



Forum

Future Steps in Teaching Desirably Difficult Learning Strategies: Reflections from the Study Smart Program



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Applying effective learning strategies during self-study is important to build long-term knowledge. However, students rarely use such strategies, because they lack metacognitive knowledge and believe they are too effortful. To facilitate students use of these so-called desirable difficulties during self-study, we developed the Study Smart program, an intervention geared toward creating awareness of, reflection on, and practice with effective learning strategies. Based on a three-year design and implementation process, we share the problems we encountered and illustrate with student testimonials. Moreover, we reflect on future steps to be taken in research and practice. Among them is the need to debunk naive theories about learning strategies in students and teachers and to support the behavior change needed to develop effective study habits by implementing effective learning strategies in teaching and providing follow-up reflection sessions.

Keywords: Desirable difficulties, Learning strategies, Educational design research, Implementation

One of the biggest challenges that students face when entering higher education is to self-regulate their learning. In contrast to high school, university teachers offer limited guidance about how, when, and what to learn. Students often lack knowledge about the science of learning and trust intuitions and routines developed in high school. However, these intuitions about which learning strategies are effective are often misleading (Kirk-Johnson, Galla, & Fraundorf, 2019). For instance, students mistake feelings of fluency for effective learning when studying and therefore prefer strategies that feel easy, compared to those that take more effort (Finn & Tauber, 2015; Karpicke, Butler, & Roediger, 2009; Koriat & Bjork, 2006).

Some of these more effortful learning strategies create so-called *desirable difficulties*. That is, they initially complicate learning, but enhance retention and understanding in the long term (Bjork, 1994; Yan, Clark, & Bjork, 2017). Examples of

learning strategies that can create such desirable difficulties are *retrieval practice*, *distributed practice*, and *interleaved practice*. The first, retrieval practice, refers to the act of actively retrieving information from memory by answering practice questions or by free recall (Adesope, Trevisan, & Sundararajan, 2017; Rowland, 2014). Second, distributed practice denotes the spacing out of study sessions over time leading to repeated study of the same learning materials. Due to longer lags between study sessions compared to massed practice, retrieval difficulty is increased and long-term retention is enhanced (Benjamin & Tullis, 2010). Finally, interleaved practice refers to the mixing of different topics during one study session. This contrasts with blocked practice, in which students study one topic until finished before switching to the next topic (Roediger & Pyc, 2012).

Although evidence from research on effective, evidence-based learning strategies is clear and known to cognitive

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psychologists (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013), it has barely found its way to academic support centers (McCabe, 2018), teachers (Glogger-Frey, Ampatziadis, Ohst, & Renkl, 2018; Morehead, Rhodes, & DeLozier, 2016; Pomerance, Greenberg, & Walsh, 2016; Surma, Vanhoyweghen, Camp, & Kirschner, 2018) and, no less important, students (Weinstein, Madan, & Sumeracki, 2018). Students in higher education still hardly receive instruction on how to study effectively, because specific interventions focusing on the importance of creating desirable difficulties during learning are scant (McCabe, 2011, 2018; Morehead et al., 2016).

To support students' use of effective and desirably difficult learning strategies, we developed a learning strategy intervention coined the "Study Smart program." Based on theoretical principles from cognitive psychological research (Dunlosky et al., 2013), the program spans three two-hour sessions focusing on awareness, reflection, and practice. Sessions are spread out over several weeks and take place in groups of about 12 students with one teacher. Session 1 aims to raise awareness about effective learning strategies and desirable difficulties by inviting students to discuss the strategies they use and how effective they believe the strategies are and by presenting the empirical evidence backing particular strategies. Session 2 encourages reflection on study motivation and learning strategy use by having students complete a questionnaire about their academic goal orientation and set goals for strategy practice. Session 3 fosters the practice of effective learning strategies by asking students to practice different effective learning strategies with their own learning materials. This includes, for example, making flashcards or planning their study schedule of the week in an interleaved manner. A detailed description of the initial version of the program can be found in a report by Biwer, oude Egbrink, Aalten, and de Bruin (2020).

After a first experimental study (Biwer et al., 2020), the Study Smart program was adapted and improved in an educational design cycle consisting of a design, evaluation, and redesign phase over three years (2018–2020). It was implemented in five different faculties at a Dutch university, with approximately 1500 students and 50 teachers participating. The degree of implementation varied per faculty, depending on available resources. More specifically, some faculties offered the program to all first-year students as an integral part of their mentoring program, while other faculties had student counselors offer the program to individual students on a voluntary basis. All faculties offered the awareness session. The reflection and practice sessions were sometimes combined, depending on the capacities of each faculty. We collected data from evaluation questionnaires, focus group discussions with students and teachers, and observations of training sessions, as well as other measures during the train-the-trainer program, which we offered to all teachers. See the appendix for an overview about the implementation in each faculty and the type of data collected.

