweise mehr Vorgaben in Form von Bearbeitungsfristen/Subzielen enthalten (vgl. Kaufman, Agars, Lopez-Wagner, 2008). Für die Stimulation von Aspekten der O könnte das Training Instruktionen und Formate enthalten, die die Studierenden ermutigen, das Gelernte anzuwenden sowie gezielte Ansprachen, sich auf etwas Neues einzulassen. Dass Studierende Austausch in Lerngemeinschaften suchen sollen, könnte Aspekte, die V beinhaltet, unterstützen.

Abschließend ist anzumerken, dass die Generalisierbarkeit der Ergebnisse eingeschränkt ist, da die Untersuchung mit Studierenden nur einer Universität durchgeführt wurde. Zukünftig sollten eine größere heterogenere Stichprobe sowie Probanden unterschiedlicher Universitäten einbezogen werden. Die Ergebnisse zu Persönlichkeit wurden bereits in anderen Stichproben gezeigt, jedoch wurde entgegen der Erwartung für Motivation kein signifikanter Einfluss gefunden. Eine weitere Limitation betrifft die Verwendung von Selbstberichten für SRL. In zukünftigen Untersuchungen wäre es wünschenswert, objektivere Instrumente zur Erfassung von SRL einzusetzen. Sogenannte Situational Judgement Tests sind eine vielversprechende Möglichkeit (vgl. Autoren2).



Diese Studie leistet einen wichtigen Beitrag auf dem Forschungsgebiet zu SRL. Sie zeigt, dass der Trainingserfolg durch SRL-Interventionen von individuellen Eigenschaften der Studierenden beeinflusst wird. Insbesondere die Persönlichkeitseigenschaften G, V sowie O spielen dabei eine Rolle. Darüber hinaus scheint auch die Berücksichtigung der Kontextfaktoren des Trainingsformats (P versus W) sowie die Trainingsphasen einer SRL-Intervention (Theorie- versus Anwendungsphase) bedeutsam, da diese mit individuellen Eigenschaften der Studierenden interagieren. Dies legt den Schluss nahe, Interventionen nicht nur global, sondern auch differentiell zu evaluieren.

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Tabelle 1

Mittelwerte (M), Standardabweichungen (SD), und Interkorrelationen zwischen allen Variablen vor Beginn des Trainings (t1), nach der Theoriephase (t2) und nach der Anwendungsphase (t3)

		Deskriptive Interkorrelationen														
Statistiken																
M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1 Abiturnote	2.22	.62	-	-.34**	-.14*	-.11	-.17*	-.22**	-.05	-.13	.06	-.09	.21**	.08	.06	-.18*
2 Studiendauer	7.01	3.71	-	-.09	-.06	-.04	-.06	.19*	-.02	-.16*	-.09	-.32**	-.23**	-.12	.33**	
3 SRL t1	4.03	.81	-	-	.67**	.60**	.44**	-.05	.07	-.07	.23**	.31**	.12	-.06	-.20**	
4 SRL t2	4.15	.73	-	-	-	.76	.55**	-.03	.17**	-.08	.15*	.23**	.20**	.05	-.20**	
5 SRL t3	4.42	.68	-	-	-	-	.63**	.07	.10	-.05	.32**	.18*	.11	-.01	-.14*	
6 G	3.99	.69	-	-	-	-	-	.03	.10	-.22**	.15*	.10	.05	-.06	-.19*	
7 E	4.07	.66	-	-	-	-	-	-	.14	-.34**	.20**	-.00	-.05	-.16*	.06	
8 V	4.39	.51	-	-	-	-	-	-	-	-.09	.10	.23**	.06	.05	-.14*	
9 N	3.26	.80	-	-	-	-	-	-	-	-	.04	-.05	.06	.18*	.07	
10 O	3.74	.65	-	-	-	-	-	-	-	-	-	.24**	.07	-.01	-.04	
11 LZ	4.06	.60	-	-	-	-	-	-	-	-	-	-	.20**	-.06	-.30**	
12 ALZ	2.51	.76	-	-	-	-	-	-	-	-	-	-	-	.60**	.09	
13 VLZ	1.88	.83	-	-	-	-	-	-	-	-	-	-	-	-	-.35**	
14 AV	2.47	.90	-	-	-	-	-	-	-	-	-	-	-	-	-	

Anmerkung. N=146, \* $p < .05$  \*\* $p < .01$ .

Tabelle 2

Präsenz-Gruppe: Vorhersage von SRL t2 (Theoriephase): Ergebnisse der hierarchischen Regressionsanalyse

	Modell 1				Modell 2				Modell 3							
	$\beta$	T	p	R <sup>2</sup>	F(df)	p	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$
Konstante		3.29	.00	.52	23.55(3,66)	.00	-82	.42	.10	3.11(5,61)	.01	-44	.66	.03	1.03(4,57)	.40
SRL t1	.73	8.26	.00			.59	6.28	.00				.57	5.58	.00		
Abiturnote	.10	1.01	.31			.18	1.90	.06				.14	1.51	.14		
Studiendauer	-.01	-1.12	.91			.08	.81	.42				.13	1.19	.24		
<u>Big Five</u>																
G						.25	2.62	.01				.25	2.52	.02		
E						-.04	-.46	.65				-.01	-.08	.94		
V						.22	2.67	.01				.17	1.80	.08		
N						.08	.89	.38				.08	.83	.41		
O						.02	.25	.80				-.00	-.02	.99		
<u>Zielorientierungen</u>																
LZ												.03	.33	.75		
ALZ												.04	.31	.76		
VLZ												.10	.82	.42		
AV												-.17	-1.6	.11		

Anmerkung. N=70.



