Using teaching activities to improve students' preparation for classes

TLHE 2019/20 course project

Steven Blurton

Motivation

Attending classes unprepared is a major obstacle for achievement in higher education. It has consistently been estimated that less than a third of students in introductory courses complete the assigned readings before class (Burchfield & Sappington, 2000; Chump, Bauer, & Bradley, 2004). A lack of preparation is associated with poorer class discussions, less efficient use of teaching time, and a worse performance in the exams (Heiner, Banet, & Wieman, 2014).

A major focus in the past has been on the importance of preparation in form of reading textbook chapters before attending class. It has been well documented that most students do not finish their reading assignments before coming to class (Burchfield & Sappington, 2000). On the other hand, it has been shown that students perform better at exams if they frequently and continuously read before class (Johnson & Kiviniemi, 2009). It is also apparent, however, that although the problem has been consistently identified in several studies, the lack of reading before class is largely overlooked in studies investigating determinants of achievement in higher education (e.g., Schneider & Preckel, 2017). This is even more surprising if one considers that a lack of preparation is also connected to skipping classes, which in turn is among the strongest predictors of academic achievement (Schneider & Preckel, 2017).

Given the importance of preparation before class, several strategies have been tested in their effectiveness to increase students' preparation before class. Employing quizzes has received particular attention in the past (Clump, Bauer & Bradley, 2004) and its effectiveness has brought some to recommend using pre-class quizzes or unannounced surprise quizzes to motivate students to read the assigned textbook chapters (Burchfield & Sappington, 2000; Johnson & Kiviniemi, 2009; Marcell, 2008; Sappington, Kinsey, & Munsayac, 2002).

The aim of my project was three-fold: First, I wanted to investigate whether other forms of in-class activities (i.e., apart from quizzes) are also effective in increasing the students' time spend on preparation. Secondly, since there are no formal requirements in my classes (not even attendance is compulsory), I was interested in whether the strategies also work in absence of any external pressure to prepare. Finally, many studies used observational designs leading to incidental evidence, rather than establishing a causal relationship between activities and preparation behaviour.

In this project, I evaluated the success of two different strategies to motivate reading before attending classes. In one group, frequent class activities took place, which required some amount of preparation before class because they were scheduled early in class (i.e., within the first 30 minutes). Instead of using quizzes, which are difficult to align with the intended learning outcomes of this course (see appendix), I chose group work and plenum discussion as activities. In another group, preparation was less important, for the same activities were only employed later in class so that students could use newly learned content to participate in those activities. In a third group, there were no activities that required reading prior to attending class. The primary variable of interest was the self-reported *number of hours spent on preparation*—that is, reading textbook chapters or articles announced as reading assignments in the week before.

Methods

The project was designed as a randomized two-arm study, conducted with my two classes (Group 1 and Group 6) in Cognitive Psychology at the University of Copenhagen in the fall semester of 2019. The intervention was class activities that required at least some reading of the relevant parts of the pensum prior to the classes. Assignment to the two groups was performed by the study administration (probably at random) and the selection which group received the intervention was determined by a coin toss. Teaching in Group 6 involved class activities that required reading, whereas teaching in Group 1 involved the same activities later in class, so that students could use knowledge gained in class to participate in those activities. Class activities included, for instance, discussions on selected topics, creating a mind map of a textbook chapter content, or group work (e.g., applying theories to data). Particularly the group work was expected to raise students' willingness to prepare due to the social pressure to be able to contribute to a small peer group.

However, the study design was changed after the first assessment of preparation behaviour because the first assessment provided evidence for possible ceiling effects; that is, the group selected for

intervention already reported a high amount of preparation prior to the intervention taking place. To accommodate for this, preparation behaviour of an additional third group was assessed and the intended control group (Group 1) received the treatment after the midterm evaluation (in Week 7).