Based on a synthesis of our experiences as program designers, program facilitators, and observers, as well as on the collected data, we formulated challenges and future steps to be taken in an

iterative process. First, each author individually formulated challenges to be addressed based on experiences and insights. The first, second, and third author subsequently discussed and refined this first draft. We then performed a thematic template analysis (King, 2004) of the qualitative data from the observations, open questions in evaluation questionnaires, and focus-group discussions with students and mentors, using the initially formulated challenges as a template. In an iterative process, we tested whether the initially formulated challenges were represented in the data, and refined the challenges where needed. Finally, we shared this list of challenges and problems with teachers of the Study Smart program (not part of the research team) in one additional focus group discussion. Based on this longitudinal educational design cycle, we share the challenges we encountered throughout the redesign phases of the Study Smart program (see Table 1 for an overview) and, more importantly, we reflect on necessary future steps in research and practice to support students in applying effective learning strategies.

One-Size-Fits-All Approach: Should Every Student Receive Learning Strategy Instruction?

Through the Study Smart program we learned that educators often assume that their students know how to prepare for tutorials or exams and how to study effectively. Research has shown, however, that students rarely receive formal instruction on how to learn and study (Hartwig & Dunlosky, 2012; Morehead et al., 2016). Students repeatedly engage in rereading their notes, but self-testing or distributed practice are rarely used in practice (Blasiman, Dunlosky, & Rawson, 2017; Karpicke et al., 2009). Indeed, the students in our program reported they had never learned how to study effectively before entering university, although they considered such knowledge as an important requirement for success. Many students expressed a need for more information and knowledge about learning strategies and had expected to be taught how to study more effectively when entering university, as the following quote from a student enrolled in the program clearly illustrates:

When I came to university, I really expected there to be a course about self-studying or at least more than just the hints how to use the library. . . . So I tried to do something by myself, I tried to borrow books in the library about how you should study but. . . I didn't feel that the books were really reflective of my situation, the student situation, and then I heard about the training and I thought it would be a perfect opportunity to learn more.

The foregoing raises the question if and to what extent educational institutes should offer a learning strategy program to all their first-year students. Learning strategies are a consistent, but modifiable predictor of dropout in higher education (Delnoij, Dirkx, Janssen, & Martens, 2020). Moreover, as many students fail to seek help (Karabenick & Dembo, 2011), we suggest that education institutes should offer a learning strategy program to all their first-year students in order to ensure adequate knowledge of and practice with effective learning strategies. Of course, some students might already be wielding the desired learning

Table 1
Challenges and Necessary Future Steps in Research on and Teaching of Desirable Difficulties

Challenge	Future Steps: Research Questions
One-size-fits-all approach	Should every student receive learning strategy instruction?
It's about time	When is the right moment to address the importance of desirable difficulties in learning?
There will be resistance	How to debunk naïve theories about learning strategies?
Change does not happen overnight	How to support the use of effective learning strategies during self-study by students?
Practice what you preach	How to implement principles of effective learning in teaching and instruction?

strategies and hence do not necessarily need the program. Nevertheless, they may grow in confidence, gain more practice, and help other learners improve.

A further challenge then is whether a learning strategy program can really be a one-size-fits-all approach. On the one hand, it can be, because evidence-based learning strategies have been shown to strengthen long-term learning for people in general, regardless of prior knowledge and in various settings. The mechanisms that explain the effects of these learning strategies are based on memory principles that apply to all humans (Dunlosky et al., 2013). On the other hand, it is necessary that students first appreciate the need to change their learning strategies. Students' willingness to act on the information received depends on multiple factors, such as their satisfaction and perceived success with the learning strategies hitherto applied, as well as their knowledge and academic achievement orientation (Dembo & Seli, 2004; Geller et al., 2018). An imperative next step in research is to address individual differences and difficulties in implementing effective learning strategies during self-study (Bjork & Bjork, 2019). How do individual differences in motivation or personal learning goals influence students' reactions and adaptations of strategies based on desirable difficulties.

It's About Time: When Is the Right Moment to Address the Importance of Desirable Difficulties in Learning?

