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Effective use of study strategies by students:The teacher perspective.

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Effectief gebruik van studie strategieën door studenten: Het docent perspectief

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Abstract

Students can use various strategies to learn to-be-studied material. Some of these techniques are more effective than others. Research has shown that students often do not use optimal strategies, at least partly because they are unaware of their (in)effectiveness. Therefore, it is important that instructors teach students which techniques are effective and how they can be utilized. The current study assessed the knowledge academic staff members have about the effectiveness of various study strategies. This was examined by a combination of an open-ended question, several closed questions consisting of scenarios describing effective and ineffective study strategies, and by strategy-by-strategy statements. The most often reported strategy advice by staff to students in the open-ended question were summarizing, self-explanation, and making mind maps. Retrieval practice and distributed practice were mentioned less frequently. For the scenarios, staff correctly rated effective strategies as significantly better than those that have been shown to be less effective. Finally, the academic teachers rated the strategies of summarizing, retrieval practice, interleaved practice, and self-explanation as most effective in the strategy-by-strategy statements. Ineffective strategies, such as highlighting or rereading, were also seen as less effective by the academic staff. These results suggest that academic staff have a good understanding of the utility of most of the commonly employed study strategies, however when actively prompted to provide advice, they fail to advise these effective techniques.

Keywords: Instructor knowledge of memory, Learning techniques, Study strategy, Teacher perspective

Effective use of study strategies by students: the teacher perspective

1. Introduction

Learning is essential in our daily life, especially in that of pupils or students who are receiving formal education. Although many definitions exist (e.g., Barron et al., 2015), from an educational perspective, learning could probably best be defined as 'the process of acquiring new and relatively lasting information or skills characterized by alteration of behaviour as a result of practice, study, or experience' (Breedlove & Watson, 2013). Learning is effective if the knowledge is retained over a long period of time, if a student comprehends the material, and if he/she is able to apply the knowledge (Dunlosky et al., 2013).

1.1 Study strategies

Students can use various strategies to learn to-be-studied material. Some of these techniques are more effective than others. One of the most effective self-study strategies is that of retrieval practice (Adesope et al., 2017; Dunlosky et al., 2013; Karpicke, 2017; Moreira et al., 2019). When using retrieval practice, the learner actively retrieves the study material from memory, for example by quizzing him/herself while studying. This technique is effective, because it can be used by people of any age, in various formats, with different types of material, and at various retention intervals (Dunlosky et al., 2013). For example, Ariel and Karpicke (2018) trained undergraduate students to use retrieval practice while learning Lithuanian-English word pairs. After learning, these students showed better retention of the word pairs compared to a group of students who had received neutral study instructions. Especially students with lower working memory capacity may benefit from retrieval practice. This was shown in a study by Agarwal and colleagues (2017), who asked college students to learn general knowledge facts. Compared to restudy, all students performed better on a final

test when using retrieval practice. Moreover, this effect was even larger for those students who generally have lower working memory capacity.

Using worked examples is another example of an effective study strategy, since it also leads to good long-term retention and understanding. Typically, when using worked examples, the learner is provided with a step-by-step procedure that is guided by an explanation as to how and why each step is undertaken to solve a certain problem. Van Harsel and colleagues (2019), for instance, asked participants from a technical educational programme to study mathematical equations. Part of the volunteers practiced only with worked examples, another group received a mix of worked examples and unguided problems to solve, and a final group only received problems to tackle on their own. The first two groups showed more effective learning at a later test in comparison to the group only receiving problems without guidance (Van Harsel et al., 2019). Especially novices who have little or no prior knowledge of a task benefit from using worked examples (for a review, see Renkl, 2011, 2014; Van Gog & Rummel, 2010).

Next to practicing the to-be-learned material, the timing of study activities also influences to which extent the content can be memorized on the long-term. Spacing the practice with study material over time, in other words performing distributed practice, stimulates long-term retention compared to massed practice (Carpenter et al., 2012; Dunlosky et al., 2013; Gerbier & Toppino, 2015). When using this technique, the learner practices with information across two or more sessions rather than spending the same amount of time on it in a single session. According to Dunlosky and colleagues (2013), the effect of distributed practice is robust, because effects of this technique are commonly found in different populations, the effect is present using a variety of test conditions and with different study materials, and it works with different intervals. However, it depends on the circumstances as to which interval between study sessions leads to the most optimal outcome, for example after

how much time the final recall or test is scheduled (Gerbier & Toppino, 2015). Positive effects of spacing have been found in undergraduate students. For example, Bude et al. (2010) found that understanding of statistics was better in undergraduate students in health sciences when they could space their studying compared to when the course period was rather short and studying was more crammed. Likewise, Sayeski et al. (2017) showed that prospective language teachers were able to learn to match speech sounds to letters better if they were allowed to distribute their practice over a couple of weeks rather than practicing this in a single 1-hour session.

Another promising technique is interleaved practice (Carvalho & Goldstone, 2019; Chen et al., 2021; Dunlosky et al., 2013). When using interleaved practice, students alternate the practice of different, but related types or problems, rather than studying all content about one type of problem before moving to the next. Research has shown that interleaving often indeed leads to better performance in comparison to this blocked studying (Carvalho & Goldstone, 2019; Chen et al., 2021; Dunlosky et al., 2013). Although this strategy has worked really well for content that can be contrasted, such as similar but different types of mathematical equations, less is known to which extent this technique may also be beneficial if the to-be-studied material cannot be easily contrasted (Dunlosky et al., 2013). Interestingly, it is sometimes suggested that the beneficial effect of interleaved practice may be caused by distributed practice, which -as described above- is highly effective. After all, when performing interleaved practice, practice on a particular topic will automatically be spaced, as other content is practiced in between. However, Brunmair and Richter (2019) showed in their meta-analysis that interleaving was more effective when hardly any spacing between items was included, in this case less than 2 seconds between item presentations, in comparison to studies in which 10-30 seconds time intervals were used. Distributed practice, therefore, does not account for the effect. Rather, they found that the interleaving effect was larger when the

to-be-studied materials were relatively similar, forcing the learner to actively contrast the material. Therefore, Brunmair and Richter (2019) suggest that the beneficial effects of interleaved practice relate to the discriminative contrast account, the fact that interleaving highlights differences between items (see also Chen et al., 2021).

Two other moderately effective strategies are elaborative interrogation and self-explanation. Although the two concepts are closely related, there are minor differences between the two as well. In elaborative interrogation, the learner asks ‘why’ questions during self-study in order to explain the relationship between a subject and an action, so to determine why facts make sense (O’Reilly et al., 1998; Roediger, 2012). For example, after reading the sentence ‘the boy ran to the left side of the court before hitting the ball with his racket’ the learner might ask why the boy performed this activity. In comparison to merely reading the sentence a number of times, the learner would memorize the sentences significantly better in the elaborative interrogation condition (Dunlosky et al., 2013). Self-explanation could also take the form of asking ‘why’ questions as in the example above. However, for this technique it is important that students try to explain concepts to themselves and think of what a fact means and how it relates to their prior knowledge (O’Reilly et al., 1998; Roediger, 2012). One could for example also ask questions such as ‘How did the boy run to the left side of the court?’ or ‘What did the boy do?’. It is commonly believed that both strategies support the integration of novel information with already existing mental schema (Brod, 2021; Dunlosky et al., 2013).

