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SHORT PAPER

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Do secondary school students make use of effective study strategies when they study on their own?

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Summary

Although there is a large body of evidence for the utility of particular study strategies such as retrieval practice and distributed practice as memory-enhancing instruments, they are seldom used by learners in educational practice. Thus far, the research on the use of these study strategies has focused only on undergraduate university students, oftentimes only investigating a set of predefined strategies. The question, thus, remains whether these results are generalisable to secondary school students. The present study is the first to explore the use of different study strategies by secondary school students. With the use of an open question, 316 secondary school students from three different secondary school levels were asked how they prepare for an exam when they are studying by themselves. The results show that secondary school students use study strategies considered to be suboptimal. In the discussion, we compare our findings with results of previous studies among undergraduate university students.

KEYWORDS

effective study strategies, learning, memory, retrieval practice, secondary school students

1 | INTRODUCTION

In 2013, Dunlosky, Rawson, Marsh, Nathan, and Willingham published an extensive overview of study strategies that have been thoroughly investigated in cognitive and educational psychology research. They present a list of 10 study strategies that enhance memory and transfer of knowledge with recommendations as to their relative utility. Two study strategies, retrieval practice and distributed practice, were evaluated as being highly effective in a wide variety of student populations, contexts, and learning materials (see Adesope, Trevisan, & Sundararajan, 2017, for a recent overview). Despite the fact that these study strategies show robust effects on memory and transfer of knowledge, recent studies show limited use of them by students in education (e.g., Bartoszweski & Gurung, 2015; Blasiman, Dunlosky, & Rawson, 2017; Hartwig & Dunlosky, 2012; Karpicke, Butler, & Roediger, 2009; Kornell & Bjork, 2007; McCabe, 2011; Morehead, Rhodes, & DeLozier, 2015; Wissman, Rawson, & Pyc, 2012). For example, Hartwig, and Dunlosky, and Morehead et al. (2015) asked undergraduate psychology students to indicate which of nine presented study strategies (e.g., flashcards and recopying notes) they regularly used. The most commonly named strategies were doing practice tests/using flashcards (both forms of retrieval practice), rereading, and cramming. In a similar vein, Bartoszweski and Gurung asked college students to rate on a 6-point scale how much they practised different study strategies for a course in relation to the final exam and found practice tests, self-explanation, use of keywords, and rereading to be most commonly used. Furthermore, McCabe and also Morehead et al. (2015) asked undergraduate students to predict on a 7-point rating scale which of two study strategies would benefit learning most for six different scenarios (e.g., testing vs. restudying). In McCabe's study, students favoured the high utility strategy in the scenarios in only

23% of the cases. This percentage was 37% in Morehead et al.'s study. Finally, Blasiman et al. (2017) monitored students' actual use of self-reported study strategies. They surveyed 268 students from different U.S. colleges. At the beginning and during their course, students were asked to report on a weekly basis how much they planned to use and how often they actually used 10 commonly applied study strategies using a 10-point Likert scale. The results showed that although students intended to use practice testing and flashcards at the start of the course, they actually did not use these strategies regularly during the course.

This overview shows that students at the undergraduate level exhibit suboptimal use and awareness of effective study strategies. The question addressed in the current study was whether these results generalise to secondary school students. Prior research has namely focused almost exclusively on (mostly psychology) undergraduate university students (see Blasiman et al., 2017, for an overview), whereas it is also known that several strategies listed by Dunlosky, Rawson, Marsh, Nathan, and Willingham, (2013) such as retrieval practice and distributed practice are also highly effective for younger students (e.g., Dirkx, 2014; Goossens, Camp, Verkoeijen, & Tabbers, 2014; Goossens, Camp, Verkoeijen, Tabbers, Bouwmeester, & Zwaan, 2016). However, as secondary school students' cognitive and metacognitive abilities are still developing (e.g., Crone & Dahl, 2012), this might affect their study strategy preferences in the sense that they use even less optimal strategies than do college students. On the other hand, secondary school students and college students may be at a similar disadvantage, because they have not made use of effective study strategies (Surma, Vanhoyweghen, Camp, & Kirschner, 2018) as no formal training in effective study strategies is offered. The strategy preferences that secondary school students develop in this context may simply persist when they enter undergraduate programmes.