Transitioning from high school to university presents a great challenge to most students (van Rooij, Jansen, & van de Grift, 2018). The question arises whether this demanding transition period is the right moment to address the importance of desirable difficulties in learning. We encountered this issue many times; in the first round of our intervention, we provided the program at the end of the first year. At that time, some students would have preferred the training earlier:

The time factor was a thing for me because I really wanted to try to learn in a new way but I was also scared to do so late in the course. So I tried the practice testing, but I felt I didn't have enough time to cover everything.

In the following year, we offered the program in one of the first weeks of the new academic year. Here we encountered resistance, especially by students with strong habits of summarizing, highlighting, and re-reading. Their commonly used strategies were experienced as effective during high-school, and students were hesitant to try different and more effortful strategies without having had a first exam experience at university, as one student explained:

I feel like I know how I should study, and that my way is the highway. Not because I don't believe in what's being supplied by the university, but I've always been... left alone in my study process. And that's what has gotten me this far and for me costs quite little energy.

To determine the optimal timing of such interventions, future research should compare the effect of different timings on students' willingness to change and actual strategy use. Based on our experiences from the Study Smart program, we recommend that students receive instruction on effective learning strategies as early as possible. First, because it is easier to create new learning practices than to change existing, habitual ones. Context cues automatically activate specific habitual responses, which are difficult to change in the same context (Carden & Wood, 2018). Given the change in context for students when going from high-school to university, this transition time seems a favorable moment to introduce desirable difficulties to students (Walker, Thomas, & Verplanken, 2014). Second, early instruction can give students ample time to try to implement new strategies such as distributed practice or practice testing, especially when it is offered *before* their first exams. This timing may help them to develop good learning habits from the beginning of higher education. In order for students to learn the most from their experiences, a follow-up reflection session *after* the first exams can address the hurdles they might have encountered. The follow-up session may prevent students from reverting to their former learning habits, which often happened. As one mentor of Psychology and Neuroscience students reported during a focus group, "Students are afraid of using new study strategies; they want to pass their exams and they easily fall back into their old habits."

There Will Be Resistance: How to Debunk Naive Theories About Learning Strategies?

Many students have strong beliefs, albeit often incorrect, about how to study most effectively. Such beliefs make it difficult to convince them of the need to apply more effective strategies, especially because they take more effort and feel more difficult. One example is the omnipresent myth about learning styles that so-called "visual learners" learn more easily from visual materials and that "aural learners" learn more easily from auditory learning materials (Kirschner, 2017; Kirschner & van Merriënboer, 2013). Another example is the belief that strategies that feel easy, such as highlighting, rereading, and summarizing, are more effective for long-term learning than strategies that feel more difficult, such as practice testing.

We recommend that teachers debunk these myths as soon as possible.

Such conceptual change, however, will not be achieved simply by offering students evidence of effective strategies. To refute misinformation effectively, apprehension of misbeliefs and the correct information must be co-activated to concurrently fill the mental gap created by the correction (de Bruin, 2020; Paynter et al., 2019). It is furthermore important not only to explain that information is false but also why it is false. This can be achieved by providing detailed evidence and refuting misinformation through visualizations (MacFarlane, Hurlstone, & Ecker, 2020). In the Study Smart program for example, we tackled this by first inviting students to brainstorm about the learning strategies they were using or other commonly used strategies. Subsequently, we asked them to sort these strategies into highly, moderately, and hardly effective ones. The teacher then presented the empirical evidence of all strategies, providing detailed explanations as to why desirably difficult strategies were more beneficial to long-term learning and how to wield them during self-study. After this presentation, teachers and students discussed how to make the strategies that students were already using more effective. When presented with the evidence about learning strategies that promote long-term learning and those that do not, students verbalized this as experiencing a “shock” or “wake-up call.” Any discrepancies between the strategies hitherto applied and those underpinned by empirical evidence might increase students’ willingness to change, as depicted in the following quote from a teacher:

They recognized that retrieval is much more difficult, while rereading feels good. You saw that this feeling hit them: “oh yes, maybe it is not good what I am doing.” Students realized they don’t learn in a good way though they thought they did. So that was very important in making them want to change behavior.

It is important to carefully consider how to effectively debunk naïve beliefs and idiosyncratic ideas held by students to make them aware of such beliefs while minimizing resistance (e.g., “but my strategies work for me”). Dealing with students’ resistance to change is a big challenge in desirable difficulties instruction. Starting with students’ own strategies and taking small steps to make these strategies more effective seemed important in making them willing to change, as one teacher of the program described:

At the beginning of the session, I did an inventory round about what you are doing now, and there were also many other techniques that came up, so in that sense you can also activate your students a bit more: what are you already doing? Not “we want you to do this,” because that doesn’t work. Because then you get that shock, and also “yes, but I don’t have time for that.”