Tabelle 3

*Web-basierte-Gruppe: Vorhersage von SRL t2 (Theoriephase): Ergebnisse der hierarchischen Regressionsanalyse*

	Modell 1			Modell 2			Modell 3									
	$\beta$	T	p	$R^2$	F(df)	p	$\beta$	T	p	$\Delta R^2$	$\Delta F(df)$	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$	
Konstante	3.60	.00	.42	17.49(3,72)	.00	.27	.79	.11	3.30(5,67)	.01	-.21	.83	.04	1.39(4,63)	.25	
SRL t1	.63	6.99	.00			.49	5.15	.00			.44	4.45	.00			
Abiturnote	-.12	-1.3	.21			.01	.12	.90			.01	.09	.93			
Studiendauer	-.00	-.03	.98			.01	.10	.92			.04	.37	.71			
<u>Big Five</u>																
G						.40	3.91	.00			.44	4.16	.00			
E						-.03	-2.9	.78			-.03	-2.6	.79			
V						.06	.67	.50			.01	.07	.95			
N						.03	.27	.79			.02	.22	.83			
O						-.05	-5.3	.60			-.02	-1.6	.87			
<u>Zielorientierungen</u>																
LZ											.03	.31	.76			
ALZ											.19	1.52	.13			
VLZ											.01	.10	.92			
AV											.04	.32	.75			

Anmerkung. N=76.

Tabelle 4

Präsenz-Gruppe: Vorhersage von SRL t3 (Anwendungsphase): Ergebnisse der hierarchischen Regressionsanalyse

	Modell 1				Modell 2				Modell 3									
	$\beta$	T	p	R <sup>2</sup>	F(df)	p	$\beta$	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$	$\beta$	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$
Konstante	4.51	.00	.36	12.55(3,66)	.00		-1.09	.28	.23	6.92(5,61)	.00		-.60	.55	.24	.90(4,57)	.47	
SRL t1	.60	5.85	.00			.35	3.60	.00					.38	3.60	.00			
Abiturnote	.01	.05	.96			.10	1.05	.30					.07	.69	.49			
Studiendauer	-.07	-.62	.54			.07	.679	.50					.08	.74	.46			
<u>Big Five</u>																		
G						.39	4.04	.00					.40	3.97	.00			
E						.06	.67	.51					.10	1.03	.31			
V						.08	.90	.37					.02	.15	.88			
N						.18	1.92	.06					.16	1.75	.09			
O						.27	3.04	.00					.28	3.01	.00			
<u>Zielorientierungen</u>																		
LZ													.01	.05	.96			
ALZ													-.14	-1.19	.24			
VLZ													.22	1.83	.07			
AV													-.14	-1.34	.19			

Anmerkung. N=70.

Tabelle 5

*Web-basierte-Gruppe: Vorhersage von SRL t3 (Anwendungsphase): Ergebnisse der hierarchischen Regressionsanalyse*

	Modell 1				Modell 2				Modell 3										
	$\beta$	T	p	R <sup>2</sup>	F(df)	p	$\beta$	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$	$\beta$	T	p	$\Delta R^2$	$\Delta F(df)$	$\Delta p$	
Konstante		6.18	.00	.41	16.88(3,72)	.00		.82	.42	.17	5.40(5,67)	.00		.50	.62	.01	.36(4,63)	.84	
SRL t1	.59	6.50	.00				.41	4.55	.00				.40	4.07	.00				
Abiturnote	-.23	-2.38	.02				-.07	-.82	.42				-.06	-.63	.53				
Studiendauer	.02	.19	.85				.03	.32	.75				.02	.19	.85				
<u>Big Five</u>																			
G							.48	4.99	.00				.51	4.9	.00				
E							.08	.89	.38				.06	.65	.52				
V							-.01	-.11	.92				-.02	-.20	.85				
N							.07	.77	.45				.07	.79	.43				
O							.03	.32	.75				.04	.41	.69				
<u>Zielorientierungen</u>																			
LZ													.01	.06	.95				
ALZ													.11	.88	.39				
VLZ													-.09	-.76	.45				
AV													.07	.63	.53				

Anmerkung. N=76.

## Appendix C - 3<sup>rd</sup> Paper (Study III)

Study III: Do minimal interventions increase the participation rate in voluntary online training at high school?

*Note:* This is the accepted version of the article published in *Psychology Learning and Teaching*, <https://doi.org/10.1177/1475725720965002>.

van der Beek, S., Bellhäuser, H., & Hertel, S. (2020). Do minimal interventions increase the participation rate in voluntary online training at high school? *Psychology Learning and Teaching*, *0(0)*, 1–23. <https://doi.org/10.1177/1475725720965002>

## Abstract

In preparation for graduation from high school, students face the challenge of having to learn the subject matter of several school years with little guidance. The ability to self-regulate learning is conducive to this. Research has shown that students' self-regulated learning (SRL) can be successfully promoted through training. However, when such a training is provided voluntarily, not all students participate and dropout rates tend to be high. Minimal interventions on utility value (U) and implementation intention (I) are promising approaches to increase the use of voluntary training. This study investigates whether short interventions can increase the participation in voluntary SRL-training and whether differences in participation can be explained by motivation-profiles. A randomized intervention study was conducted with  $N=269$  students assigned to one of four conditions: U, I, a combination of U-I or a control-condition. Regression analyses show that the minimal interventions on U and I had no effect on training participation. Positive predictors, however, were expectancy for success and mean grade score. In addition, latent profile-analyses showed a three-class model with the profiles "motivated", "balanced", and "unmotivated". Motivated students participated in the training significantly more often than students with other profiles. Implications for theory development and practice are discussed.