One study strategy that also seems promising is related to the generation effect (McCurdy et al., 2020). When using generation, the learner tries to generate information while studying. For example, the learner might read a text and then produce a number of questions one could ask about the text, including the correct answers to them. There is a memory advantage for information that is self-generated instead of experimenter-provided or merely

read. In a typical self-generation experiment, participants are asked to study word pairs or number bigrams. For example, for half of the pairs, participants self-generate a target word, for example for the word pair ‘hot-co…’, they generate the word ‘cold’. For the other half of the word pairs, participants read an intact, complete pair, for example ‘above-below’. During the final test, in which participants have to recall the target words, the ones that were self-generated are recalled better than the intact word pairs (Bertsch et al., 2007; McCurdy et al., 2020).

In an extensive review, Dunlosky and colleagues (2013) discussed most of the strategies described above. They concluded that retrieval practice and distributed practice have the highest utility, because (amongst others) they can be applied in many settings and by many different types of learners. Interleaved practice, self-explanation, and elaborative generation had moderate utility. This relates to the fact that it is currently unknown to which extent these strategies are effective for different types of learners and in varying educational settings (Dunlosky et al., 2013). Additionally, not for all types of final assessment of performance, for example forced-choice questions or free recall, these methods have shown beneficial outcomes (Dunlosky et al., 2013). Using worked examples and generating knowledge were not discussed in their review. However, because both strategies lead to active learning similarly to the way the strategies addressed by Dunlosky do (Brod, 2021), they produce long-term retention and application. It is questionable, though, whether these two strategies can be effectively employed already in younger children (Brod, 2021).

In contrast to the strategies mentioned above, several study strategies have not revealed such promising results. For instance, rereading the to-be-learned materials, highlighting parts of a text, or literally summarizing a text only have low utility (Dunlosky et al., 2013). Rereading and highlighting may lead to short-term optimal performance (Dunlosky et al., 2013), but information is more quickly forgotten, which hampers long-term retention.

Summarizing, on the other hand, could be effective if used well, such as when writing a summary from memory rather than copying it from the text, thereby making the learning process more active, similar to the effective strategies mentioned above. In addition, the quality of the summary matters. It is only beneficial if the most relevant information is indeed written into the summary (Dunlosky et al., 2013).

1.2 Students' use of effective study strategies

Strikingly, recent studies have shown that students often do not use the most effective techniques when preparing for a test (e.g., Hartwig & Dunlosky, 2012; Karpicke et al., 2009; McCabe, 2011; Morehead et al., 2016). Even though around 70% of students indicate that they perform retrieval practice when studying, over half of the students cram information the night before a test (Hartwig & Dunlosky, 2012; Morehead et al., 2016). In other words, they would not use the effective technique of spacing. In addition, around 66% of all students tend to take part in rereading before an exam and 50% highlights relevant texts in their readings (Hartwig & Dunlosky, 2012; Morehead et al., 2016). Unfortunately, those surveys only used forced-choice questions and did not ask for the use of all the strategies introduced in this paper. For example, while Morehead et al. (2016) questioned their undergraduate students about the use of retrieval practice and distributed practice, they did not ask about interleaved practice, worked examples, elaborative interrogation/self-explanation, and generation. Therefore, from that research it is not entirely clear whether students would for example use worked-examples or self-explanation. Karpicke et al. (2009) and Dirkx and co-workers (2019), on the other hand, used an open question in their survey, which provided their respondents with the opportunity to mention any effective study techniques they might use. Again, some highly effective strategies were hardly mentioned or not mentioned at all. For example, in the study by Karpicke and colleagues (2009), nobody mentioned interleaved

practice or elaborative interrogation as a strategy they would use. Likewise, only 0.3% of respondents stated they used interleaved practice, 3.8% spaced their studying, and 1.9/2.9% used the techniques of elaborative interrogation/self-explanation in Dirkx' study (2019). This again provides evidence for the lack of use of effective techniques by students.

One of the reasons why students do not use more optimal strategies might be the fact that they think there is not enough time to prepare the material if they would use techniques such as spacing and retrieval practice (Bjork et al., 2013). In addition, if students may pace their own learning or if they are allowed to use retrieval practice when studying, students will almost exclusively study those items they did not perform well on before. As soon as a certain topic is mastered, students start to ignore this topic (Bjork et al., 2013), possibly because of believed time constraints, although the repetition during the retrieval practice and spacing helps to acquire long-term retention.

A third reason is related to the experienced-learning-versus-actual-learning-paradox (Soderstrom & Bjork, 2015), also sometimes called the misinterpreted-effort hypothesis (Kirk-Johnson et al., 2019). When reading a text a second time, one may feel familiar with the material, which could mistakenly be seen as an indicator of long-term learning. Studying using retrieval practice or generation, on the other hand, may feel more difficult because it costs much effort (Kirk-Johnson et al., 2019), consequently leading to the idea that one did not learn much. The seemingly efficient studying using rereading or highlighting coincides well with the fact that often students base their decisions on what to study next by checking whatever is due soonest rather than what they have not studied for the longest time or on what they feel they are not good at (Hartwig & Dunlosky, 2012; Kornell & Bjork, 2007; Morehead et al., 2016).

Another reason for the lack of use of the most optimal strategies is that students are unaware of the effectiveness of the methods. Bjork and colleagues (2013) noted in their

review on self-regulated learning that students often study in a habitual manner (see also Dunlosky & Ariel, 2011), thus not easily switch to more effective opportunities. Probably, students continue using their old study patterns if they were successful in previous instances, which makes them think their used strategies are effective. McCabe (2011) asked 255 undergraduate students to read a number of scenarios that each time contrasted a scientifically proven effective strategy with an ineffective technique. Students believed that rereading would lead to better outcomes than retrieval practice. In addition, cramming the learning was seen as more useful than spacing the learning. This indeed shows students' unawareness of how to effectively study.

1.3 Instructor's knowledge of effective study strategies

If students are indeed unaware how to study effectively, they should learn which strategies are effective and how they can use them. This is where the instructor comes into play. Next to paying attention to course content, it is the instructor's responsibility to also introduce study strategies and advice on how to use them. However, it is unclear to which extent teachers are aware of the usefulness of the various available study techniques. The sparse research that has so far been performed does not provide too promising results. Similar to McCabe's (2011) study in university students, Morehead and colleagues (2016) asked 146 university instructors to read a number of scenarios that each time contrasted a scientifically proven effective strategy with an ineffective technique. The teachers provided high ratings for retrieval practice, spacing, and self-generation of information compared to rereading, massing, and using teacher-generated information, respectively. However, for three other scenarios, instructors favoured ineffective techniques. For example, they thought that learning particular material in separate blocks would lead to better performance than mixing different

materials within the blocks (Morehead et al., 2016), although the latter interleaved practice commonly leads to better outcomes (Rohrer & Taylor, 2007).