Simply creating an open atmosphere may dampen reluctance to change idiosyncratic ideas but cannot prevent resistance entirely. Finding a balance between constructive versus destructive confrontation is a challenge worth addressing more specifically in future research.

Related to this issue is the challenge of how to translate scientific evidence to students’ practice. One potential route to explore is to not only use scientific evidence, but also relate to concrete student examples. More specifically, scientific evidence will ensure the credibility of the learning strategy program. Such evidence might include graphs and data from cognitive psychological research about the testing effect as well as proof that students’ perceptions of learning differ from actual learning outcomes (e.g., Nunez et al., 2011; Roediger & Karpicke, 2006). Despite ample research showing that desirably difficult learning strategies, such as retrieval practice, are effective in classroom settings (Moreira, Pinto, Starling, & Jaeger, 2019), students find it hard to translate such evidence to their own situation (e.g., Wissman, Rawson, & Pyc, 2012). The evidence still seems abstract, making students prone to think that it does not apply to them personally (Hofer, 2004). Examining how to include relatable student examples in the program to prepare students for change is a necessary future step in research. These examples could take the form of authentic written or videotaped narratives—stories by students who have changed the way they studied and describe their struggles, efforts, and setbacks in this process. Although said narratives have a potential to improve behavior (Hinyard & Kreuter, 2007), students’ use of new strategies remains dependent on their individual struggles, such as uncertainty about time, effort, and consequences concerning exam results (Biber et al., 2020).

Change Does Not Happen Overnight: How to Support the Use of Effective Learning Strategies During Self-Study by Students?

To effect sustainable change in students’ learning behavior, the desired learning strategies must first and foremost fit in the learning context (Nilson, 2018). Students are often hesitant to transition to effective learning strategies, because they harbor many uncertainties. For instance, they worry about how to apply them to their own learning materials, how much energy and time it will take them, or how a strategy change will influence their exam grades, as clearly is depicted in the following remark from a student:

You have to apply new study strategies that are also more time consuming, so for me it was really stressful at one point. . . . I think it is really difficult to know how you get into that routine and I think that is something I miss in the training as well.

This uncertainty in using new learning strategies is an issue that links closely to matters of behavior change (Sheeran, 2002). How to deal with the uncertainties of implementing new study behavior and how to cope with the difficulty of sustaining these over time is in many ways similar to, for example, improving eating behavior or exercise routines. We see a great need for research inspired by the behavior change literature on habit formation. As Fiorella (2020) pointed out, habit formation contributes to effective self-regulation and educational research can therefore learn from the literature on behavior change interventions. We see a parallel between changing poor learning habits

and changing other kinds of habits, such as unhealthy eating. Changing your eating behavior requires accurate knowledge of healthy eating, being motivated to change, and possessing adequate strategies to change eating behavior. For example, a US national campaign on eating more fruits and vegetables that presented information about the advantages of eating healthy, increased people's knowledge and motivation to change, but had only limited effect on actual eating habits (Casagrande, Wang, Anderson, & Gary, 2007). Similarly, in the first version of the Study Smart program, including adequate information but only limited practice sessions, participants' knowledge about effective learning strategies and the intention to change increased, but more specific practice was needed to lead to a sustained use of these strategies (Biber et al., 2020).

An interesting avenue for future research from the field of behavior change is the use of *implementation intentions*. Implementation intentions are if-then plans that specify the when and where (*if*), and specific action (*then*) of a planned behavior and were shown to facilitate initiating and pursuing goals (Gollwitzer & Sheeran, 2006). Potentially, implementation intentions could support the use of more desirably difficult learning strategies. Furthermore, habit-based interventions focusing on identifying cues that may trigger the use of beneficial learning strategies may foster the development of effective habits in students (Wood & Neal, 2016). We see a potential merit in applying insights from behavior change research in the health domain to learning-strategy research, for example, from research on implementation intentions (Gollwitzer & Sheeran, 2006), nudging (Hansen, Skov, & Skov, 2016), or narratives (Hinyard & Kreuter, 2007). Although metacognitive training can be a starting point for learning strategy change, students need continuous support in the form of guided practice and follow-up meetings to reflect on experiences. Consequently, relevant future research should determine which types of support and cues will help students to acquire beneficial learning-strategy habits. For example, teachers could organize regular in-class quizzes or provide practice questions to their students to facilitate retrieval practice. Another question for future research concerns how long this support should be provided to evoke sustainable learning-strategy changes.

Practice What You Preach: How to Implement Principles of Effective Learning in Teaching and Instruction?