Keywords: utility value, implementation intention, voluntary training, high school, self-regulated learning

## 1 Introduction

In preparation for graduating from high school, students have to learn and revise the learning material of their last semesters on their own, which can be seen as a great challenge. The ability to learn in a self-regulated way can facilitate the learning process because self-regulated learning (SRL) is an essential condition for studying successfully (e.g., Dignath & Büttner, 2008). However, students often show deficits in their SRL-ability (e.g., Peverly et al., 2003). Research has shown that students in a school context can be successfully trained in SRL and that acquired skills are associated with improved academic achievement (e.g., Dignath & Büttner, 2008) underlining the need of providing SRL-training. However, voluntary training is often not used by all potential participants and dropout rates are rather high (Nistor & Neubauer, 2010). It has been shown that minimal interventions on utility value and implementation intentions are a promising approach to foster students' performance and to engage in a goal-oriented behavior (e.g., Gollwitzer, 2014; Hulleman & Harackiewicz, 2009). In this study, we want to investigate how the use of voluntary online training can be increased by utility value and implementation intention interventions.

## 2 Minimal interventions

Brief - also known as wise or minimal psychological - interventions currently gain in importance in an educational context (Walton, 2014; Yeager & Walton, 2011). These interventions are considered as efficient approaches to promote motivation and performance of students in a school and university context and are defined as brief exercises that “target students' thoughts, feelings, and beliefs in and about school” (Yeager & Walton, 2011, p. 268). Minimal interventions address recurring negative psychological processes in order to change them in a positive direction with little effort (Walton, 2014). The interventions themselves do not focus on academic content, but target the underlying processes (Yeager & Walton, 2011). Brief exercises can produce significant and long-lasting benefits when they are based on a precise, well-founded theory of psychological processes. More concretely, it is assumed that their effectiveness relies on three principles (Walton, 2014). First, the intervention has to be meaningful to the applied context; second, it has to change the intended psychological process. Third, the intervention can have long-term effects if it alters recursive processes and if the context provides adequate affordances. Thus, due to their dependency on context factors, interventions should be adapted to contextual particularities such as school. Research on different minimal interventions (e.g., growth mind-set, utility value, goal-setting) has shown positive effects in school context (e.g., Blackwell et al., 2007; Burnette et al., 2019; Hulleman & Harackiewicz, 2009; Hulleman et al., 2017; Paunesku et al., 2015; Schippers et al., 2020). In this study, we focus on two approaches for which positive effects have already been shown: implementation intentions and utility value (Gollwitzer, 2014; Hulleman & Harackiewicz, 2009) and examine the effectiveness in the context of voluntary SRL-training.

## 2.1 Implementation intentions

Individuals often do not meet their goals because they face obstacles. Planning in advance how to deal with possible obstacles is an effective strategy of supporting goal striving (e.g., Gollwitzer, 1999; Duckworth et al., 2013). Forming of implementation intentions, or if-then planning, can help people linking anticipated situations to goal-directed responses. That is the reason why implementation intentions go beyond the intention to meet a goal (e.g., physical activity; Bélanger-Gravel et al., 2013). An individual forming an implementation intention commits himself to respond to a certain situation in a specific manner. As implementation intentions combine situational cues with instrumental goal-directed responses, individuals know when, where, and how one wants to act to reach a goal. For example, a student who intends to write a review, may formulate the following implementation intention „If I have read the last chapter of my textbook, then I start writing the review.“. Thereby, the student identifies a goal-relevant situational cue - the last chapter of the textbook - and links it to a goal-directed response - the writing of the review. The student could also identify an obstacle which prevents him from writing his review. Then, the student had to link it to a goal-directed response, which supports him to solve the obstacle. In both cases, when the student plans in advance and the critical situation occurs, the intended behavior is initiated automatically, which is an effective strategy to meet the actual goal (Gollwitzer, 1999). Indeed, research shows that implementation intentions help people to meet their goals in various life-domains (e.g., Gollwitzer, 2014). Conducting a brief written online goal-setting intervention with first-year university students, Schippers et al. (2020) found that students in the goal-setting condition showed an increase in academic performance compared to the control condition. The specificity of students' strategies, the extent of their participation, and the number of written words influenced the increase in academic performance whereas goal-type (academic or non-academic) did not. In another study, Oettingen, Kappes, Guttenberg, and Gollwitzer (2015) found implementation intentions to improve time-management.

## 2.2 Utility value interventions

Many utility value interventions (e.g., Hulleman et al., 2010; Hulleman & Harackiewicz, 2009) are based on the expectancy-value model (Eccles & Wigfield, 2002), postulating that task-choices, performance, and persistence are influenced by expectancy for success and value of a given task. Expectancy for success is defined as individuals' beliefs about how well they will perform a task. Thus, students who believe that they can perform well on a given task are more likely to be motivated and persistent. Four components of task-value can be differentiated: attainment value (personal importance of doing well), intrinsic value (enjoyment of performing the task), utility value (how well a task relates to current and future goals and their relevance), and cost (effort, fear of failure) (Eccles et al., 1983).

Research has shown the importance of utility value for task choice and performance (Eccles & Wigfield, 2002) and that utility value can be fostered in students via writing interventions (e.g., Gaspard et al., 2015; Harackiewicz et al., 2014). It can be assumed that when students

perceive utility value, their interest is fostered resulting in higher performance (e.g., Harackiewicz et al., 2008). Students who doubt their competencies are at risk for less interest and a lower performance (Hulleman & Harackiewicz, 2009). Research indicates, however, that interventions fostering utility value are most effective for students showing a low performance and do not believe in their competence (e.g., Harackiewicz et al., 2016, Hulleman & Harackiewicz, 2009; Hulleman et al., 2017). It can be expected that these low performing students become energized and more involved in learning when they make connections to the learning material (Hidi & Harackiewicz, 2000; Hulleman & Harackiewicz, 2009).

