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The Use of Flashcards in an Introduction to Psychology Class

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Abstract

Four hundred fifteen undergraduate students in an Introduction to Psychology course voluntarily reported their use of flashcards on three exams as well as answered other questions dealing with flashcard use (e.g., when did a student first use flashcards). Almost 70% of the class used flashcards to study for one or more exams. Students who used flashcards for all three exams had significantly higher exam scores overall than those students who did not use flashcards at all or only used flashcards on one or two exams. These results are discussed in terms of retrieval practice, a specific component of using flashcards.

Keywords

study aids, introductory psychology, flashcards

Across college campuses, students can often be seen sitting in hallways, lounges, and dining halls continuously flipping through stacks of index cards that have exam material on both sides—a question on one side and an answer on the other side. Typically, students read the question or vocabulary word and try to answer the question or recall the definition before flipping the card over to check their answer. Students usually test themselves multiple times prior to taking the exam. These cards are commonly referred to as ''flashcards,'' and they are used to prepare for an exam or quiz. Kornell and Bjork (2008) estimate that ''perhaps no memorization technique is more widely used than flashcards . . .'' (p. 125). Part of their popularity is likely tied to the fact that students can generate their own flashcards or use various computer applications to generate flashcards (e.g., Study Blue, 2011) and that students feel they are ''doing'' something when they study for an exam. The vast majority of Introductory Psychology textbooks provide flashcard options (e.g., Griggs, 2012). There are many claims, especially on the Internet, for the effectiveness of flashcards due to the repetition and active learning involved in their use (e.g., Cohen, 2011; Isaac, 2006). Despite their apparent prevalence and impressive claims regarding their effectiveness, there appear to be no published studies examining whether flashcard use increases students' exam performance in a naturalistic context. The present study compared exam performance for students who chose to use flashcards to that of students who did not use flashcards in a naturalistic context (i.e., an Introduction to Psychology class) and investigated specific characteristics of flashcard use (e.g., when did a student first use flashcards) using a self-report methodology.

Researchers have investigated flashcard effectiveness in laboratory settings. For example, in several studies, Kornell examined flashcard use with regard to self-regulated study of vocabulary words (Kornell & Bjork, 2007). In one study, Kornell (2009) showed that studying one large stack of flashcards was more effective than studying smaller stacks of the same total number of flashcards. However, research examining flashcard use in a laboratory setting differs from flashcard use in a naturalistic context in noteworthy ways: participants in the lab did not generate the flashcards themselves nor determine how to use them to study. Thus, the number of flashcards created, the flashcard content, and how students use their flashcards may vary in a natural setting.

Flashcards should be distinguished from other ways students prepare for exams, such as crib sheets. A crib sheet (or *cheat* sheet) is an index card that contains ''brief written notes'' for a class and that a student can use during an exam (Dickson & Miller, 2005). Although students can use crib sheets to organize material in preparation for an exam, crib sheets differ from flashcards in that students are allowed to use crib sheets during an exam and require explicit permission from the instructor to prepare them. Nonetheless, some research on crib sheets may pertain to how flashcards influence exam performance. Studies have shown that merely creating crib sheets does not aid in student learning because students depend on being able to use the crib sheets during an exam and may not actually learn the exam material (Dickson & Bauer, 2008; Funk & Dickson, 2011). Yet, Funk and Dickson (2011) found that when students created crib sheets but did not expect to use them during an exam, they

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performed better on that exam than on another exam for which they expected to use their crib sheets. The former condition may be similar to creating flashcards in that students generate and use flashcards with the clear understanding that these cards will not be used during the exam.

In the present study, students completed a survey about their use of flashcards to prepare for three different multiple-choice exams, whether these flashcards were self-generated or computer generated, how many flashcards students typically generated, when were flashcards as a study tool first learned, who taught students to use flashcards, and in what other classes they used flashcards. Based on Karpicke and Blunt's (2011; see also Hays, Kornell, & Bjork, 2010) finding that memory improved when information was continually retrieved (a specific component of using flashcards), it was predicted that in an ecologically valid context—an Introduction to Psychology course—students who used flashcards would have higher exam scores than students who did not use flashcards. This hypothesis pertains to those students who used flashcards on all exams compared to those students who did not use flashcards at all or on only some exams, and to using flashcards versus not using flashcards on each individual exam. As for the other questions on the survey, the data were descriptive in nature with no specific hypotheses proposed, as there appears to be no prior research that examines these topics.

Method

Participants

Four hundred and fifteen undergraduates from an Introduction to Psychology class at a large southeastern public research university participated as volunteers; there was no reward (e.g., course credit) for participating and no penalty for not participating. The class was approximately 60% first years, 67% female, 80% White (representative of university demographics), and generally between the ages of 18 and 22.