The ignorance of which study strategies are most effective may be related to the fact that teacher education does not pay much attention to this topic (Dunlosky et al., 2013; Pomerance et al., 2016; Surma et al., 2018). For example, Surma and colleagues examined 61 textbooks used in Flemish and Dutch teacher education programmes and found that 21% fully covered conceptual information about distributed practice and only 11% information on retrieval practice. The scientific evidence those books provided was even scarcer, being 7% and 5%, respectively. Pomerance et al. (2016) found similar results when examining 48 educational psychology textbooks for primary and secondary school teacher programmes in the United States. None of the six strategies examined by this study were accurately described in the textbooks.

The two studies mentioned above assessed textbooks used for primary and secondary education. As far as I know, no research has looked into the programmes universities offer for teacher professionalization. In the Netherlands, in order to obtain responsible teaching roles, academic staff must obtain the so-called University Teaching Qualification (i.e., Basiskwalificatie Onderwijs). The Dutch universities have agreed on a number of competencies staff members should obtain before they receive this certificate (see VSNU, 2018). These competencies are designing education, delivering education, student assessment, evaluating education, and supervising individual students. Given that those topics are rather broad, it is difficult to say whether effective study strategies are part of such programmes. At Maastricht University, the university in which the current research took place, effective learning is currently not part of the programme (see Maastricht University, 2018).

1.4 This study

Given that many students do not know how to study effectively, and as teachers may play a role in educating students on these learning processes, it is imperative to know more about teachers' understanding of study strategies. The present exploratory study examined to which extent academic teachers of the Faculty of Psychology and Neuroscience (FPN), Maastricht University, are knowledgeable about which study strategies are most effective. To this end, a survey was administered that uses both open-ended and closed questions.

Prior survey studies in students (Hartwig & Dunlosky, 2012; McCabe, 2011; Morehead et al., 2016) and instructors (Morehead et al., 2016) predominantly used forced-choice questions (but see Karpicke et al., 2009; Surma et al., in preparation). This may direct the responder's attention to strategies they would not spontaneously report, potentially leading to inflation of reported strategies. Likewise, techniques often being used may be underrepresented if not specifically asked for in closed questions (Dirkx et al., 2019).

A disadvantage of using only open questions might be that the respondent does not consider a certain technique to be a strategy and will, therefore, not mention it in an open-ended question (Bjork et al., 2013). Only when forced to evaluate, the person may realize this being a strategy. For example, when Karpicke and colleagues (2009) asked 177 undergraduate students what type of study strategy they use when studying, only 11% mentioned retrieval practice. However, when later being forced to choose between rereading, retrieval practice (potentially followed by rereading), or another strategy, 42% of them chose retrieval practice. In the current study, one open-ended question was asked at the start of the survey in order to overcome such issues. Namely, here participants had to explain in detail strategies they would advise their students to use. Only after answering this question, a number of closed questions consisting of scenarios describing effective and ineffective study strategies and consisting of strategy-by-strategy evaluations was presented.

By first determining the level of teaching experience for each respondent, by asking which strategies staff would advise their students to use for self-study purposes, and by presenting a number of effective and ineffective techniques in scenarios and short strategy-by-strategy statements, the following research questions were answered:

1) What knowledge do academic staff members teaching in psychology curricula have about the effectiveness of study strategies? Based on the findings of Morehead et al. (2016), staff was hypothesized to underscore the effectiveness of retrieval practice, distributed practice, and generation, and they would not deem interleaved practice to be effective. Additionally, ineffective techniques like summarizing, rereading, or highlighting would not be seen as effective. Questions related to the other moderately effective strategies of self-explanation, elaborative interrogation, and using worked examples were analysed more exploratory given the lack of prior research amongst teaching staff on this topic.

2) Do academic staff members teaching in psychology curricula discuss strategy use with their students and advise their students to use particular strategies for self-study? In the study by Morehead and co-workers (2016), 79% of staff members indicated discussing strategies in class. It is, therefore, hypothesized that most current academic staff members indeed discuss strategies and advise their students on which particular strategies may be best for them.

2. Methods

2.1 Participants

Participants consisted of academic staff members of the Faculty of Psychology and Neuroscience of Maastricht University. The faculty currently employs around 250 academic staff members with a part-time or full-time teaching assignment. These employees were

recruited by email. Relevant characteristics of the staff members surveyed were their current position, their teaching experience, the teacher professionalization activities they had taken part in, and their most responsible role as a teacher. Ethical approval for this project was obtained from the Ethics Research Committee Psychology and Neuroscience (ERCPN) of Maastricht University, within the approved research line ERCPN_OZL_ 234_35_02_2021.

2.2 Instruments and materials

The web-based survey was created in Qualtrics and consisted of five sections (see Appendix for entire survey). Section 1 asked about the background of the staff member. Questions asked were related to: 1) the type of position the staff member currently held, 2) how many years of teaching experience the staff member had, 3) whether the staff had taken part in the so-called tutor training or had obtained the University Teaching Qualification, 4) and what was the most responsible role this staff member has had in education at Maastricht University.

The second section was dedicated to one open question. The staff members were asked which study strategies they would advise a student to use when performing self-study activities in preparation of a final exam, including why they would do this. This section provided information as to the knowledge teachers have about effective study strategies and which types of techniques they would advise their students to use when performing self-study.

In Section 3, six learning scenarios, partly adapted from McCabe (2011) and Morehead et al. (2016), and partly taken from Surma et al. (in preparation), were administered. Each scenario presented two strategies, one that has been proven to be effective and another that has been proven not to be effective. By means of a five-point Likert scale, participants were asked to rate the extent to which they believe either of those strategies will benefit learning, i.e., leads to better performance on a test. A rating of ‘1’ indicated that a

strategy will result in only little long-term learning, a rating of ‘3’ meant that the situation is neither beneficial nor unbeneficial, and a rating of ‘5’ indicated that the situation will lead to optimal long-term learning. The items were designed such that in four situations, Situation B led to better learning according to scientific literature; in the other two, Situation A led to a better test result. In addition, the scenarios did not contain any terminology representing the concept under investigation.

The six scenarios presented were related to 1) generating your own information rather than receiving it (Bertsch et al., 2007; McCurdy et al., 2020), 2) elaborative interrogation/self-explanation instead of restudying (Brod, 2021; Dunlosky et al., 2013), 3) practice with worked examples in comparison to practice without guidance (Renkl, 2011, 2014), 4) interleaving against blocking (Rohrer & Taylor, 2007), 5) spacing study material instead of massing the studying (Carpenter et al., 2012), and 6) testing versus restudying (Adesope et al., 2017; Roediger & Karpicke, 2006). For example, for interleaving against blocking, for which Situation B is more favourable, the following was asked:

> Two students are studying for an exam. For the same study material, different types of assignments are available. Student A practices all assignments from the same type before moving to the assignments of the next type. Student B mixes the types of assignments while practicing.

This third section provided data on the knowledge academic teachers have regarding how effective different types of study strategies are.

Section 4 presented 23 short category-by-category statements that represent different self-study strategies. Some of these have been shown to be highly effective, e.g. the statements ‘Try to study bits of the text several times’ and ‘alternating practice assignments of different types’. A number of activities have not proven to be effective, such as ‘read the text a number of times’ or ‘underline or highlight the most important concepts in the text’. Using a five-point Likert scale, it was the participants’ task to rate each of those strategies on their

effectiveness. This section again provided information about the knowledge academic staff have regarding effectiveness of study strategies.