For example, Hulleman and Harackiewicz (2009) showed in a randomized field experiment with 262 high school students that a utility value intervention, that aimed at helping students to make connections between science course material and their lives, increased interest and learning particularly in students with low expectations of success. Hulleman et al. (2017) were able to replicate these findings.

Canning, Priniski and Harackiewicz (2019) compared the effectiveness of a student-framed utility value writing intervention versus a teacher-framed intervention. In some contrast to other studies (e.g., Hulleman et al., 2017) students with low performance showed decreased interest and perceived utility value, whereas high-performing students were unaffected by the interventions. Moreover, the student-framed condition differentially affected grades for low versus high performing students. That is, there was a negative effect for low performers and a positive for high performers. Taken together, the research on utility value interventions in an educational context is ambiguous and therefore, more research is needed. In this study, we follow most intervention studies (e.g., Hulleman & Harackiewicz, 2009; Hulleman et al., 2017), which mainly focus on fostering one component of task value, namely utility value. Utility value is more extrinsic (Eccles & Wigfield, 2002) and therefore easier to influence directly with extrinsic reasons to engage in a task than intrinsic value and attainment value (Gaspard et al.; 2015).

### 3 The current study

Overall, based on the previous literature, both implementation intention and utility value interventions are approaches that can have effects on motivation and performance in an educational context. Therefore, we implement these approaches to foster the participation in a voluntary web-based SRL-training, offered to support students in their preparation for final exams. Although participation in the training is voluntary, it is embedded in a meaningful context, as students are likely to seek a successful graduation. It can be assumed that the interventions may increase participation rate in a voluntary training, that was already proven effective for prospective and university students (Bellhäuser et al., 2016; van der Beek et al., 2019). So far, no research has been conducted comparing the effectiveness of implementation intention and utility value interventions or investigating the interaction between the two interventions when combined.

The aim of this study is to analyze conditions for training participation. It was examined whether training participation is influenced by minimal interventions, students' motivation



(expectancy, interest, utility, cost), and grades as a covariate as a criterion for academic performance. To complement this variable-centered approach and to further develop SRL-training, it is important to analyze which specific subgroups profit most from the interventions and participate in the training. A person-centered approach helps characterize heterogeneity between individuals, which might be unobserved by traditional variable-centered analyses as these only focus on average outcomes (Hickendorff et al., 2018). In order to avoid misinterpretations of a global intervention success across different groups, the consideration of individual characteristics in the analysis and evaluation of training effects seems important (e.g., Lapka et al., 2011). Therefore, to contribute to the understanding of how the interventions work and to detect qualitative differences between the learners, a person-centered approach was conducted by exploring motivational profiles and examining their relations to students' training participation. Against this background, we state the following research questions and hypotheses:

Research question 1: Do minimal interventions on utility value and implementation intentions increase the participation in the training?

Hypothesis 1: Students who received the utility value intervention will log into the training-units significantly more often than students in the control group.

Hypothesis 2: Students who received the implementation intention intervention will log into the training-units significantly more often than students in the control group.

Hypothesis 3: Students with low expectation of success will profit more from the utility value intervention than students with high expectation of success and therefore log into the training-units more often.

Hypothesis 4: There is an additive effect of both interventions, such as that students who received both interventions will log into the training-units significantly more often than students who received only one intervention.

Research question 2: Can differences in training participation be explained by specific profiles of students' motivation?

It is assumed that different profiles on students' motivation (expectancy, interest, utility, cost) and academic performance as a control variable can be found. It is analyzed in an exploratory manner which specific profiles are most adaptive for training participation.

## 4 Methods

### 4.1 Design

Data come from a randomized intervention study conducted in German high schools. High school graduates in their last year could register for a voluntary online SRL-course and were randomly assigned to the waiting control group (WCG) or one of the four experimental conditions: Utility value (U), implementation intention (I), a combination of U and I (UI) and a control condition (C). Three assessment points were scheduled. At pretest at the beginning of the school year before the online course started, background variables, motivation and grades were collected with online questionnaires. In addition, students' log files related to SRL-

training were assessed throughout the school year. There were two more measurement points, which are not part of this study: A first posttest after the course units, and a second posttest was conducted before winter break. Participation in our study was voluntary.

#### 4.2 Participants

Participants were recruited from German high schools. Out of 58 schools, contacted via standardized invitation letters, 17 schools agreed to participate. Informed consent was obtained from parents and students. 647 students took part in the pretest. Some participants, however, had to be excluded. Due to the fact that the WCG ( $n=246$ ) did not receive any intervention and therefore not relevant for answering the research questions, these participants were excluded. Apart from that, in one school only six students took part and therefore they could not be randomized. Moreover, seven participants stated that they had not answered the questions *conscientiously and honestly at all*, and 119 participants did not fulfil the assignment for their condition. The exclusion of these participants left a final  $N$  of 269 for the analyses. A MANOVA revealed that the excluded individuals did not differ from the participants in the final sample concerning age, mean grade score, and gender (Wilks'  $\lambda = .99, p=.55$ ).

In the final sample of  $N=269$  participants ( $n=102$  male,  $n=164$  female,  $n=3$  unspecified; mean age=17.77 years,  $SD=.71$ ,  $Range=15-20$ ; mean grade score=9.99 (0 lowest grade – 15 highest grade),  $SD=2.01$ ,  $Range=5.38-14.90$ ),  $n=70$  students were in the I-condition,  $n=75$  students were in the U-condition,  $n=53$  students were in the UI-condition, and  $n=71$  students were in the C-condition. A MANOVA was computed to analyze differences in demographic variables (age, gender, mean grade score) between the groups (randomization check). The alpha level was set to .20 in order to test  $H_0$  and thereby minimize the Type II error rate (Bortz, 1999). The multivariate effect (Wilks'  $\lambda=.98, p=.73$ ) was not significant.

