
STUDENT EXPERIENCES OF MAKING AND USING CHEAT SHEETS IN MATHEMATICAL EXAMS



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In many mathematics courses at school and university—including in all South Australian Year 12 mathematics subjects—students are allowed to make a “cheat sheet” to take into their exams. However, despite their widespread use, there is little research on the effect of making and using cheat sheets—whether on the students’ performance, learning or learning experience. As a preliminary stage in researching this issue, students in several first-year statistics courses at the University of Adelaide were surveyed on their experiences of making and using cheat sheets. The results and implications of this survey are discussed in this paper.

Introduction

This paper describes the preliminary stages in an investigation into the effects of using cheat sheets in mathematical exams. A “cheat sheet” in this context is a page of notes that students are allowed to make and take with them into their exam (also known as “crib sheets” or “crib notes”.) It is important to highlight the fact that they are not actually used to *cheat* because they are explicitly allowed by the instructions given to students.

Cheat sheets are common practice in many exams today. In South Australia, cheat sheets are allowed in the exams for every Year 12 SACE mathematics subject; and at the University of Adelaide at first-year level, six mathematics and statistics courses and several science and humanities courses all allow their students to make cheat sheets. These examples alone amount to literally thousands of individual cheat sheets being made every year.

Considering how widespread their use is, there is comparatively little research into the effects that making and using cheat sheets have, whether on the students’ performance in the exam, on the quality of their learning, or on their experience of learning and assessment. Therefore, educators are making decisions about whether to allow cheat sheets mostly without the benefit of existing discussion on the topic; and they give advice to students on how to make and use cheat sheets without really knowing whether the advice is actually helpful. This research is the first stage in beginning to fill these gaps.

Background and aims of the research

This research began when the lecturer for a first-year statistics course commented to us about the students' use of cheat sheets. The lecturer felt that students were not making the best of the opportunity to have a cheat sheet. So, we began to prepare a presentation for the students on how to make and use a cheat sheet effectively.

While preparing this seminar, we quizzed individual students on their experiences of cheat sheets, knowing that most of them had used cheat sheets in their Year 12 exams. The response was always, "I made a cheat sheet, but I didn't use it much in the exam. Still, I think making the cheat sheet helped me to revise, and reduced my exam stress."

As further preparation, we looked for existing resources giving advice to students on cheat sheets, as well as the results of previous research. Both were surprisingly difficult to find. The advice available online for cheat sheets was not directed at helping students learn, and more often was advice on how to actually cheat. Moreover, the previous research did not seem to come to a conclusion about the usefulness of cheat sheets, other than perhaps as a way of reducing exam stress. It also did not consider the issue of what advice might be given to students to maximise the possible benefits of their cheat sheets.

So we finally decided to begin researching cheat sheets ourselves. Based on our experiences with students and the gaps in the research literature, we decided to focus on the following questions for this preliminary research:

How common is the experience expressed to us by students? That is:

- How do students use their own cheat sheets?
- How useful do students find their own cheat sheets?
- Does making the cheat sheet help students revise and how?
- Does the cheat sheet help reduce exam stress and how?

The second question of exactly what advice should be given to students to help them use cheat sheets most effectively is a topic for future research.

Literature review

In the research literature there are several arguments both for and against the use of cheat sheets in exams. The first and most common argument in favour of cheat sheets is that they reduce exam stress. Davis (1993) and Erbe (2007) both advocate the cheat sheet for reducing exam stress, though do not put forward any new research of their own in support. Other authors have confirmed through interviews and questionnaires that having a cheat sheet reduces exam stress for the majority of their students (Trigwell, 1987; Drake, Freed & Hunter, 1998; Theophilides & Koustelini, 2000; Dickson & Miller, 2005). However, Dickson and Bauer (2008) do express the concern that students may study less comprehensively *because* they are less worried about their exam.

Another argument in favour of cheat sheets is that students, with their memory aided by the cheat sheet, will have more time and energy to focus on higher-order thinking skills such as understanding and interpretation (Erbe, 2007). Theophilides and Koustelini (2000) provided support for this argument when the students they surveyed reported study behaviours more consistent with a deep approach to learning when studying for an open-book exam. On the other hand, in a designed classroom

experiment, Dickson and Miller (2005) found that cheat sheets had no significant effect on performance in either lower-order or higher-order thinking items. If cheat sheets helped with memory and so allowed for more energy to focus on higher-order skills, one would expect them to affect performance on at least one type of question.

This leads to one of the arguments against cheat sheets, which is that they hinder the students by creating a dependency relationship, rather than helping them learn the course material *before* the exam. Dorsel and Cundiff (1979) and Dickson and Bauer (2008) have supported this argument by showing that students who prepare cheat sheets but are then not allowed to use them do not perform as well in the exam. Further evidence of this dependency is reported by Vessey and Woodbury (1992) who note that students tend to copy things straight from the cheat sheet even if it does not match the question. The hindrance may be worse for students already at risk: In an observational study on open-book exams, Boniface (1985) discovered that those students who continually need to refer to their notes during the exam are the ones who do not perform well.