Materials

The PSY 100 Flashcard Survey: Fall 2010 (available from the first author) was used. The 14-question survey asked multiple choice and open-ended questions about flashcard (both written and computer generated) use on specific exams, number of flashcards, whether flashcards were written out by the student or computer generated, use of flashcards in other classes, when the student first used flashcards, and who taught the student about using flashcards. The survey also asked for the student's "code number." All students in this class had a unique code number to help with record keeping. The code number was used to link survey answers with exam grades without identifying any student by name.

Procedure

At the beginning of the first class after the completion of the third exam, the instructor asked students to voluntarily complete a short survey (5 min) about flashcard use in this and other classes. This 500-student class is a combined lecture/lab class in which everyone meets 3 days a week for 50-min lectures and then students break up into 20 sections of 25 students for a weekly laboratory session. Each multiple choice, 50-question exams covered about the same amount of material (i.e., three chapters from the textbook and two to three labs). Also, the course instructor mentioned that using flashcards might be an effective study strategy prior to Exam 1, but did not mention their use since that time and did not provide a specific definition for "flashcards." Approximately 450 students attended class the day the instructor administered the survey. Those who chose not to participate ($N = 35$) waited quietly until the instructor collected the surveys.

Results

Relationship Between Flashcard Use and Exam Performance

Two sets of analyses were conducted. First, a one-way analysis of variance was conducted on mean exam score for each student (based on the 50 questions per exam) to compare students who reported using flashcards on different numbers of exams (0, 1, 2, or 3 exams). This analysis was significant, $F(3, 384) = 6.20$, $p = .0001$, $\eta^2 = .046$. Post hoc comparisons showed that students who used flashcards on all exams ($N = 141$; $M = 41.34$, $SD = 5.16$) had higher scores compared to those who used flashcards on one exam ($N = 79$; $M = 38.67$, $SD = 4.86$), $t(218) = -3.75$, $p = .0001$, $d = .53$, two exams ($N = 48$; $M = 38.57$, $SD = 5.21$), $t(187) = -3.21$, $p = .002$, $d = .53$, and no exams ($N = 120$; $M = 40.03$, $SD = 5.23$), $t(259) = -2.03$, $p = .043$, $d = .25$. All other comparisons were not significant, $ps > .067$.

Second, independent samples t tests for each exam were conducted to compare those students who reported using flashcards and those who did not. For Exam 1, those who used flashcards ($N = 205$, $M = 40.24$, $SD = 5.80$) had significantly higher scores than those who did not use flashcards ($N = 187$, $M = 37.74$, $SD = 6.49$), $t(391) = 4.04$, $p < .0001$, $d = .41$. For Exam 2, those who used flashcards ($N = 224$, $M = 42.40$, $SD = 4.94$) had higher scores than those who did not use flashcards ($N = 166$, $M = 41.52$, $SD = 6.01$), but this difference was not significant, $t(389) = 1.58$, $p = .116$, $d = .16$. For Exam 3, those who used flashcards ($N = 203$, $M = 39.68$, $SD = 6.08$) had higher scores than those who did not use flashcards ($N = 185$, $M = 38.51$, $SD = 5.77$); this difference was marginally significant, $t(387) = 1.94$, $p = .053$, $d = .20$.

As for the one exam analysis (i.e., Exam 2) that did not yield a significant difference, a post hoc analysis sheds some light on why flashcard use did not lead to higher scores than no flashcard use. There were a number of students who did not use flashcards on Exam 1 but chose to use them on Exam 2 ($N = 55$). These students scored lower on Exam 2 ($M = 40.80$, $SD = 4.92$) than students who used flashcards on both Exam 1 and Exam 2 ($N = 169$, $M = 42.91$, $SD = 4.85$), $t(222) = -2.79$,

$p = .006$, $d = .41$. It may be that students who used flashcards for the first time in the present class on Exam 2 did not use flashcards as effectively as students who had already used flashcards on Exam 1. Future research will need to investigate exactly how students are using flashcards as well as how experience with flashcards impacts performance within a course or between courses.

Descriptive Statistics About Flashcard Use

Overall, 69.9% of the class used flashcards for at least one of the three exams; 65.5% used written flashcards, 3.9% used computer flashcards, and 0.5% used both self-generated and computer flashcards. Also, 55.2% of the class used flashcards (either written or computer) to study for two of the three exams and 34.9% used flashcards to study for all exams. The mean number of flashcards (either written or computer) generated for each exam was as follows: Exam 1 = 69.23 ($SD = 44.10$); Exam 2 = 77.25 ($SD = 48.12$); and Exam 3 = 82.20 ($SD = 56.35$).

The results showed that flashcards were also used in other classes: 48% used only written flashcards in other classes, 2% used only computer flashcards in other classes, and 6.5% used written and computer flashcards in other classes. About half of students (49%) who used flashcards in the present Psychology course used them in other courses. Only about a quarter of students (23%) did not use flashcards in any class. Finally, only a small percentage of students (7%) did not use flashcards in Introduction to Psychology, but used flashcards in other courses.