#### 4.3 Procedure

Two research assistants visited each school and introduced the online course. During this meeting students were randomly assigned to intervention conditions. Students had to fill in online questionnaires, an introduction to the SRL-course was presented online and depending on their condition (U, I, UI, C) they had to write down a statement. Teachers were informed that the research concerned the effectiveness of an SRL-training but were blind to the hypotheses and students' experimental conditions.

#### 4.4 Minimal interventions

*Implementation intention (I)*. The students had to write down when they wanted to start with the first unit of the training. Then, they had to think about possible obstacles that could prevent them from starting, write them down and afterwards they had to describe solutions to overcome those obstacles.

*Utility value (U).* The students had to describe their typical learning problems. Then, they had to describe how the learning strategies taught in the training are relevant to their life and useful to their personal learning problems.

*Combined intervention (UI).* The students received the U intervention followed by the I intervention.

*Control group (C).* Students had to briefly summarize the main points of the training's introduction.

The instructions for the minimal interventions can be found along with the data set in the public repository: <https://osf.io/693am>.

#### 4.5 Course program

A web-based training developed and evaluated by Bellhäuser et al. (2016), aimed at supporting students' SRL, was presented to the participants. The training concept was based on the process model by Schmitz and Wiese (2006), which is an adaptation of Zimmerman's (2000) three-phase cyclical SRL model, but specified for a concrete situation, namely learning, and in which SRL is exclusively defined as a process of learning states. Six units (approximately 45-minutes each) were available for participants after completing the pretest with the recommendation to focus on one unit per week. As this study does not investigate the effects of the training, its content is not described in detail here. More information can be found in Bellhäuser et al. (2016). The course was provided in an online learning platform, and the content was transmitted through different media, for example, videos, power point presentations, interactive exercises, and discussion forums. The training was accessible immediately after the pretest until the first posttest (85 days).

#### 4.6 Measures

*Course grade.* Course grades were obtained from students' self-reports. Students had to indicate the grades of their two advanced courses and their two oral examination subjects of the last and penultimate certificate (0 lowest grade – 15 highest grade). A mean grade score was used for all analyses, and for profile-analyses, a z-standardized score was used so that *course grade* and *motivation* fit the same scale.

*Participation.* Participation was operationalized via log files, which measure whether the training units were opened. The log files of each unit were dummy-coded (0 not opened – 1 opened). A total score of all six units (*range* = 0-6) was used for analyses.

*Motivation.* Motivation was measured with four scales at pretest after the students had watched the training introduction: utility value, expectancy, interest, and cost (following Hulleman et al., 2017). The participants were asked to indicate their agreement on a six-point Likert scale ranging from 1 (not true) to 6 (true). The *utility value* scale consists of 8 items (e.g., "I can use what we learn in the online training in real life.",  $\alpha = .88$ ), the *expectancy* scale consists of 6 items (e.g., "I am confident that I will successfully complete the online training.",  $\alpha = .83$ ), *interest* was captured with 6 items (e.g., "The online training is very interesting.",  $\alpha =$

.86), and *cost* was measured with 7 items (e.g., “I don't have time for the online training this school year.”,  $\alpha = .82$ ). For profile-analyses, z-standardized scores were used so that *motivation* and *course grade* fit the same scale.

*Coding of articulated utility value, implementation intention and summary (manipulation check)*. The statements of the students were dummy-coded by the authors. “1” indicates a fit to the condition the person belongs, “0” indicates that either no utility value (U-condition) / implementation intention (I-condition) / summary (C-condition) was provided by the participant or that the answer substantially diverged from instruction. Inter-rater reliability was substantial to high (85%/66%/86%). Disagreements were resolved by discussion.

## 5 Results

Descriptive data and correlations between all measures can be found in Table 1. Students in the U-condition opened the units on average 1.1 times ( $SD=1.69$ ;  $range=0-6$ ), students in the I-Condition on average 1 time ( $SD=1.66$ ,  $range=0-6$ ), students in the UI-condition on average 1.08 ( $SD=1.71$ ,  $range=0-6$ ), and students in the C-condition .97 times ( $SD=1.70$ ,  $range=0-6$ ). Table 2 shows the percentages of students per condition who participated in the training-units.

In order to answer research question one, whether minimal interventions on utility and implementation intentions increase the participation in the training-units, regression analysis with robust maximum likelihood was conducted in Mplus (Version 7.3, Muthén & Muthén, 2014). Although students were randomly assigned to the condition at student level, “type is complex” was used to account for the nested structure of the data because the students are arranged in classes and schools. The sum of the log file entries was entered as a dependent variable. Independent variables were the dummy-coded experimental conditions (U, I, UI), the mean grade score as control variable, and the interactions between the training conditions and the mean grade score.

In the first model, the experimental conditions (U, I, UI) were entered as independent variables. In the second model, the motivation variables expectancy, utility value, interest, and cost were added. Then, the mean grade score was added. Results show that expectancy ( $\beta=.19$ ,  $p<.001$ ) and mean grade score ( $\beta=.10$ ,  $p=.003$ ) were significant positive predictors of logging into the units (Table 3). Because of these results, in a fourth and fifth model, the interactions expectancy x experimental conditions, and mean grade score x experimental conditions were entered. None of these were significant predictors. Contrary to our hypotheses, neither of the experimental conditions had a significant effect on training participation.

Insert Table 1, 2 and 3 here

Furthermore, in order to analyze which specific subgroups profit most from the interventions and log into the training (research question two), latent profile-analyses were

conducted. To define these latent profiles, scale scores for measures of the motivation variables and the mean grade score as a control variable were used (values were z-standardized). We specified models with 1–5 latent profiles and compared their model fits, which included Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Lo–Mendell–Rubin Test (LMR), and Entropy.