Section 5 presented two final questions: one item about whether academic staff discusses the use of different study strategies during educational activities, and one question about whether academic staff also actively advise students to use particular strategies. This section added knowledge about whether or not staff members actively guide the learning process of their students.

2.3 Procedure

Participants were invited to take part in this survey study by an email. First, at a participant-chosen day and time, they red information about the study, which included the aim of the study, namely to determine which study strategies the staff would advise their students. After reading the information, they ticked a box to consent to their participation in this study.

Each section provided a separate instruction for how to answer the questions. The order of presentation of all sections was the same for all participants. First, they received the background questions, then the open question including a case, next the learning scenarios, and finally the strategy-by-strategy items on the usefulness of specific strategies and those on the extent to which study techniques are discussed during educational activities. Filling in the survey was done at their own pace and took participants between 10-15 minutes.

When filling in the survey, the academic staff members took the educational context of their faculty into consideration. At Maastricht University, Problem-Based Learning (PBL) is the main teaching method applied. In this educational system, students are presented with authentic problems they need to actively understand in teams of around 12 students. After defining the problems and developing learning goals in a group setting, students individually read literature to answer those goals. During a next group meeting, the literature to understand

the problem is discussed (Dolmans et al., 2016; Edview, 2018). A tutor guides the group meetings. A common course at the Faculty of Psychology and Neuroscience consists of 10 group meetings that take place over a period of 7 weeks. In week 8, the final assessment takes place.

2.4 Analysis

Descriptives were provided for each question, if relevant. These included n, mean, and standard deviation. Each of the detailed answers provided to the open-ended question in Section 2 was analysed qualitatively by using template analysis and coding. This is a form of thematic analysis, which allows for a flexible approach to coding by identifying themes in the data as the coding process develops (Brooks et al., 2015). The template designed in this study was inspired by the 10 most prominently used study strategies according to Dunlosky et al. (2013), see the first ten entries in Table 1. For objectivity, two raters scored the answers. Discrepancies were resolved by the responsible researcher (see also Dirkx et al., 2019).

An overview was made of the percentages of staff members who spontaneously listed each of the 10 Dunlosky et al. (2013) strategies in Section 2. This percentage was calculated based on the number of responses for a strategy divided by the total number of all responses and then multiplied by 100. This was compared to the ratings of each of those strategies from the scenarios in Section 3 and the short category-by-category statements in Section 4.

For each of the six learning scenarios presented in Section 3, paired-sample t-tests were performed to compare the ratings given for Situations A and B. This determined to which extent staff significantly chose a strategy that has scientifically proven effectiveness. A Bonferroni correction was applied to account for the number of statistical tests applied, namely 6. The alpha level was, therefore, set at 0.008 (i.e., 0.05/6).

Table 1

Study strategy categories (Dunlosky et al., 2013) combined with self-constructed categories based on the template analysis, including an interpretation of those categories (see also Dirkx et al., 2019) and example responses given during the current study

Nr.	Category	Definition	Example response
1	Elaborative Interrogation	Generating plausible explanations for information	Try to find the logic behind the fact
2	Self-Explanation	Determining what facts mean and linking them to prior knowledge	Explain or imagine you have to explain the content to someone else
3	Summarising	Making a summary, writing down important information	Go through chapter and summarize main points
4	Highlighting or Underlining	Underlining or marking a text	Highlight important facts in book chapters
5	Keyword Mnemonic	Using cues to memorize, such as making rhymes	Use mnemonics to improve remembering
6	Imagery Use	Imagining, visualising information in your mind	Try to visualize the material
7	Rereading	Reading a chapter/summary/notes again	Read the material a few more times again
8	Retrieval Practice	Doing practice tests, quizzes or using flashcards	Make flashcards for the harder to remember topics
9	Distributed Practice	Repeating practice over a longer period of time	Start studying early instead of doing it the day before

10	Interleaved Practice	Alternating the study between different topics	Not mentioned
11	Mind maps	Linking key concepts using images, lines, and links	Stimulate to create a mind map or other visualizations
12	Collaborative Learning	Learning together with peers, asking peers for help	Discuss with fellow students
13	Generation	Thinking of a real-life example, producing one's own questions about a text, linking information to known context	Prepare your own practice exam questions
14	Combination	For example, Retrieval Practice and Generation	Quiz with another student

3. Results

Eighty-six staff members who at least partly teach as part of their employment filled in the survey. Of these, 17 were Associate or Full Professor, 15 were Assistant Professor, 22 had the position of Academic Teacher, and 32 were PhD student or Postdoctoral researcher. While most had more than 5 years of teaching experience (n=49), others had only been teaching for less than 1 year (n=4), 1-3 years (n=19), or 3-5 years (n=14). Almost 90% had received a tutor training, the initial training to guide groups of students in a PBL setting, and 62% had obtained the University Teaching Qualification, the training to obtain more responsible teaching roles in an educational program in the Netherlands.

3.1 Open-ended question

First, the author and a second, independent rater discussed the template for the analysis. Next to finding agreement on the interpretation of each strategy, a scoring sheet including a definition of each strategy was made that would guide the final scoring of the open-ended question, see Table 1. Additionally, both raters did a preliminary check on the results to assess whether the list of the 10 Dunlosky et al. (2013) strategies sufficiently represented the data. Based on this, three separate categories (11-13) were constructed for strategies mentioned by staff members that were not described by Dunlosky et al. (2013). These categories were making mind maps (Pudelko et al., 2012), collaborative learning (Edview, 2018), and generation (Brod, 2021). In addition, responses that included a combination of strategies made up a separate category (nr. 14), similarly to the study by Dirkx et al. (2019). Finally, the category 'other' was included for responses that could not clearly fit into any of the above-mentioned categories.

Next, both raters scored the three types of advice each of the staff members would give their students. After a first comparison, the two raters already fairly agreed in the strategies they had rated (Cronbach's $\alpha = 0.70$). Next, they discussed the major discrepancies and determined for several types of responses to which category they should belong. This led to an adaptation of the scoring sheet. Next, the data were scored a second time. This led to a higher reliability, Cronbach's $\alpha = 0.85$. All remaining discrepancies were resolved by the author.

Of the 86 respondents, five staff members only gave one or two types of advice instead of three. Therefore, the total number of responses given was 250. Of those responses, 18 were classified as 'other'. These were mainly represented by responses referring to planning of self-study activities or looking into the learning goals that students had to

determine previously in the PBL sessions. In 25 cases, a staff member suggested combinations of strategies to be used.

Table 2 presents the percentages of staff members who advised the strategies listed in Table 1. The low utility strategy summarising was reported most often by the educators (16.8%). This was followed by the moderate utility strategy self-explanation (16.4%). The third most frequently advised strategy was making mind maps (12.4%).

The two high utility strategies retrieval practice and distributed practice were only the 6th (7.6%) and 8th (6.4%) most often advised strategies. Additionally, the low utility strategy of rereading was advised equally often as retrieval practice (7.6%).