Another issue with prior research is that it is unclear whether the level at which students perform is related to their strategy use (Geller et al., 2018). In the Netherlands, where the current study was conducted, there are different levels within secondary school (prevocational education, general secondary education, and preuniversity education), which offers the opportunity to explore differences in strategy use between these levels. Prevocation is a 4-year programme offering theoretical and practical courses. In the first 2 years, pupils follow a general curriculum, and at the end of those 2 years, they choose one of 10 profiles (e.g., care and welfare or engineering and technology). General secondary education (5 years) and preuniversity education (6 years) prepare pupils for higher professional education and university studies, respectively. In the lower years (i.e., years 1, 2, and 3), all pupils follow a general curriculum, and in the upper years, there is a compulsory programme (Dutch, mathematics, etc.) and a specialisation (e.g., science and technology). Information on strategy use among different levels of secondary school can provide useful information when developing remedial teaching programmes on study habits of pupils, and it can provide insight into the generalisability of previous studies that solely focused on students from the highest educational level.

The current study also used a method that is different from that of most of the earlier studies (see Karpicke et al., 2009, for an exception). Previous research predominantly asked students to report the use of or to compare a set of predefined strategies (Bartoszweski & Gurung, 2015; Blasiman et al., 2017; Hartwig & Dunlosky, 2012; McCabe, 2011; Morehead et al., 2015). This precluded the possibility for respondents to report other strategies that they may have used. Also, presenting a predefined set of strategies may have inflated the report of strategies that would not have come to mind spontaneously. Therefore, in this study, participants answered an open-ended question about their strategy use and were asked to rank them from most to least often used (see Karpicke et al., 2009).

Because of the descriptive and explorative nature of this study, there were no specific hypotheses regarding strategy use in secondary school.

2 | METHOD

In three different schools in secondary education in the Netherlands, 318 Dutch-speaking students (48.3% male; *Mean age* = 15.44; *SD* = 1.09; prevocational [*n* = 103], general secondary education [*n* = 108], or preuniversity [*n* = 107] track) were asked about the study strategies they use prior to participation in an experimental study not reported here. The students were in their fourth year of secondary education.

In the survey, pupils were asked to describe which strategies they use during self-study. Next, they were asked to rank the strategies from most often used to least often used. There was no limit to the number of strategies participants could report. The specification *self-study* was used to determine the strategies that students choose when studying at home or during self-study hours at school without involvement of the teacher. The paper-and-pencil survey was administered at the school in the classroom. Participants needed about 5 min to complete the survey.

To assess the effectiveness of the reported strategies, all responses were categorised. Two researchers assessed whether the students' responses were an example of one of the strategies that were evaluated by Dunlosky et al. (2013; Strategies 1–10 in Table 1). In Table 1, study strategies and example responses are presented. Separate categories (11–14) were constructed for strategies that were not discussed by Dunlosky et al. 2013 and for responses that included a combination of strategies (15). The new categories were copying (i.e., copying of a chapter or summary; also included in the study of Blasiman et al., 2017), generating examples (see Karpicke et al., 2009), cramming (as the opposite of distributed practice), and doing practice problems (i.e., solving problems provided in the textbook) or a combination of the previous 14 strategies.

3 | RESULTS

Three hundred sixteen students answered the question (prevocation, *n* = 102; general secondary, *n* = 107; preuniversity, *n* = 107). Figure 1 shows the frequency distribution of the number of strategies listed by students. The figure shows that most students listed and described three strategies (*M* = 3.27; *SD* = 1.09). We found no significant differences in the number of study strategies reported by students of the three different school levels, $F(2, 316) = .72$, p = ns.

TABLE 1 Responses per category (translated from Dutch)

Category	Example
1. Elaborative interrogation	Describe positive and negative aspects
2. Self-explaining	Explaining to myself, think aloud
3. Summarising	Summarising, making a summary, write down important information
4. Highlighting/ underlining	Underlining, marking
5. Keyword mnemonic	Using mnemonics, making rhymes
6. Imagery use	Imagining, visualising
7. Rereading	Read, reread a chapter/summary/notes
8. Practice testing	Testing, quizzing (online or paper-based), flashcards
9. Distributed practice	Starting on time, repeating practice
10. Interleaved practice	Study something different in between
11. Copying	Copying the textbook chapter
12. Thinking of real-life examples	Think of an example
13. Cramming	Read right before the exam, massed learning
14. Doing practice problems	Solving text book problems, practicing math problems
15. Combination	Summarising and highlighting

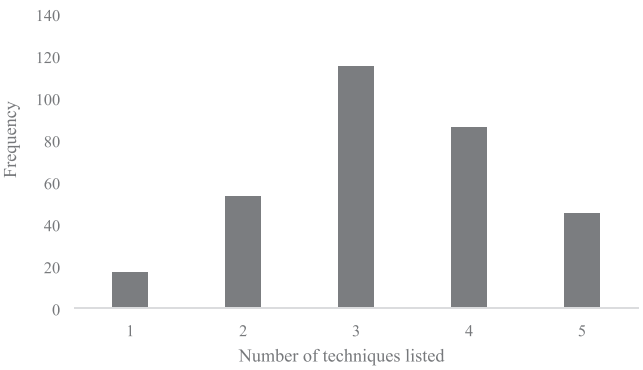

FIGURE 1 Frequency distribution of the number of strategies listed by students

Of the responses, 18 could not be categorised because they were underspecified (e.g., "try to remember the learning material" or "learning") or referred to strategies that did not involve interaction with the learning material (e.g., "planning"). These were coded as missing values. Both raters fairly agreed in their assignment of the responses to the categories (Cronbach's α = .75). The few discrepancies were resolved by the first author.