The fit statistics AIC and BIC indicated improvements in model fit up to four classes, while the LMR and Entropy indicated improvements in model fit up to three classes. The three-class model was selected as the preferred model because it was considered plausible and more readily interpretable. Fit statistics for 1–5 class models are presented in Table 4 and the 3-class model is also displayed graphically in Figure 1. Students in the “motivated” class (38%) showed high values in expectancy, interest, utility value, mean grade, and low values in cost. Students in the “balanced” class (51%) showed average values in all measures. Students in the “unmotivated” (11%) class showed high values in cost, average values in mean grade, and low values in the other measures. There were significant differences across classes in terms of logging into the units. The “motivated” class ( $M=1.38$ ,  $SD=.19$ ) opened the units significantly more often than the “balanced” ( $M=.90$ ,  $SD=.14$ ,  $p<.05$ ) and the “not motivated” ( $M=.55$ ,  $SD=.22$ ,  $p<.01$ ) classes. There were no significant differences between the “balanced” and the “not motivated” classes.

Insert Table 4 and Figure 1 here

## 6 Discussion

The aim of this study was to explore whether minimal interventions on utility value and implementation intention could foster the participation in an online SRL-training. Moreover, this study takes a person-centered approach by addressing the question whether there are different profiles in students’ motivation and grades and whether these profiles affect the training use. Apart from very few exceptions (Canning et al., 2019; Hoch et al., 2020), minimal interventions seemed to have great effects. The present study, however, gives reason to critically evaluate in which contexts minimal interventions are successful.

### 6.1 Research question one: Minimal interventions

It was expected that a utility value intervention could foster the training participation in a voluntary online SRL-training and that it would be even more effective for low performing students (Hypotheses 1 and 3). Contrary to most findings in the literature, in our study the minimal interventions did not have an impact on students’ participation in the training.

Our results regarding utility value, however, fit in the results shown by Canning et al. (2019) who implemented a utility value intervention in a college class and found that struggling students became less interested and perceived less utility value on class content. Moreover,

good students profited even more from the intervention when it was student-framed whereby struggling students showed decreased grades (Canning et al., 2019). Reasons for these unexpected results are that struggling students doubted their preparedness for the class, lost confidence about their performance, and cared less about doing well, which, in turn, led to decreased interest and perceived utility value. For example, Canning and Harackiewicz (2015) showed that providing students with directly communicated utility value examples may be threatening for students who lack confidence in their ability to do well, but that self-generated utility can have positive effects. Apart from that, the source of information may influence the effectiveness of a utility value intervention (e.g., Canning et al., 2019; Shin et al., 2017). When utility value is transmitted through peer groups instead of authorities, it may be easier for the individual to generate personal examples because the individual sees that his peer is also able to make these connections. Our study followed the findings of Canning and Harackiewicz (2015) by letting the students formulate their own utility value instead of only presenting examples, which might have been threatening for low performers. The fact that research shows different pictures on the effectiveness of utility value interventions indicates a need for further research. However, as far as implementation intentions are concerned, the source of information does not seem to have any influence on effectiveness (Gollwitzer, 2014).

The implementation intention intervention in this study did not have an effect on training participation either, which was also unexpected (Hypothesis 2) because its effectiveness was already shown in many studies and meta-analyses (e.g., Gollwitzer & Sheeran, 2006; Oettingen, et al., 2015). The participants in our study had to first make a plan when they want to start with the training and then self-generate an implementation intention for the case that they face an obstacle that could prevent them from acting out their plan. Maybe, the effect of the implementation intention was not strong enough to endure all training-units. Apart from this, it could have been more effective if the participants generated if-then plans about their goal to actually participate in the training, rather than about the obstacles. Maybe, some students did not face an obstacle and therefore, they had no cue to pursue the actual goal of participation in the training. In a study in which implementation intention was successful, the students had a three hour training on the technique with a real trainer and the students chose their own goals (Duckworth et al., 2013). Our intervention included a shorter introduction, which was presented online. A low specificity of the implementation intention (e.g., Hoch et al., 2020) may also account for our findings because the students were free to formulate their implementation intention.

Literature also shows that the success of an implementation intention might be moderated by intention stability (e.g., Godin et al., 2010; Prestwich & Kellar, 2014) or peer and school norms (e.g., Yeager et al., 2019). Prestwich and Kellar (2014) discuss further potential moderators (e.g., plan reminders) in order to analyze for whom implementation intention interventions are most effective. Thus, further research is needed to investigate moderating effects.

In the present study, students in the UI-condition received both interventions. It was expected that this condition was more effective than the conditions with only one minimal

intervention (Hypothesis 4). This, however, was not the case, which is not surprising, given that both interventions did not have an effect.

Furthermore, a reason why the minimal interventions did not have an effect could lay in the introduction to the training. Students only got a short overview of the SRL-training. This could have been too little information for the students to have seen enough relevance to the topic. Usually, implementation intentions as well as utility-interventions deal with topics that are already known to the students and that are an obligatory learning content, for example, the utility of science courses (e.g., Hulleman & Harackiewicz, 2009) as opposed to the voluntary training of this study. In future research, it should be ensured that all students understand the main points of the training by having them write a short summary of the introduction, which can also foster a deeper cognitive processing. In this study, only the control group had to write a short summary. Nevertheless, all U- and I-statements were analyzed for plausibility and completeness resulting in excluding students. The excluded persons either did not write anything at all or wrote a text that did not fit the task. This gives reason to critically evaluate whether the tasks were comprehensible for all students.