Next, it was checked which type of advice academic staff members would give first, second, or third. Whereas almost 1 out of 3 would advise summarising first (30.2%), they would not recommend it as much in second or third instance (12.0% and 7.4%, respectively). Self-explanation, the second most advised overall, showed an opposite pattern. Although self-explanation was not suggested often in first instance (5.8%), approximately 1 out of 5 academic teachers suggested this in their second and third advice (20.5% and 23.5%, respectively). The two high utility strategies of retrieval practice and distributed practice were advised more often as third strategy (9.9% and 8.6%, respectively) than as first strategy. Additionally, collaborative learning (12.3%) and generation (12.3%) were more often suggested as third strategy.

Table 2

Overview of the strategies advised by academic staff member in order from most to least mentioned, in percentages (%). In addition to the total advice given, it is also presented whether staff gave an advice first, second, or third.

Strategy	Total	1st advice	2nd advice	3rd advice
Summarising	16.8	30.2	12.0	7.4
Self-Explanation	16.4	5.8	20.5	23.5
Mind maps	12.4	15.1	18.1	3.7
Combination	10.0	11.6	10.8	7.4
Collaborative Learning	8.8	5.8	7.2	13.6
Rereading	7.6	4.7	7.2	11.1
Retrieval Practice	7.6	4.7	8.4	9.9
Distributed Practice	6.4	4.7	6.0	8.6
Generation	4.4	-	1.2	12.3
Highlighting or Underlining	0.8	2.3	-	-
Imagery Use	0.8	1.2	1.2	-
Elaborative Interrogation	0.4	-	1.2	-
Keyword Mnemonic	0.4	-	-	1.2
Interleaved Practice	-	-	-	-

3.2 Scenarios

Table 3 shows the mean ratings for both the effective and less effective options for each of the six strategies used. The paired-samples t-test showed that staff members provided significantly higher ratings for all effective strategies than for ineffective ones, all p-values being < 0.008. In addition, most effect sizes, as represented by Cohen's d, were large,

meaning that the effects were strong. Only the ratings for interleaved practice revealed a medium effect, indicating that the magnitude of the effect was smaller than for the other study strategies.

Table 3

Mean ratings and standard deviations, and statistical comparison (t-values and effect sizes with Cohen's d) for the effective and the not effective strategies for the learning scenario questions. All t-values are significant with p-values smaller than 0.008.

	Effective strategy		Ineffective strategy		Comparison	
Scenario	M	SD	M	SD	t-value	Cohen's d
Generation	4.60	0.56	2.78	0.74	18.35	1.98
Retrieval Practice	4.21	0.65	2.95	0.73	13.82	1.49
Interleaved Practice	4.21	0.71	3.58	0.74	5.60	0.60
Distributed Practice	4.38	0.51	2.81	0.86	14.91	1.61
Worked examples	4.44	0.52	3.23	0.82	12.00	1.29
Self-explanation	4.50	0.53	2.85	0.81	16.93	1.83

3.3 Category-by-category statements

Appendix B presents the mean ratings given for each of the statements from Section 4. Some statements represented the same strategy. Therefore, the means per overarching strategy were calculated separately (see Table 4). For example, statements 2, 3, and 14 represented retrieval practice and were averaged into one score.

While the staff members gave the high utility strategy retrieval practice a score of 4.31 out of 5, the high utility approach distributed practice was seen as less effective, with a score of 3.35 being slightly above the mean of the scale (=3). The strategies that have intermediate

utility, namely self-explanation and interleaved practice, were both rated as more effective than distributed practice, with means of 4.31 and 3.74, respectively.

Highlighting and underlining, keyword mnemonics, imagery use, and rereading, which have low utility, were given average ratings in relation to the scale, with scores of 3.04, 3.56, 3.52, and 2.78, respectively. Summarising, another low utility strategy, was given a rating of 4.46.

Table 4

Mean ratings and standard deviation per strategy for the mostly used strategies according to Dunlosky et al. (2013), calculated based on the 23 statements that shared a strategy (see Appendix B for all separate ratings).

Strategy	M	SD
Self-explanation	4.31	0.49
Summarising	4.24	0.53
Highlighting	3.04	0.97
Keyword Mnemonic	3.56	0.84
Imagery use	3.52	1.01
Rereading	2.78	0.67
Retrieval Practice	4.31	0.51
Distributed Practice	3.35	0.78
Interleaved Practice	3.74	0.61

3.4 Advising on strategies

The final two questions that were asked in the survey were 1) if staff discusses study strategies during educational activities and 2) if staff actively advises students to use

particular strategies. Sixty-seven teachers indicated that they discussed study strategies. Of all staff members, 2.3% discussed strategies during each session, 19.8% would do this once per week, and 55.8% stated they discuss study strategies once per course. When asking the staff if they also recommend particular strategies in class, 73.3% of them stated they actively do this.

4 Discussion

The aim of the current study was to determine what knowledge academic staff members teaching in psychology curricula have regarding the effectiveness of study strategies. A second aim was to examine to which extent those staff members discuss and advise their students on the use of strategies. Almost 80% of teachers stated that they discuss study strategies at least once during a course with a group of students. Three out of four reported to offer specific advice on which strategies to use.

Regarding the first aim, three different question formats were used to answer this question. First, in an open question, the academic teachers were asked to state which three study strategies they would advise their students to use (see also Dirkx et al., 2019). Overall, the three most often advised strategies were summarizing, self-explanation, and making mind maps (see Table 2). When zooming in on the order in which the advices were stated, almost one out of three staff members advised summarizing first. Self-explanation, on the other hand, was mostly advised second or third. Retrieval practice and distributed practice, which are commonly seen as having high utility, were only ranked as sixth and 8th out of the 14 assessed strategies.

Second, the learning scenario items, for which staff had to rate to what degree particular situations would lead to long-term learning, showed that the academic staff had significant knowledge about the effectiveness of particular strategies. For all six scenarios,

they rated the self-study scenario in which effective learning strategies were used significantly higher than an ineffective one (see Table 3).

Third, participants rated short strategy-by-strategy statements about how one could learn. Here, the three strategies they rated as most effective were retrieval practice, self-explanation, and summarizing (see Table 4). Distributed practice was not rated much better than using keyword mnemonics or imagery.

4.1 Contrast between open-ended and forced-choice questions

One clear outcome of this study was that staff members were not entirely consistent in their responses to the open-ended and forced-choice questions. Retrieval practice was not mentioned much in the open question, although the respondents did rate it as highly effective in the scenario and strategy-by-strategy questions. Similarly, they rated interleaved practice as effective in both closed-question types, yet did not mention this strategy at all in the open question. Finally, although they rated distributed practice as having high utility in the scenario, they did not mention it often in the open question. The fact that the open-ended and forced-choice questions led to differential outcomes underlines the importance of using both methods in such research. In this particular case, it also shows a more complete pattern of the teacher's knowledge. While the academic staff are aware that techniques with at least moderate utility (Dunlosky et al., 2013) are indeed beneficial for self-study purposes, they also seem to advocate strategies commonly seen as less effective. Where does this contrast come from?