The final argument presented is simply that performance improves when students use cheat sheets in exams, as reported by Francis (1982), by Skidmore and Aagaard (2004), by Stangl, Banks, House and Reiter (2006) and by Dickson and Bauer (2008). However other authors report no significant improvements (Dorsel & Cundiff, 1979; Trigwell, 1987; Dickson & Miller, 2005). Moreover, it is not at all clear whether it is the cheat sheet, the exam itself, or some other factor that is causing the change. For example, in the study by Skidmore and Aagaard (2004), the exams were on different aspects of the course involved, and it may be that one was more focussed on memory than the other.

Taking the existing literature together, a strong conclusion cannot be made about the usefulness of cheat sheets for performance or for learning. There is a clear need for more research to separate the different variables involved. We also note that the existing research concerns students studying psychology, teaching, English literature, nursing, and research methods. There does not seem to be any research explicitly dealing with cheat sheets for mathematics exams, which may be quite different. Finally, none of the articles reviewed mentioned ways of counteracting the possible negative effects of cheat sheets by giving students appropriate advice.

Research methodology

We felt that it was essential to collect preliminary data in order to inform future research in this area. To this end, we sought to survey students from those first year mathematics courses at the University of Adelaide that allow cheat sheets. Three courses in Semester 2 of 2010 were identified: one financial mathematics course, and two statistics courses offered by different schools within the university. All three courses are compulsory for students studying particular degrees. These courses will be called here FM, StatsA, and StatsB.

All three courses allowed students to bring a single A4 sheet with information on both sides, but each course had its own rules for the format. In StatsA, the cheat sheet had to be handwritten; in FM, students were allowed typed information as long as it was in 11pt font or larger; in StatsB, there were no restrictions on the format of the information.

It is important to mention that we agreed to give a seminar on how to prepare and use cheat sheets to the students in the course StatsA before beginning this research project, and feedback on the usefulness of the advice given was incorporated into the survey.

The questions in the survey contained both multiple choice questions and text response questions and asked students to comment on various experiences of making and using cheat sheets for their exam. Specific details of the actual questions are given in the results section below.

The online survey tool Survey Monkey was used to administer the anonymous survey. Students in the three courses were emailed a link to the survey on the day after each of their exams, with a reminder email was sent a week later. In total 1480 students were sent the link to the survey and 284 responded (a response rate of 19%).

The aim of this preliminary research is exploratory, and so the survey responses were analysed mainly using descriptive statistics. The themes from the text responses were noted, but no attempt was made at this stage to assess statistically the relationship between these themes and the other responses.

Results and discussion

Overall cheat sheet usage

The survey began with questions asking what course the student was enrolled in, and whether they made and then used a cheat sheet. A total of 284 students began the survey, and among these only two said they did not make a cheat sheet. Only nine of those who said they made a cheat sheet said they did not use their cheat sheet. Since the survey was voluntary, we cannot glean from this how many students actually do use cheat sheets.

Twenty-one students only answered these general questions and did not respond to any more of the survey, so these students have not been included in the totals for the remaining analysis.

The usefulness of cheat sheets

The following graph displays the results to the question “How useful did you find your cheat sheet during the exam?”

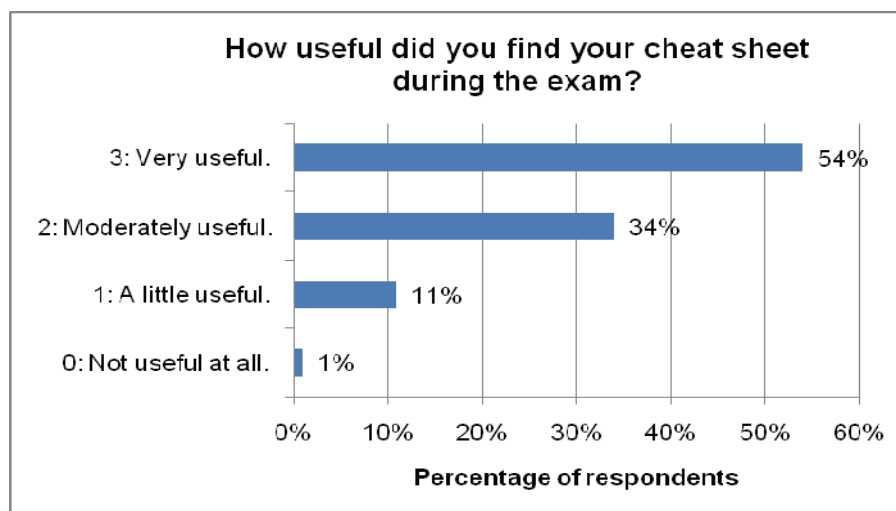


Figure 1. Responses concerning usefulness of cheat sheets.