Not only students, but teachers, too, can have strong, idiosyncratic ideas about different learning strategies (Morehead et al., 2016), especially if they have no background in educational sciences or cognitive psychology and are therefore unfamiliar with the scientific evidence. During the train-the-trainer sessions, we observed that many teachers ran into the same conceptual issues as students. However, only when teachers learn about this evidence themselves will they be able to teach their students how to study more effectively. Likewise, only if they are aware of the benefits of desirably difficult learning strategies, can teachers support students' sustained use of effective strategies. Teachers need to learn how to implement principles of effective learning in their teaching and instruction. Practically, this could take the

form of short quizzes during lectures to reduce mind wandering and improve retention (e.g., Szpunar, Khan, & Schacter, 2013) or letting students generate, share, and answer peer-generated questions to enhance retrieval practice in the classroom (Kelley, Chapman-Orr, Calkins, & Lemke, 2019). Additionally, teachers can connect good self-regulators with weaker students, for whom they can serve as role models (Rovers, Stalmeijer, van Merriënboer, Savelberg, & de Bruin, 2018). Future research is needed to further investigate such effective classroom interventions and how to support teachers in implementing these.

In conclusion, supporting students to learn more effectively requires a shift in teaching approach, from knowledge transmission toward learning strategy support. While to teachers this shift may appear to diminish content knowledge and result in uncertainty about students' knowledge level, it will likely make their teaching more effective (Loyens, Magda, & Rikers, 2008). Moreover, if we want to prepare our students for lifelong learning, higher education institutions should focus not only on teaching knowledge and skills, but also on teaching how to gain and retain that knowledge and skills.

Conclusion

Despite the growing body of research into desirably difficult learning strategies, implementing an intervention that fosters students' knowledge and use of these strategies is no easy feat. Such interventions require deliberate design, implementation, and guidance in order to guarantee students a high-quality learning experience and qualified support. Based on our experiences in designing and implementing such an intervention, we presented challenges that others may run into as well and how our efforts generated questions for future research that should be addressed. As diverse as the student population might be, the struggle to put desirable difficulties into practice is common and unifying.

Author Contributions

All authors, Felicitas Biber (FB), Anique de Bruin (AdB), Sanne Schreurs (SS), and Mirjam oude Egbrink (MoE) were responsible for the conception and design of the commentary. AdB is the project leader of the Study Smart program. AdB, FB, and SS gave training sessions together, FB and SS performed observations and focus group discussions and were responsible for data acquisition. FB performed analysis of the data, in close collaboration with SS and AdB. FB drafted the manuscript, incorporating edits, and feedback from all other authors (SS, MoE, and AdB). All authors made a substantial contribution to the interpretation of the data for this work.

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Conflict of Interest

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Appendix

Implementation of Study Smart in Each Faculty

Faculty	Year	Implementation	Sessions	Students	Teachers	Data collected
Faculty of Health Medicine and Life Sciences (FHML)	2018	Pilot study ^a	A, R, P	<i>N</i> = 47	2 researchers	Evaluation questionnaires – 2 FG with students ^b –
Faculty of Psychology and Neurosciences (FPN)	2018/2019	In mentor groups; all first-year students	A, R	<i>N</i> = 403	27 mentors	Observations Evaluation questionnaires – 2 FG with students– 1 FG with mentors– Train-the-trainer program
	2019/2020	In mentor groups; all first-year students	A, R, P	<i>N</i> = 400	27 mentors	Evaluation questionnaires – 1 FG with mentors– 14 observations– Train-the-trainer program
School for Business and Economics (SBE)	2018/2019	Available for all first-year students; twice a year	A, R	<i>N</i> = 30	3 dedicated teachers; student counselors	Evaluation questionnaires– Train-the-trainer program
	2019/2020	Available for all first-year students; twice a year	A, R, P	<i>N</i> = 30	3 dedicated teachers	Evaluation questionnaires– Train-the-trainer program
Faculty of Law (LAW)	2018/2019	Integrated in Dutch Law course; targeted at all undergraduate students	A, R	<i>N</i> = 250	7 tutors	Train-the-trainer program
	2019/2020	Integrated in Dutch Law course; targeted at all undergraduate students	A, R, P	<i>N</i> = 250	7 tutors	Train-the-trainer program
University College Maastricht (UCM)	2018/2019	Part of faculty introduction and skills course	A, R	<i>N</i> = 215	10 tutors	Evaluation questionnaires
	2019/2020	“Introduction to academic skills”	A, R	<i>N</i> = 268	10 tutors	Train-the-trainer program

Note. A = Awareness session, R = Reflection session, P = Practice session, FG = Focus group discussion.

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