It has often been shown that students and staff have strong beliefs on what works and what does not. Kornell and Bjork (2009) for example presented volunteers with sets of word pairs and asked them to predict their performance for the second word when being cued with the first word during a later test. Participants tended to overestimate their current memory

performance, while they were under-confident about their future learning ability. This suggests that people's metacognitive beliefs are inconsistent (Kornell & Bjork, 2009). In relation to this, learners may experience the so-called experienced-learning-versus-actual-learning-paradox (Soderstrom & Bjork, 2015). Techniques such as rereading may feel easy, because reading a text a second time elicits familiarity for the material, which may mistakenly be seen as an indicator for long-term learning. Other techniques such as retrieval practice may feel more difficult, which can lead to the idea that one did not learn much, yet in reality it did lead to long-term learning. Even so, participants may still have had correct knowledge about the effectiveness of particular strategies. Knowledge and belief about the effectiveness of learning strategies may not always be in line. A student or teacher may know that a particular strategy is effective, but may believe that it does not work for himself of his students (see McDaniel & Einstein, 2020). Thus, potentially, when being prompted to provide advice in an open-ended question, the academic staff provided their *belief* about learning, yet later, when being provided with forced-choice questions, they applied their *knowledge* of the effectiveness of the presented strategies.

Another explanation may be found in the dual process model (Yonelinas, 2002). According to this model, recognition memory performance depends on two factors, familiarity and recollection. If somebody has the sense they experienced an event before, this person shows familiarity, while recollection is needed to recall past events in more detail. This also links to the activities of recall and recognition, for which familiarity with a stimulus is sufficient to correctly respond in a recognition task, whereas the detailed recollection is needed for verbal recall. Perhaps the current academic staff members did not have sufficient recollection for a number of the high utility strategies like retrieval practice or distributed practice. On the other hand, when later presented with forced-choice questions, they may have recognized the more effective techniques and, therefore, rated them as effective. In other

words, the staff may have had a relatively weak memory trace for high utility strategies, but it was not strong enough to actively recollect the memory during the open-ended question.

Finally, in the introduction it was already mentioned that using only closed questions may direct the respondent's attention to strategies they would not spontaneously report. However, a drawback of these types of questions is that underrepresentation may occur if the closed questions lack strategies that are often used (Dirkx et al., 2019). Using an open-ended question may have pitfalls too, however, if a respondent does not think of a certain technique as a learning strategy. This may have been apparent in the current study, where retrieval practice was not mentioned substantially in the open-ended question, although it was rated as high utility in both the scenarios and strategy-by-strategy questions. Another aspect often encountered when using open-ended questions is the diversity of responding being much higher in comparison to closed questions (Reja et al., 2003). Indeed, in the present study, not even counting the combinations of strategies that were advised, participants tended to differentiate between at least 14 strategies, excluding the 'other' category. Potentially due to this reason, the study strategy that was mentioned most was only recommended by 16.8% of all respondents. Likewise, retrieval practice was only advised 7.6% of the time, although it received a rating of 4.31 in the strategy-by-strategy questions, indicating that substantially more respondents thought this strategy to be of high utility. The reason for this higher diversity can be the spontaneity involved in the use of open-ended questions (Reja et al., 2003).

4.2 Staff members' current knowledge on effective strategies

One key aim of this study was to determine to which extent academic staff has knowledge about the effectiveness of study strategies. As we can see from part of the open-ended and strategy-by-strategy questions, the advice and ratings provided suggest that many

academic teachers were unaware of the effectiveness of study techniques. I discuss the results on the open-ended questions, scenarios, and strategy-by-strategy questions in more detail.

4.2.1. Open-ended questions

In this paragraph, I discuss these findings per strategy for a subset of the strategies. First, staff advised summarizing in 16.8% of the cases and also rated it as effective in the closed question, with a score of 4.46 out of 5. However, summarizing is not seen as effective by Dunlosky and colleagues (2013), based on the evidence at hand at that time. Dunlosky et al. state that, if one is trained on how to properly summarize, summarizing can nevertheless be a learning strategy that is more effective than what is generally applied by students, which is highlighting or rereading. Thus, it may be that academic staff overestimate the proficiency of the summarizing skills of their students and do not provide training or advice about how to make a good summary. Some teachers specifically mentioned in their open answer that they suggest to their students to write a summary in their own words. However, if the summary is not short, indicates what is most important to the author, and states the information that actually needs to be studied, the summary may still not be effective (Friend, 2000). In addition, high-quality summaries that are linked to prior knowledge may lead to better performance in comparison to summaries that only link to the to-be-read text (Bednall & Kehoe, 2011). Future research should look into what type of summaries academic teachers may advise.

The third most advised strategy in the current project was making mind maps. Strictly speaking, mind maps are a graphical form of a summary, which is one of the reasons it was not mentioned as a separate category in Dunlosky et al. (2013). However, because of the overlap with summarizing, mind mapping could be seen as having low utility, which would mean that the academic teachers advised a low utility strategy. Typically, when making a

mind map, the learner tries to summarize the content graphically and connect the key ideas that have a link (Pudelko et al., 2012). Trying to link ideas that are related may lead to active learning and this active process may be the main reason why making a mind map can be effective (Fiorella & Mayer, 2016). Therefore, the type of advice given by the staff may be interpreted as them having knowledge about an effective strategy. However, similarly to the advice of the current academic staff to make summaries, it is unclear whether the teachers advocate the active process in their students, advising them to make the process of learning as active as possible. It is, therefore, unknown to which extent the staff provides effective advice or whether they are unaware of the pitfalls of mind mapping and advise it ineffectively.

Another strategy the academic staff appear not to have sufficient knowledge about is distributed practice. Dunlosky et al. (2013) rated this strategy as having high utility in their review, demonstrating that spacing study sessions over time is better than cramming them into one single session and that spacing with longer lags is more beneficial than spacing with shorter lags. Distributed practice is beneficial, as the learner's brain responds more efficiently to the to-be-learned material after a delay in comparison to repeating the material directly after having seen it once (Gerbier & Toppino, 2015). Additionally, when experiencing an event a second time, so-called reconsolidation of previously formed memory takes place, which provides the opportunity to manipulate and strengthen the memory that was previously stored (Gerbier & Toppino, 2015). In the current study, the respondents did not advise distributed practice much in the open-ended question. Additionally, the rating for distributed practice was not higher than that for some of the low utility strategies. However, they did favour spacing over cramming in a scenario. This suggests that the staff did understand that distributed practice might lead to optimal learning, but that they did not favour it over other types of strategies.

4.2.2. Scenario questions

Based on the advice given regarding summarizing and making mind maps, and the lack of advice on distributed practice, one would conclude that the academic staff members of the current study are not knowledgeable of effective study techniques. However, when using forced-choice questions, the staff revealed at least reasonable knowledge of the low, moderate, or high utility of common study strategies. For all six scenarios, academic teachers rated the self-study scenario in which effective learning strategies were used significantly higher than an ineffective one. Four of the used scenarios in the current study overlapped with those of Morehead and co-workers (2016), namely retrieval practice, distributed practice, interleaved practice, and generation. Where the present instructors assessed those all as more effective than their ineffective counterparts, staff in the Morehead study only rated retrieval practice, distributed practice, and generation as effective. Interleaved practice was seen as less effective than blocking in their study (Morehead et al., 2016), which would indicate that the staff in the present study had better knowledge about that interleaving. In both the current and Morehead's study, though, awareness was higher than the awareness students commonly show (McCabe, 2011; Morehead et al., 2016). Morehead and colleagues (2016) also used scenarios for students and found that of those four overlapping scenarios, only distributed practice was seen as more effective than cramming. For the retrieval practice and generation, students were unaware of the effectiveness and for interleaving, they even significantly thought blocking has a higher utility. These results correspond well with those of McCabe (2011), who found that students favoured rereading over retrieval practice, cramming over spacing the studying, and showed no signs of knowledge that generation is effective.