In addition to the primary variable of interest, several additional items were included in the questionnaires. The students were asked to rate these items on a scale of 1 to 5 (1: “do not agree”, 5: “completely agree”). The items assessed: (i) feeling well prepared for class, (ii) perceived benefit of reading prior to class, (iii) personal preference for reading *after* class, (iv) feeling of spending enough time on preparation, (v) appraisal of time pressure. Items (iii) and (v) were dropped after the first assessment due to floor and ceiling effects, respectively. They were substituted in Assessments 2 and 3 for two different items that assessed (vi) the perceived effectiveness of own preparation, and (vii) the influence of getting closer to the exam. There were no clear hypotheses regarding any of those items; they were merely included to gain some additional, exploratory insight into preparation behaviour.

The relevance of preparation for reaching the intended learning outcomes was assessed by comparing the grades of the two groups in the final oral exam. The data was collected anonymously and participation in the study was completely voluntary. The students were naïve regarding the research question.

Results

Primary outcome

While the three groups were largely similar across other items on the short questionnaire, they substantially differed in the primary dependent variable: the amount of time spent on preparation. The three groups differed in their self-reported time spent on preparation at the beginning of the semester (T0, see Table 1). The intervention group (Group 6; n = 23) reported more time spent on preparation than the intended control group (Group 1; n = 29). Even though this difference is not significant ($T(39) = 1.564$, $p = .143$), I changed the study design to include a third group (n = 27), taught by a different teacher. This was done for two reasons: (i) checking which of the two groups was more alike the other teaching classes and (ii) to administer the intervention in the intended control group (Group 1) after the midterm evaluation.

With these additional data, it seems that Group 1 was more like the other groups, whereas time spent on preparation was indeed quite high in Group 6 at the beginning of the semester (T0). This made it

necessary to administer the intervention to the intended control group (Group 1), because even if it were successful, the intervention might not have increased the time spent on reading in Group 6.

Table 1. Average time (in hours, ±SD) spent on weekly preparation.

	Group 1	Group 6	Control Group
Assessment:			
Week 2 (T0)	6.8 (5.5)	**9.9 (6.9)**	5.6 (3.7)
Week 7 (T1)	**4.7 (2.8)**	9.8 (7.6)	—
Week 13 (T2)	4.5 (4.7)	2.7 (2.6)	2.7 (4.3)

Note—Bold numbers indicate the last assessment in each group before the intervention. Group 1 is the intended control group (received intervention from Week 8 on), Group 6 is the intervention group (received the intervention from Week 3 on).

From the initial assessment, the self-reported time spent on preparation dropped in all groups over the course of the semester. The amount of preparation was particularly low in the last week (T2). This was due to reports to be handed in in this week and an exam in another course, so that the students' ability to spend time on preparation was severely limited in this week.

After the initial drop of preparation time in Group 1, I adjusted this group's in-class activities by implementing the same activities at the same time (in class) as they were held in Group 6. The control group remained unchanged. An Analysis of Variance (Tabachnick & Fidell, 2014) with the factor *intervention*, controlled for the extra time pressure at the last assessment (i.e., an extra factor for this time point) yielded a significant effect (reduction of time spend) at the last time point ($F(1,131) = 20.234$, $p < .001$, , $\eta_p^2 = 0.134$), but not for the intervention ($F(1,131) = 2.914$, $p = .090$, $\eta_p^2 = 0.022$). Their interaction effect was also not significant ($F(1,131) = 0.823$, $p = .366$, $\eta_p^2 = 0.006$). Corrected for the dip in time spent on reading in the last week, students spent 4.8 hours [$CI_{0.95}$: 3.6—5.9] on average on preparation with no in-class activities or in-class activities at a later time that required no or little preparation, whereas with activities early in class, students spent 6.7 hours [4.8—8.6] on average on preparation (Figure 1). Thus, there was a positive effect of the type of activities, but this

effect was not large enough to attain statistical significance in the rather small sample included in this project.