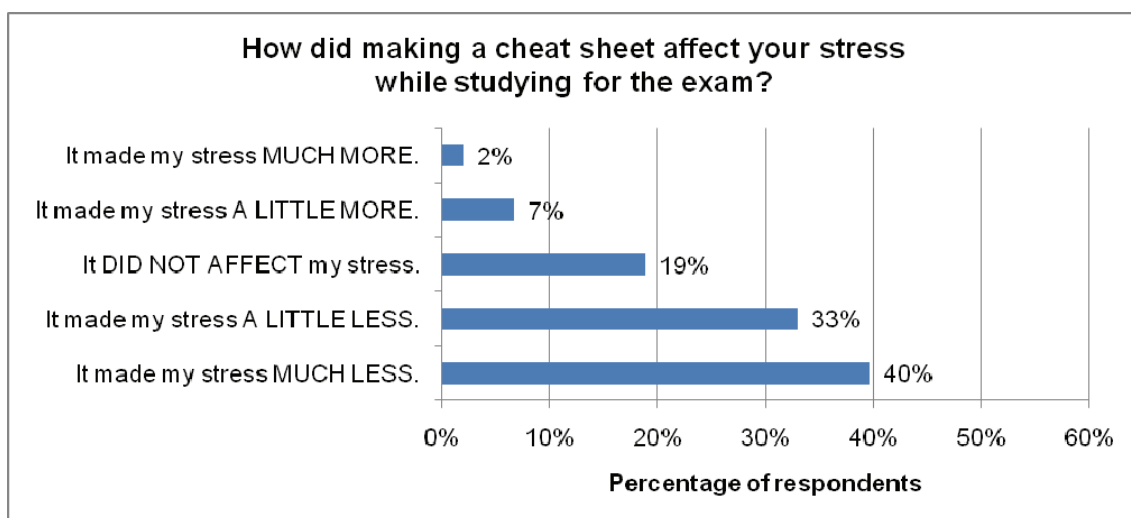
The majority of students found their cheat sheet useful in the exam, which is the opposite of what students have said to us in the past. A possible explanation is that the majority of students surveyed were studying introductory statistics courses, which tend to have a greater need to remember specific formulas and procedures than other mathematics courses.

We also asked students to explain more about why the cheat sheet was useful in order to gain insight into what might cause the increase or reduction of stress. Those who said their cheat sheet was not useful at all felt that they had not prepared properly for the exam. Those who said the cheat sheet was a little useful mainly commented that the majority of what they had put on the cheat sheet was not necessary for their exam. Those who said the cheat sheet was moderately useful mainly said this was because they had formulas on the cheat sheet. Many of these students explained that it was not “very useful” because most of the information they included was irrelevant, because they were able to remember the information anyway without the cheat sheet, and because they left important information off the cheat sheet. Finally, those who said the cheat sheet was very useful said this was because it had formulas, definitions, procedures and examples. Many also commented that it was useful because it helped them to study.

Overall these comments indicate that students have different definitions of what usefulness is, and indeed, what a cheat sheet *should* be useful for. It seems many students believe that they should be referring to the cheat sheet constantly because the exam will require them to regurgitate a lot of information. This does seem to reflect a surface approach to learning as reported by Trigwell (1987), and also an interaction with the perceived usefulness of cheat sheets and the style of exam. Other students see it as merely an aid to the memory of specific details and so are pleased when it does exactly that.

The effect of cheat sheets on stress

The following graphs display the responses from the two questions, “How did having a cheat sheet affect your stress during the exam?” and “How did making a cheat sheet affect your stress while studying for the exam?”