4.2.3. strategy-by-strategy questions

In relation to the strategy-by-strategy statements provided in the current study, the results are mixed. Academic staff showed understanding of the utility of the strategies that were given moderate to high utility in the review by Dunlosky et al. (2013), for example for retrieval practice, self-explanation, and interleaved practice. Likewise, some of the low-utility strategies were indeed rated low in the present study, such as highlighting or rereading. However, the academic teachers did not see advantages of the high-utility technique distributed practice. Instead, they rated summarizing as highly effective, although it is generally seen as a low utility technique. The closed questions addressed by Morehead and co-workers (2016) differed substantially from the category-by-category statements used in the present study. Morehead mainly asked closed questions relating to retrieval practice and distributed practice. On average, two out of three staff members acknowledged the high utility of these methods, which only corresponds to the current findings regarding retrieval practice.

In sum, although the academic staff showed knowledge of effective study strategies in most of the closed questions, they did advise more ineffective ones in the open-ended question. More studies need to be done for the sake of generalizing these results across teacher populations.

4.3 Implications for teacher professionalization

Three out of four academic staff members surveyed in the current study stated they actively advise their students to use particular study techniques, similarly to the study by Morehead and co-workers (2016), in which even 86% recommended study strategies. If academic teachers do not have sufficient knowledge and recommend students to for example make summaries like was done much in the current study, staff could teach their students ineffective study routines. This could lead to a self-sustaining cycle of information and

misinformation that repeats (Morehead et al., 2016; Simons & Chabris, 2011). In fact, two respondents mentioned that they advise summarizing because it also worked well for them during their own studies.

One way to reduce misinformation is to train academic staff about the effectiveness of study strategies. If staff has more knowledge about the different moderate or high utility techniques, they can more easily advise students about the techniques. However, having the mere knowledge about how effective a technique is may not always be sufficient to guide other learners in this process. This is especially relevant because students may be reluctant to change or worry about whether they use the techniques in the proper way (Biwer et al., 2020). Therefore, academic staff should not only receive an awareness session about the effectiveness, but should also have the opportunity to practice various moderate and high utility strategies such as retrieval practice or self-explanation. Various types of training for students already exist that could be utilized for this, such as the Study Smart Program (Biwer et al., 2020), an experience-based training on generating knowledge (DeWinstanley & Bjork, 2004), or the knowledge, belief, commitment, and planning framework (McDaniel & Einstein, 2020).

Training by providing awareness and practice alone may still not be sufficient to truly understand why certain techniques work better than others. As mentioned before, learners may experience the so-called experienced-learning-versus-actual-learning-paradox (Soderstrom & Bjork, 2015). It is important to provide awareness about this paradox to academic staff when providing study strategy training, so that they can also make students aware of this pitfall.

4.4 Limitations and reflections

A number of points need to be addressed that could improve a similar study in the future. The open-ended question stated that a student had read all information once and needed to prepare for an exam three weeks from now. What type of topic the student would study was not mentioned. Several staff members said it depends on the type of to-be-studied material which strategies they would advise. Indeed, as described in the introduction, interleaved practice may be highly effective if the material can easily be contrasted such as with different types of maths problems (Brunmair & Richter; Chen, 2021), but it is currently unknown whether the technique also works well for long theoretical texts for example (Dunlosky et al., 2013). Due to this lack of information, academic teachers may not have advised strategies they truly find effective and may rather have chosen those that they think can generally be utilized for all types of material. Interestingly though, the two strategies with highest utility, retrieval practice and distributed practice, are effective in many situations for many types of learners (Dunlosky et al., 2013), which means that addressing those would always have been beneficial.

Another point is the fact that we asked the respondents to advise three study strategies to their students. Though many participants stated in which order they would provide advice to their students, providing statements such as ‘first I would advise … and next …’, the sequence in which they should advise was not asked for. Nevertheless, in the results section, the three types of advice were separated. This showed that staff would advise summarizing mostly in first instance, whereas they suggested self-explanation mainly in second and third case. Whether this sequencing is a true representation of the entire sample or only represents some of the respondents is unclear at this point.

The context in which this study was performed may not be representative for Higher Education in general. As already explained in the method section, the respondents of the

current study were employed at a university that uses PBL. In this educational setting, students first determine learning goals in small groups. When subsequently performing self-study on large amounts of texts, they are instructed to answer those learning goals, so that they can discuss these answers with their peers during the next educational session. Making a summary of the literature for each of the goals could provide the learners with a short and clear overview of such goals. Thus, as a starting point of the practice process after reading the literature, one could advise to make a summary. This is also exactly what the academic teachers did. Almost one out of three mentioned summarizing as their first advice, but summarizing was only mentioned by 7.4% of the staff as third advice. This does not mean, however, that academic staff who teaches at more lecture-based universities would offer the same advice.

Another example of the academic staff in the current study potentially responding differently to those from other universities is related to the fact that many opted for self-explanation in the open-ended questions. Linking new material to prior knowledge is one of the features of active learning, the situation in which students are actively engaged with their course material. Active learning is also one of the key features behind the PBL philosophy (Edview, 2018), which is promoted by the use of constructive, collaborative, contextual, and self-directed learning. Self-explanation relates to all of those four components, with the collaborative aspect being that you explain the course material to your peers. This may be one of the reasons why the academic staff advised self-explanation as a study strategy.

A final activity strongly linked with PBL and advised relatively much by the respondents in this study is collaborative learning (Edview, 2018). In the current study, 8.8% of the staff recommended students to study with their peers. According to the PBL philosophy, collaborative learning enforces mutual interaction and (shared) understanding of a problem. This latter aspect is a key element of active learning (Dolmans et al., 2016; Edview,

2018) and may be the reason why collaborative learning can have high utility (Nokes-Malach et al., 2015). In the study by Morehead et al. (2016), 59% of staff advised students to study with friends, which corresponds with the findings of the current study. This means that academic staff from different contexts also sees the benefits of this strategy, yet potentially in a different way. More research is needed to determine why academic teachers find collaboration effective.

4.5 Conclusions

Overall, this study showed that academic teaching staff have a good understanding of the utility most of the commonly employed study strategies. However, when actively prompted to provide advice, they fail to advise these effective techniques and rather go for ineffective ones. The study also showed the importance of using a mix of open-ended and force-choice questions, as this leads to a more complete picture on staff's knowledge and perceptions, showing the complexity of this topic. Finally, academic staff employed at universities needs training on the effectiveness of study strategies, so that they can address this topic optimally in class.

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Appendix A

Survey items

Section 1
In this first section, we ask you a number of questions about you as a teacher.