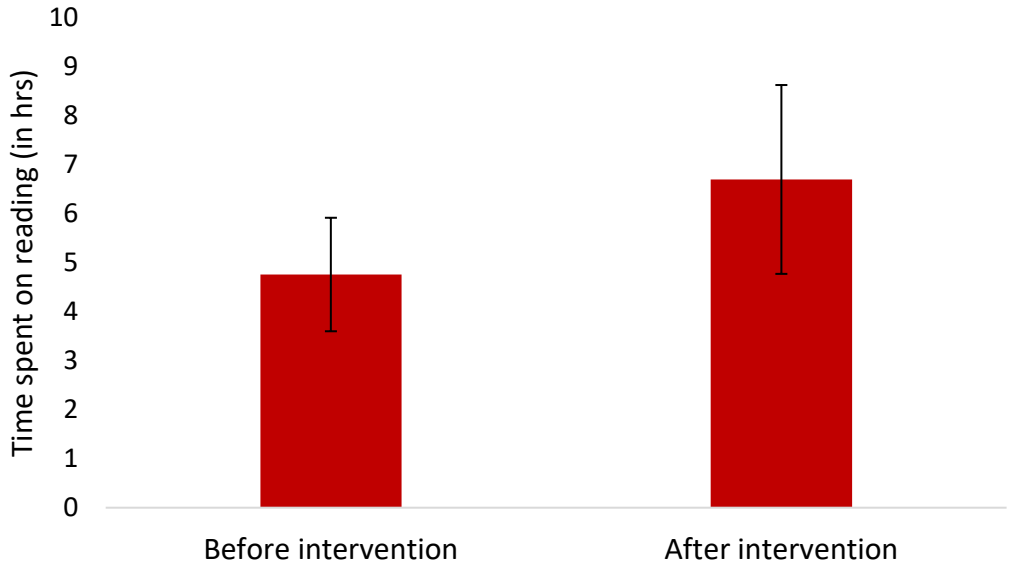

Figure 1: Average (± 95%-CI) time spent on reading before and after the intervention, corrected for the decline at the last assessment (T2).

Similarly, there was a difference in the average exam grade between the groups: In Group 1, students attending the exam received an average grade of 7.27, whereas the average grade in Group 6 was 8.53 (both on the Danish 7-grade scale). Thus, students in the group that spent more time on reading received better grades, on average, than students in the group which reported less time spent on reading. This connection between reading behaviour and grades is merely correlational, of course, but it is in line with prior studies that showed positive effects of preparation on exam grades (Heiner, Banet, & Wieman, 2014).

Secondary outcomes

This section contains analyses of the additional items included in each questionnaire (see Methods). All these items were answered on a scale of 1 to 5 (1: “do not agree”, 5: “completely agree”).

In all three groups, students overwhelmingly reported a lack of time for preparation: students scored an average of 4.4 (SD: ± 0.85) on this item (Figure 2). Thus, most students report that they would spend more time on preparation if they had more time available. It seems clear, therefore, that a lack of

preparation is largely influenced by extraneous factors that are not under the control of the teacher (or the student).