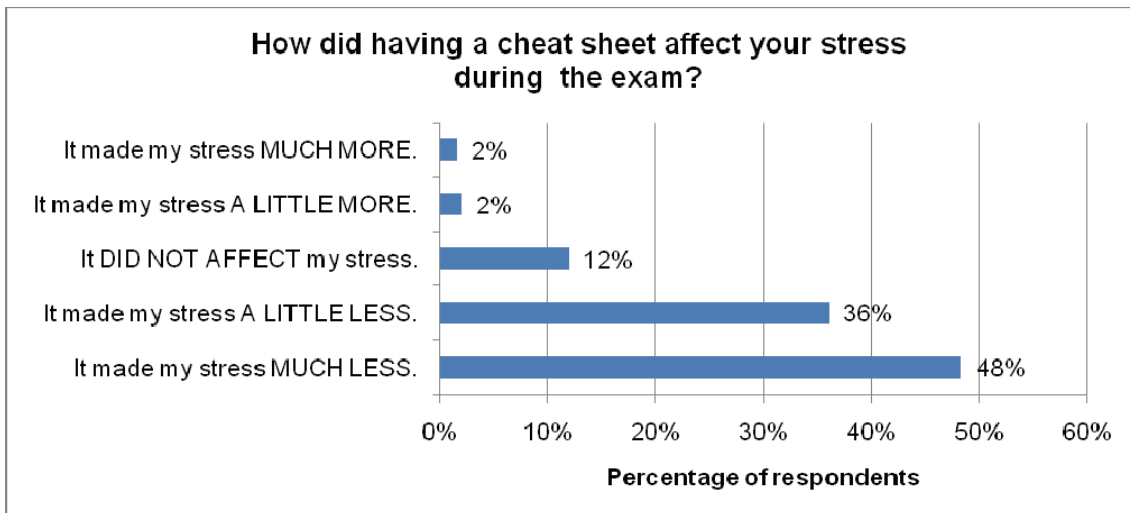


Figure 2. Responses concerning the effect of cheat sheets on exam stress.

According to these two sets of responses, most students do find that their cheat sheet reduces the stress associated with their exam, as described in the literature (Trigwell, 1987; Drake, Freed & Hunter, 1998; Theophilides & Koustelini, 2000; Dickson & Miller, 2005; Dickson & Bauer, 2008). However, it is important not to discount the 9% of students who said that making a cheat sheet actually *increased* their stress while studying—students who might need extra support in order to succeed.

The students were also asked to comment on how the cheat sheet had this effect on their stress. By far the most common reasons given for reductions in stress both before and during the exam were that the cheat sheet increased the students' confidence, or meant they did not have to worry about forgetting things. Almost as many students said the cheat sheet reduced stress before the exam because it encouraged them to study. Some elaborated further saying that the cheat sheet provided them with a way to organise their thoughts and figure out what they really needed to understand, showing that they were using it as an opportunity to take a deeper approach to learning, as reported by Theophilides and Koustelini (2008).

The students who said that the cheat sheet did not reduce their stress most often cited that they had trouble deciding what to put on the cheat sheet and were afraid of leaving something out. They also related how they panicked during the exam when something was *not* on their cheat sheet. These students appeared to believe the cheat sheet should tell them everything they needed to know, rather than merely support their memory of details. Some other students were overwhelmed by having to make a cheat sheet as well as study. This is particularly interesting when compared to the students who used the cheat sheet as tool to *help* them study, and may mean that coaching in study skills is necessary if cheat sheets are to be allowed.

The different uses of cheat sheets

A separate question on the survey asked students to describe how they used their cheat sheet. Almost every respondent said they used their cheat sheet for formulas, for lists of assumptions with hypothesis tests, for exact definitions, or for steps in specific procedures. This indicates that students are using the cheat sheet as an aid to memory of facts in order to help apply the concepts they had learned. A large number of students,

however, did comment that they had put fully worked examples on their cheat sheet, or even a whole past exam. They describe reading their exam and looking for similar questions in the examples on their cheat sheet, then copying the working with the new words and numbers. This indicates that these students are merely trying to pass the exam, rather than learn the concepts at all. That is, the students are again using a surface approach to learning. We wonder how many of these students merely copied something even if it did not match, as described by Vessey and Woodbury (1992).

Finally, many students also recounted referring to the cheat sheet for inspiration when they felt confused or stuck. Some commented that they were inspired by things that they put on the cheat sheet for a different purpose, but somehow it formed the connection in their mind. This may support the idea that the creation of the cheat sheet in fact does help students to draw connections between ideas in the course.

Conclusion

Using the results of our survey, we have explored the experience students have of using cheat sheets in mathematical exams. Some students used their cheat sheet as a catalyst for organising and understanding the concepts in their course, while others took a surface approach and used it as a way to *avoid* understanding. Most said it reduced their stress, but some were overwhelmed by it. Finally, most students found their cheat sheet useful, but each appeared to define differently what useful was, depending on their expectations of how cheat sheets could help them.

The respondents are a small subset of students from three particular courses at one university, and as such, the results may not generalise well to other students. However, we feel that one conclusion is clear: different students react differently to the opportunity to make and use a cheat sheet in an exam. Hence, it is unwise to generalise.

Further research is needed into how students go about creating and using cheat sheets, and the effects that these have on their learning and performance. The first stage of this will be to widen the range of mathematical disciplines that we survey in our exploration. After this, future research could include observation of students in actual exams, as well as designed experiments to separate various variables involved. We also feel that future research needs to focus on how those students with negative attitudes and habits can be encouraged to take a more positive approach to the opportunity of using cheat sheets.

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