1	What type of position do you have at FPN?	• Associate or Full professor • Assistant professor • Teacher • PhD student or postdoc
2	For how long in your career have you been performing teaching activities?	• Less than one year • 1-3 years • 3-5 years • 5 year or more
3	Have you taken part in a PBL tutor training?	• Yes • No
4	Did you obtain the University Teaching Qualification (i.e., BKO)?	• Yes • No, I am working on it • No
5	What is the most responsible role you have or had as a teacher within FPN or another UM faculty?	• Education Management (e.g., Programme coordinator, specialisation coordinator, internship coordinator) • Coordinator of course or practical • Thesis supervisor (both bachelor's or master's) • Tutor

Section 2
If a student takes part in one of the educational programmes of FPN, a significant amount of time is spent on self-study activities. When we ask students how they study, different study strategies or techniques are mentioned. Not all of them are equally effective. A particular study strategy is deemed effective if it helps students to remember the studied material over a long period of time. In this first section, you will be asked about study strategies you would advise your students to use.

Imagine a random student in a first-year course in the Bachelor in Psychology. This student has to study a number of book chapters and research papers for the final exam, which takes place in three weeks. The student has already read all pages of all materials thoroughly once. Which three study strategies would you advise the student to use when studying for this exam? For each strategy, please explain what you mean and describe it as detailed as possible.

1.

2.

3.

Section 3

As described in the prior section, students may use different types of strategies during self-study that are not equally effective. A particular study strategy is deemed effective if it helps students to remember the studied material over a long period of time. For each of the six learning scenarios presented below, please rate on a 5-point scale the extent to which you think the two contrasting situations would or would not benefit long-term learning. A rating of 1 means that a scenario is highly ineffective and a rating of 5 indicates that it is highly effective.

S1. Two students are asked to learn three text passages about ancient cities.

- Student A reads each passage twice.
- Student B reads each passage once and then tries to generate questions including answers related to the passages.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

S2. Two students need to study a text passage from a book.

- Student A first studies the passage and then writes down from memory as much of the material from the passage as he/she can.
- Student B first studies the passage and then studies the passage again.

Both students spend an equal amount of time on these activities.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

S3. Two students are studying for an exam. For the same study material, different types of assignments are available.

- Student A practices all assignments from the same type before moving to the assignments of the next type.
- Student B mixes the types of assignments while practicing.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

S4. Two students are studying for an exam.

- Student A studies the two days leading up to the exam.
- Student B starts studying two weeks before the exam, studying a little bit every day.

Both students spend the same total of hours on self-study.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

S5. Two students are doing practice assignments while preparing for an exam. They are both beginners in these types of assignments.

- Student A prepares by first studying two worked- examples that also include the thinking steps needed to solve the assignment. Next, he/she tries to independently master some assignments.
- Student B prepares by only independently trying to master all practice assignments.

In total, both students perform the same number of assignments.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

S6. Two students have to read a chapter in preparation of an exam.

- Student A decides to read the text twice.
- Student B decides to read the text once and then starts asking him/herself who-what-why-how questions about the studied material.

	Effectiveness				
Student A:	1	2	3	4	5
Student B:	1	2	3	4	5

Section 4

Please recall that a study strategy is deemed effective if it helps students to remember the studied material over a long period of time. In the next section, you will be presented with a number of study strategies. For each of them, please state to which extent they are in your opinion effective. A score of '1' indicates that the strategy is not effective at all; a score of '5' indicates that it is highly effective.

1	Read the text a number of times	1	2	3	4	5
2	Practice by answering questions about the text	1	2	3	4	5
3	Test yourself with practice tests	1	2	3	4	5
4	Try to study bits of the text several times	1	2	3	4	5
5	Make a summary, mind map or schema of the text	1	2	3	4	5
6	Study a long time at once for your course	1	2	3	4	5
7	Use concrete examples to explain difficult concepts	1	2	3	4	5
8	Search for similarities and differences in the text	1	2	3	4	5
9	Use mind maps, summaries, or schemas	1	2	3	4	5
10	Search for pictures to clarify difficult concepts	1	2	3	4	5
11	Study by explaining the text to others	1	2	3	4	5
12	Think of mnemonics (such as rhyming, acronyms, etc.)	1	2	3	4	5
13	Restudy the part of the text you highlighted or underlined	1	2	3	4	5
14	Use flashcards to test yourself	1	2	3	4	5
15	Underline or highlight the most important concepts in the text	1	2	3	4	5
16	Study the same text a number of times at different time points	1	2	3	4	5
17	Alternate the order in which you practice different topics within a single study session	1	2	3	4	5

18	Read the text out loud	1	2	3	4	5
19	Literally copy the text	1	2	3	4	5
20	Use examples explaining how to solve an assignment	1	2	3	4	5
21	Ask yourself who-what-why-how questions	1	2	3	4	5
22	Study by imagining or visualizing the text while reading	1	2	3	4	5
23	Alternating practice assignments of different types	1	2	3	4	5

Section 5

Please recall that a study strategy is deemed effective if it helps students to remember the studied material over a long period of time. In the next section, you will be asked some final questions about your role as teacher in advising our students to use particular study strategies.

1	Do you discuss study strategies/techniques in class, such as during tutorial meetings, practicals or lectures?	• Yes • No
2	If yes, how often do you discuss study strategies?	• once every session • once per week • once per course
3	Do you recommend particular study strategies to students, either during or out of meetings?	• Yes • No

Appendix B

Mean ratings and standard deviations for 23 statements presented using a five-point Likert scale. For each statement, the strategy involved is also mentioned.

Statement	Strategy	M	SD
Read the text a number of times	RR	2.62	.83
Practice by answering questions about the text	RP	4.42	.61
Test yourself with practice tests	RP	4.39	.66
Try to study bits of the text several times	DP	3.40	.92
Make a summary, mind map or schema of the text	SUM	4.46	.67
Study a long time at once for your course	CR	2.18	.76
Use concrete examples to explain difficult concepts	EX	4.55	.55
Search for similarities and differences in the text	SE	3.84	.94
Use mind maps, summaries, or schemas	SUM	4.13	.88
Search for pictures to clarify difficult concepts	SUM	4.12	.75
Study by explaining the text to others	SE	4.72	.50
Think of mnemonics (such as rhyming, acronyms, etc.)	KM	3.56	.84
Restudy the part of the text you highlighted or underlined	RR	3.00	1.00
Use flashcards to test yourself	RP	4.12	.76
Underline or highlight the most important concepts in the text	UH	3.04	.97
Study the same text a number of times at different time points	DP	3.29	.90
Alternate the order in which you practice different topics within a single study session	IP	3.52	.84
Read the text out loud	RR	2.72	.91
Literally copy the text	CP	1.72	.78
Use examples explaining how to solve an assignment	GEN	4.05	.69

Ask yourself who-what-why-how questions	SE	4.39	.58
Study by imagining or visualizing the text while reading	IMA	3.52	1.01
Alternating practice assignments of different types	IP	3.95	.67

Note. CR = Cramming; CP = Copying; DP = Distributed Practice; EX = Examples; IMA = Imagery; IP = Interleaved Practice; KM = Keyword mnemonic; RP = Retrieval Practice; RR = Rereading; SE = Self-explanation; SUM = Summary; UH = Underlining or Highlighting