Table 2 shows an overview of the percentages of students who listed the strategies presented in Table 1 and the percentages of students who ranked each study strategy as their primary strategy. Rereading was reported most often (i.e., see left column); it was reported by 87.7% of the students and ranked as primary strategy by 51.1%. Summarising was the second most frequently reported strategy (by 76.9% of the students) and preferred as primary strategy by 23.6%. Practice testing was the third most frequently reported strategy (by 60.1% of the students) but was listed as primary strategy by only 8.1% of the students. Other strategies listed in the review of Dunlosky et al. (2013) such as distributed practice, interleaved practice, and elaborative interrogation were reported by very few students (<5%), and these strategies were also rarely reported as primary strategy. In addition, 11 times students (3.4% of the respondents) reported a combination of strategies. The most common combinations of strategies were summarising and practice testing (n = 4) and summarising and highlighting (n = 2).

TABLE 2 Overview of reported strategies in percentages

Strategy	Reported as used (%) N = 316	Reported as primary (%) N = 308
Strategies investigated by Dunlosky et al. (2013)		
1. Elaborative interrogation	1.9	—
2. Self-explaining	2.9	1.6
3. Summarising	76.9	23.6
4. Highlighting	26.6	0.3
5. Keyword mnemonics	0.3	—
6. Imagery use	—	—
7. Rereading	87.7	51.1
8. Practice testing	60.1	8.1
9. Distributed practice	3.8	0.6
10. Interleaved practice	0.3	0.3
New categories based on student responses		
11. Copying	12.3	2.9
12. Thinking of real-life examples	6.0	0.3
13. Cramming	0.6	0.3
14. Doing practice problems	47.8	7.4
15. Combination	3.4	3.2

Next, it was explored if there were differences between school levels in the reported strategies (see Table 3). Statistical analysis showed significant differences between the school levels in the frequencies of reported strategies (Cramer's V = .16, p < .001) and also strategies reported as primary strategy (Cramer's V = .31, p < .001).

Table 3 shows that rereading was reported most frequently at all school levels, both overall and as primary strategy. Summarising was the second most frequently reported strategy for all school levels, again both overall and as primary strategy. Practice testing and doing practice problems (in different orders) were the third and fourth most frequently reported strategies for all school levels. Although the number of students doing practice problems does not seem to differ between the school levels, more students in prevocational education (79.4%) reported practice testing as compared with general secondary and preuniversity students (53.3% and 48.6%, respectively). The difference regarding the use of practice testing between the school

TABLE 3 Overview of reported strategies per school level

Strategy	Prevocation (%)		General secondary (%)		Preuniversity (%)	
	Overall (*N* = 102)	Primary strategy (*N* = 99)	Overall (*N* = 107)	Primary strategy (*N* = 104)	Overall (*N* = 107)	Primary strategy (*N* = 105)
1. Summarising	71.6	20.2	78.5	28.9	80.4	21.9
2. Highlighting	25.5	—	32.7	—	21.5	—
3. Rereading	85.3	44.4	87.9	54.8	89.7	54.3
4. Practice testing	79.4	18.2	53.3	—	48.6	—
5. Distributed practice	—	—	—	—	8.4	—
6. Rewriting	23.5	9.1	10.1	—	4.7	—
7. Thinking of real-life examples	—	—	12.1	—	4.7	—
8. Doing practice problems	41.2	5.1	50.5	8.7	47.7	9.5
9. Combination	—	—	—	—	5.6	5.7
10. Other[a]	7	3	11.8	7.7	5.6	8.5

[a]Strategies reported by <5% of the students.

levels also appeared in the reported primary strategies. In prevocational education, 18.2% of the students reported using practice testing as primary strategy. However, in general secondary and preuniversity education, practice testing was reported by only 2.9% and 3.8% of the students, respectively. Students in prevocational education also reported copying more often (23.5%) than did general secondary and preuniversity students (10.1% and 4.7%, respectively). Table 3 also shows that none of the general secondary and preuniversity students use copying as primary strategy, whereas 9% of the prevocational students use copying as primary strategy.