Students listed a variety of other classes for which either type of flashcard was used; the top three responses were Chemistry (40%), Biology (25%), and Communications (24%). However, the range of courses included those in all disciplinary areas. Students were able to list up to five other courses for which they used flashcards. Forty-seven percent listed one course, 26% listed two courses, 9% listed three courses, 3% listed four courses, and 1% listed five courses.

Fifty percent of the students who had ever used written flashcards learned to use them when in high school. Others learned about written flashcards equally often in grades 1–8 (26%) and college (24%). For those using computer flashcards, the top answer of "when learned" was college (58%), followed by high school (38%) and Grades 1–8 (4%).

Students who had ever used written flashcards ($N = 295$) indicated that teachers/professors most often taught their use (52%). Students learned about flashcards from family members (21%), the student himself/herself (16%), friends (5%), or a combination of sources (3%). As for teaching about computer flashcards ($N = 54$), the order of responses was the student himself/herself (43%), teachers/professors (28%), friends (26%), and family (4%).

Discussion

The present study was among the first attempts to describe the use of flashcards (both written and computer generated) in a college class and to determine the relationship between flashcards and exam performance. Results indicated that students used flashcards a great deal in the present Introduction to Psychology course (and other courses). Moreover, students who used flashcards on all three exams had significantly higher exam scores overall than those students who only used flashcards on one or two exams and those who did not use flashcards at all. Students who used flashcards on each exam had higher scores than students who did not use flashcards. For Exam 1, this difference was significant, for Exam 2, it was not significant, and for Exam 3, it was marginally significant ($p = .053$). Thus, for almost all analyses the results provide tentative support for Karpicke and Roediger's (2008) retrieval hypothesis—repeated retrieval of information through the use of flashcards may be an effective exam-preparation strategy.

It is interesting that students in the present study generated approximately 75 flashcards per exam because a typical Introduction to Psychology textbook provides about the same number of computer flashcards. For example, Myers (2009) and Griggs (2012) have about 25–40 flashcards per chapter depending on the material covered (e.g., the physiological chapter has more flashcards). However, the flashcards generated for the present exams could have included information from the textbook as well as lecture material not covered in the textbook, in-class videos and demonstrations, and lab material.

In our study, students primarily used self-generated flashcards. In fact, so few students used computer flashcards that analyses could not be conducted comparing the two types of flashcards. We do not know if students were not using computer-generated flashcards by choice or they did not know about this resource. With regard to the former, the extremely low percentage of students using computer flashcards might reflect students' belief that actively making the cards will help them learn the materials (i.e., coding hypothesis; Dorsel & Cundiff, 1979). Or, perhaps, students feel it is critical to have their flashcards handy at all times; one never knows when he or she will have a study break but a computer will be unavailable. However, it is likely that the proliferation of smaller computers and electronic devices (e.g., iPads) will lead to an increase in computer flashcard use in the years ahead.

Finally, the present results also gave important insight concerning when students initially used flashcards and who taught students to use flashcards. Whereas written flashcards were learned primarily in high school from teachers/professors, computer flashcards were most often first used in college and students learned about them themselves. These findings likely partially reflect the increased use of computers by students in all aspects of college life. Since the present results indicate that using flashcards may impact exam performance, it could be argued that parents and teachers should teach the use of flashcards (both written and computer) at an earlier time than indicated by the present results.

Although the present study offers significant information about the use of flashcards, there are three important methodological limitations that should be noted. First, because the study

involved self-reporting there is the possibility that students may have exaggerated or misremembered information about flashcard use. Still, the present study is an important first step in understanding flashcard use that will hopefully lead to more controlled experimental studies. Second, the survey was only conducted with a single Psychology class. Although this class was large and led to a relatively large number of data points, future research should examine flashcard use in other Psychology classes as well as classes from other disciplines. Finally, the present study did not include information that might differentiate flashcard users and nonusers. For example, a pretest could have determined if flashcard users were better test takers than nonflashcard users.

In conclusion, the present study offered an initial empirical examination of flashcard use in a college class. The results indicate that a large proportion of students use this study technique and provide evidence that using flashcards can improve exam performance. Flashcard use should be examined in greater detail by investigating the composition of the flashcards that are generated (i.e., what is on each card), how students actually use the cards (e.g., how often do the students test themselves, how long do students spend generating and using flashcards), whether other study techniques are used in conjunction with flashcards, and how the nature of the materials to be studied impacts flashcard use. With regard to the last point, it may be that flashcards work best with certain types of questions, for instance, those requiring lower order thinking skills such as memorization of specific facts (see Anderson & Krathworthl, 2001). Furthermore, additional theoretical aspects of memory should be investigated. For example, does increasing the number of times students tested themselves with their flashcards provide greater support for the retrieval hypothesis? Finally, it will be important to examine whether there are other potential differences between students who do and do not use flashcards (e.g., test-taking ability, grade point average). It is clear that flashcards, a studying technique that students have used for many years, remains a common staple on college campuses, and that further research will be required to better understand its impact on student performance.

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