The results of the regression analyses, however, indicate that motivation is associated with training participation and has an impact beyond minimal interventions. Unexpectedly, students with a positive expectancy motivation and good grades logged into the training-units the most. Students with low expectancy motivation and poor grades did not show a desirable behavior to improve their performance. Although these results were unexpected, they, however, fit in the general principle of different expectancy constructs (e.g., Eccles & Wigfield, 2002; Pintrich, 2003), which postulate that people persist and perform better when they expect to do well.

## 6.2 Research question two: Motivation-profiles

In this study, we also focused on a rather explorative person-centered approach by carrying out latent profile-analyses in order to find out whether training participation is influenced by motivational patterns. We found three different profiles in students' motivation which indeed affected training participation. The "motivated" students logged into the training-units significantly more often than the "balanced" or the "unmotivated" students. This finding indicates that motivation has a positive influence on training participation beyond the effect of minimal interventions on utility value and implementation intention. The latent motivation profile was defined by the motivation variables expectancy, value, interest and cost, and the mean grade score. We included the mean grade score as a control variable for academic performance and because it was included in the regression analysis. While the mean grade score remained stable, the motivation variables showed different patterns in the different profiles. It is important to note, however, that the "motivated" students had high values in expectancy, value, and interest and low values in cost. This indicates that in fact, expectancy, value and interest positively influence training participation, which is in line with the results of the regression analysis. In this study, however, we were not able to foster these variables in the students and the average participation rate was rather low even in the "motivated" group. The

findings indicate, however, that motivation influences voluntary training participation beyond the implemented minimal interventions.

### 6.3 Strengths, limitations, and future research

A strength of the present study is that it was conducted in a real and relevant setting. Real behavior data from a large sample including different schools were collected and all participants were randomly assigned to the different intervention conditions. Another strength of the study is the implementation of a multimethod evaluation by combining variable-centered and person-centered analysis methods to present a bigger picture. In further studies, however, students in different situations should be recruited in order to assess whether our findings remain stable. The students in our study were about to graduate from high school and our intervention was not related to a specific school subject. Studies, which showed positive effects of minimal interventions, however, were not conducted just before graduation and were related to a specific subject (e.g., Hulleman & Harackiewicz, 2009). Thus, the context in which minimal interventions are implemented seems to influence their effectiveness.

Although most studies on minimal interventions show small effect sizes, the practical relevance of the interventions is high because they can be easily implemented and a great number of students can be reached (e.g., Yeager et al., 2019).

Nevertheless, in this study the participation rate in the training was low. In a review by Delnoij, Dirx, Janssen and Martens (2020) it was analyzed which factors are (non-)modifiable predictors of non-completion in online higher-education programs. For example, academic goals and intentions belong to the most modifiable predictors. Moreover, the authors give an overview of interventions to raise completion rates with coaching and remedial teaching, and peer monitoring being the most promising approaches to increase completion rates. Some interventions were indeed provided online and had a short duration (30 minutes). They concluded that a systematic approach is needed to analyze the effectiveness of various interventions in both traditional and online education. Although the study focused on higher education, factors might be transferable to the school context. Thus, our study can be seen as an approach to contribute to this research gap.

In future studies, however, it would be desirable to ask students directly about their goal of participating in the voluntary training because as mentioned by Gollwitzer and Sheeran (2006) implementation intentions require goal setting and minimal interventions have to be meaningful (Walton, 2014). Students who stated that they had not answered the questions *conscientiously and honestly at all* and who did not fulfil the assignment of their condition were excluded from our analyses. This served as an indication that the included participants were conscious and took the training seriously. Although this procedure shows ecological validity, we cannot be sure that the students really set the goal of participation in the training, which might be one reason that participation rate could not be fostered through minimal interventions. Nevertheless, SRL-training was embedded in a meaningful context as it aims at fostering SRL, which in turn should support students in their preparation for the final exams. The fact that the training was



voluntary, however, seems to play an important role for the effectiveness of minimal interventions.

Another point which might be criticized is the operationalization of training participation. In this study, participation was operationalized via log files, in more detail, whether a student opened a unit or not. One might think that the total time students spent online may be a better indicator for participation. First of all, the training's platform does not automatically track the total time spent online and the students are not asked to push an "exit" button when they have finished a unit. Therefore, the researcher would need to define an arbitrary termination criterion. They would also still not know what a student does between two clicks – is he really concentrating on the content or is he doing something else – this cannot be controlled. We decided to use the criterion "opened/not opened" for the operationalization of participation because this highly correlates with the total amount of log files ( $r=.95$ ,  $p<.001$ ), and can therefore serve as a proxy. Furthermore, the minimal interventions focused on opening a unit, not on willingness to persist. Moreover, in an attendance-based course one can also not be sure whether the students follow the lecturer attentively or are distracted, for example, by contents from other sources such as fellow students, smartphones or laptops.

Apart from that, in this study, we only focused on fostering one component of task value, namely utility value as this component seemed to be influenced easier than attainment and intrinsic value as these two rely on individual characteristics as opposed to utility value, which can be easier fostered by extrinsic reasons (Eccles & Wigfield, 2002). However, for example, Gaspard et al. (2015) showed that one condition of their utility value intervention, where students had to reflect on given arguments, also affected students' attainment and intrinsic value. Thus, in future studies, one could also try to implement an adapted utility value approach in terms of evaluating quotations in order to also foster attainment and intrinsic value. Apart from that, one could also try to target these two components directly in order to foster task value and in turn participation in our training. For example, Acee and Weinstein (2010) targeted all components in their intervention study.

In the current study, however, we were not able to replicate the results of studies that have shown positive effects of the implemented minimal interventions (e.g., Hulleman & Harackiewicz, 2009). Nevertheless, the present investigation complements existing literature by showing that minimal interventions are not effective per se because they seem to be context dependent, which is relevant for the practical implementation.