4 | DISCUSSION

The objective of the present study was to explore which study strategies secondary school students use during self-study and whether there are differences in reported strategy use between three different school levels. These questions were investigated using an open question in which students were asked which strategies they use when preparing for an exam (see Karpicke et al., 2009). Pupils from all three secondary school levels reported rereading and summarising most frequently, followed by retrieval practice and doing practice problems. The most notable differences between school levels were the more frequently reported use of retrieval practice and copying by students in prevocational education as compared with students in general secondary and preuniversity education. One tentative explanation for this is that prevocational students are presented with less elaborate study materials that more easily elicit retrieval practice and copying strategies (e.g., studying definitions). Students from general secondary and preuniversity level on the other hand are more often presented with elaborate text materials for self-study, which may elicit strategies such as summarising, rereading, and highlighting to a larger extent.

A second question addressed in this paper was if the results from prior studies among college students are generalisable to secondary school students. To answer this question, the results are compared with the results of earlier studies among college students (Hartwig & Dunlosky, 2012; Karpicke et al., 2009; Morehead et al., 2015). In Table 4, the frequencies of the most reported strategies in these studies and the present study are displayed. Practice testing and rereading are frequently reported in all four studies, although practice testing does not appear to be reported spontaneously by undergraduate students (Karpicke et al., 2009). Interestingly, summarising was reported frequently by secondary school students (77%), but not by undergraduate students (13%). From this comparison, it can be concluded that both college students and secondary school students seem to heavily rely on rereading, but there are also some important differences between these two populations. Most secondary school students, for example, use summarising, whereas only few college students use that strategy.

TABLE 4 Comparison of reported study strategies across studies[a]

Study strategy	Hartwig and Dunlosky (2012), %	Morehead et al. (2015), %	Karpicke et al. (2009), %	Present study, %
Rereading	66	67	84	88
Summarising	—	—	13	77
Practice testing	71	72	11	60
Flashcards	62	54	40	—[b]
Highlighting	72	53	6	27
Cramming	66	53	—	2
Copying	33	33	30	12
Doing practice problems	—	—	43	48

[a]Bartoszweski and Gurung's (2015) data were not included in the table, because they investigated strategy use using a 6-point scale, which is difficult to compare with the frequencies reported in the four studies represented in the table.

[b]In the present study, use of flashcards and practice testing were seen as the same study strategy (as both are based on retrieval practice), and therefore, use of flashcards was not analysed separately.

In addition, the comparison in Table 4 shows that the way study strategies are inventoried (i.e., question format) seems to play an important role in the frequencies of the reported strategies (i.e., compare Karpicke et al. (2009) and the present study using an open-ended question versus Hartwig and Dunlosy and Morehead et al. 2015 using closed-format questions). For example, two strategies that were not included in the predefined set of strategies used in Hartwig and Dunlosky (2012) and Morehead et al. (2015) were frequently reported spontaneously in the present study: summarising and doing practice problems (see also Karpicke et al., 2009). Highlighting and cramming were less frequently reported spontaneously by students (Karpicke et al., 2009, and the present study) than when presented in a predefined set of strategies (Hartwig & Dunlosky, 2012; Morehead et al., 2015). This could indicate that asking students to report the use of a predefined set of strategies might direct attention to strategies that would not have been reported spontaneously and could also lead to underrepresentation of strategies that are frequently used in practice by students, because they were not included in the predefined set. Thus, one must be cautious when interpreting the differences in frequencies between these studies, because multiple factors could have contributed to these differences, among which are question format (open versus closed) and also population (school level, age, and nationality).

Another limitation of the present study is that some of the strategies reported in Table 2 and 3 are not mutually exclusive. For example, cramming and distributed practice concern the timing of learning events, whereas the other strategies are about what the pupil actually does during these learning events. Thus, for example, repeated rereading and cramming may be implemented at the same time (i.e., cramming rereading sessions). In future research, separate questions could be used that ask for timing of learning events and content of learning events.

Finally, the present study did not address how study strategies are combined during learning. However, in educational practice, pupils may use a combination of different strategies (i.e., making a summary and then practice testing, or testing themselves before rereading a text). However, only few students (3.6%) report a combination in response to the question asked in this study. In future research, a rephrasing of the question might be important to assess the combinations of strategies used by secondary school students.

Despite these limitations, the present study contributes to the literature regarding strategy use by students of different ages and educational levels and points also out that secondary school students predominately report using suboptimal study strategies when preparing for an exam. A comparison of our results and previous studies among college students furthermore showed that strategies used among secondary school students are quite different from strategies reported by college students. These findings imply that there is a need for creating awareness about the effectiveness of frequently used study strategies among secondary school students and provide training in selecting, combining (Fritz, Morris, Acton, Voelkel, & Etkind, 2007), and implementing (Kornell, 2009) the most effective study strategies in their self-study.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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DATA AVAILABILITY

Data are available after requesting permission from the corresponding author at https://doi.org/10.17026/dans-xne-za5h.

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