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## Tables

Table 1

*Means (M), Standard Deviations (SD), and Intercorrelations between all Measures at t1*

Measure	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1 Age	17.77	.71	-	-.24**	.08	.08	.08	-.14*	-.05
2 Mean grade score	9.99	2.01		-	-.08	-.21**	-.19**	.11	.15*
3 Expectancy	4.39	.82			-	.69**	.66**	-.56**	.23**
4 Utility value	4.33	.81				-	.79**	-.40**	.19**
5 Interest	4.18	.83					-	-.41**	.21**
6 Cost	3.57	.90						-	-.16*
7 Training Participation	1.04	1.68							-

Note. *N* = 269, grade score: 0 (lowest grade) - 15 (highest grade), \*\**p* < .01, \**p* < .05.

Table 2

*Students' Participation Rate per Unit*

Condition	<i>N</i>	0 Units	1 Unit	2 Units	3 Units	4 Units	5 Units	6 Units
U	75	50.7%	24.0%	13.3%	2.7%	0%	2.7%	6.7%
I	70	61.4%	14.3%	8.6%	5.7%	2.9%	2.9%	4.3%
UI	53	58.5%	15.1%	11.3%	3.8%	3.8%	1.9%	5.7%
C	71	62.0%	16.9%	7.0%	4.2%	1.4%	2.8%	5.6%
Overall	269	58.0%	17.8%	10.0%	4.1%	1.9%	2.6%	5.6%

Note. U: Utility value, I: Implementation intention, UI: a combination of U and I, C: Control condition.

Table 3

*Training Participation: Results from Latent Regression Analysis*

	Model 1				Model 2				Model 3			
	$\beta$	S.E.	<i>p</i>	$R^2$	$\beta$	S.E.	<i>p</i>	$R^2$	$\beta$	S.E.	<i>p</i>	$R^2$
<u>Training Conditions</u>												
U	.09	1.12	.47	.001	.04	.10	.71	.06**	.01	.10	.94	.10**
I	.02	.09	.85		.06	.09	.55		.02	.10	.86	
UI	.06	.07	.38		.01	.08	.90		-.05	.07	.46	
<u>Motivation</u>												
Expectancy					.19	.06	.00		.14	.05	.01	
Utility value					-.03	.11	.82		.03	.10	.76	
Interest					.13	.13	.31		.16	.13	.21	
Cost					-.04	.07	.58		-.06	.07	.40	
<u>Grade</u>												
Mean grade score									.10	.03	.00	

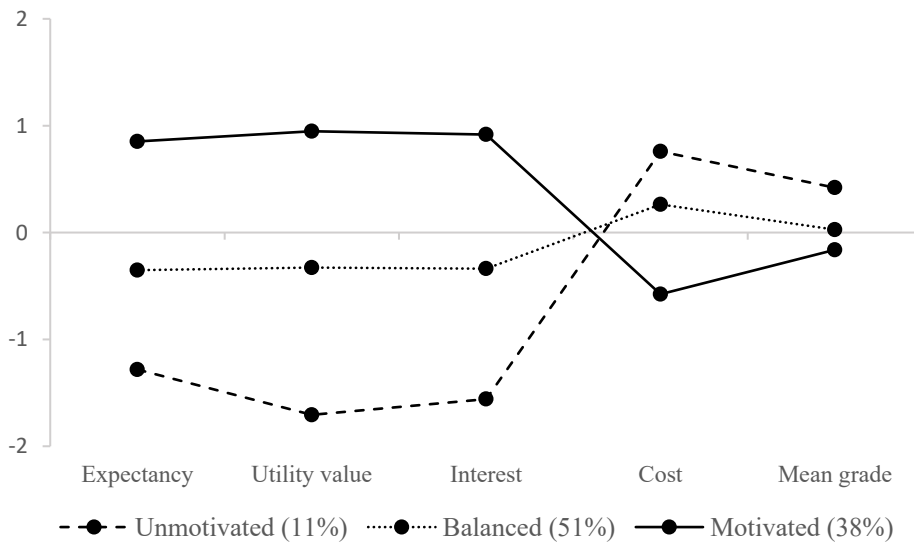
Note.  $N = 269$ , U: Utility value, I: Implementation intention, UI: a combination of U and I, Grade score: 0 (lowest grade) - 15 (highest grade), \*\* $p < .01$ , \* $p < .05$

Table 4

*Model Fit Statistics across Five Latent Profile Models of Students' Motivation*

Class model	Model fit statistics				Class size				
	AIC	BIC	Entropy	LMR ( <i>p</i> -value)	1	2	3	4	5
1	3831.94	3867.88			1.00				
2	3481.64	3539.16	0.82	0.00	0.52	0.48			
3	3368.28	3447.36	0.87	0.01	0.11	0.51	0.38		
4	3331.63	3432.28	0.85	0.08	0.09	0.37	0.09	0.45	
5	3312.24	3434.46	0.80	0.15	0.25	0.31	0.29	0.07	0.08

Figures



Note. Values are z-standardized.

Figure 1. Patterns of Motivation across a Three-Class Model.



# Declaration in accordance to § 8 (1) c) and (d) of the doctoral degree regulation of the Faculty



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Doctoral Committee of the Faculty of Behavioural and Cultural Studies of Heidelberg University

### **Erklärung gemäß § 8 (1) c) der Promotionsordnung der Universität Heidelberg für die Fakultät für Verhaltens- und Empirische Kulturwissenschaften**

Declaration in accordance to § 8 (1) c) of the doctoral degree regulation of Heidelberg University, Faculty of Behavioural and Cultural Studies

Ich erkläre, dass ich die vorgelegte Dissertation selbstständig angefertigt, nur die angegebenen Hilfsmittel benutzt und die Zitate gekennzeichnet habe.

I declare that I have made the submitted dissertation independently, using only the specified tools and have correctly marked all quotations.

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