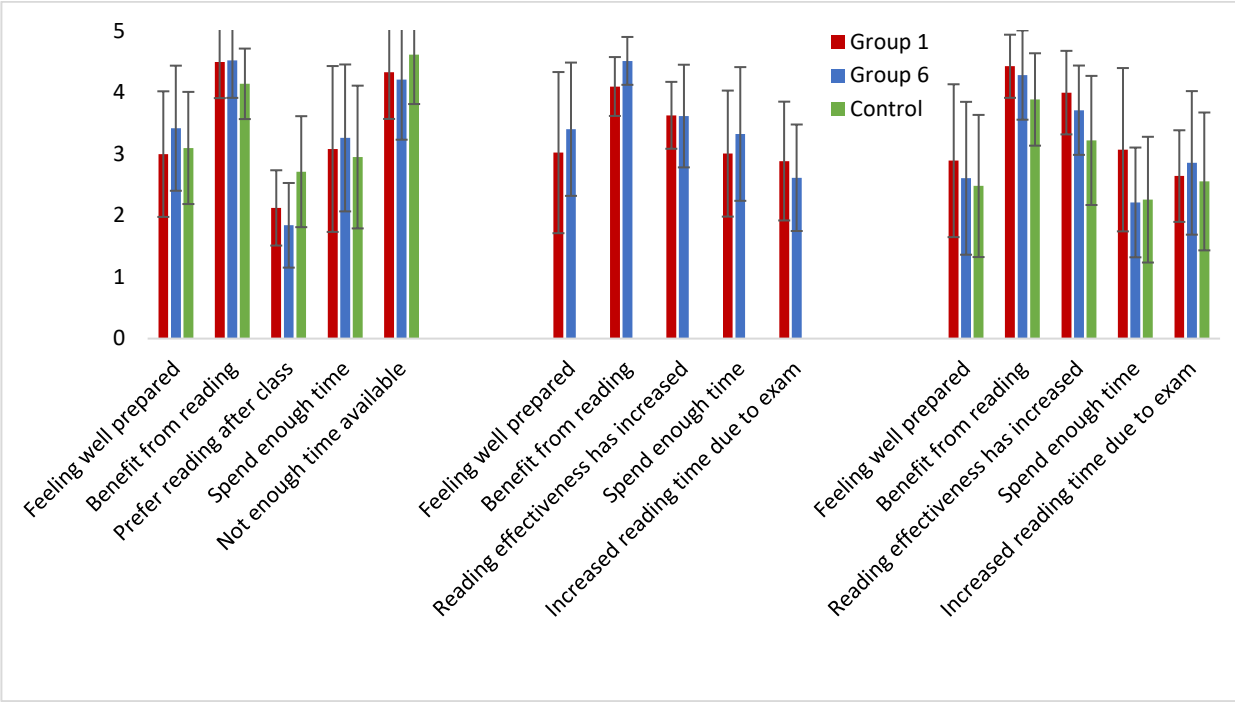

Figure 2: Average responses (± SD) to additional questionnaire items in the different groups and at different time points (Assessments 1 to 3 from left to right). Group 1 is the intended control group (received intervention after the second assessment), Group 6 is the intervention group (received the intervention after the first assessment).

Most students also perceived the benefits of preparation prior to class. Irrespective of group membership most students agreed with the statement "I benefit more from attending classes if I am well prepared" at the beginning of the semester (mean: 4.4 ± 0.61). The agreement stayed on that high level in the two groups with intervention until the end of the semester (Group 6: 4.4 ± 0.73, Group 1: 4.3 ± 0.51), however, the agreement dropped slightly in the control group (mean: 3.9 ± 0.75). Thus, there seems to be no lack of attitude, adding to the conclusion that a perceived lack of time is a major cause of spending less time on preparation than necessary.

The temporal proximity to the exams did not play a role: The influence of exams on the own reading behaviour was judged similar at Assessment 2 (2.9 ± 0.92) and Assessment 3 (2.8 ± 1.04). Only few

reported that they preferred reading after class (2.2 ± 0.81). The perceived effectiveness of the own preparation increased minimally from Assessment 2 (3.8 ± 0.67) to Assessment 3 (mean: 3.9 ± 0.94).

The correlation of the subjective impression of 'feeling well prepared' and the time spent on preparation increased from 0.388 (Group 1) and 0.505 (Group 6) to 0.533 (Group 1) and 0.716 (Group 6), meaning that the students' perceived level of preparation more closely matched their actual preparation behaviour over time. This demonstrates the potential of future studies if it was possible to analyse individual study behaviour to control for the considerable variation across students.

Discussion

Activities such as quizzes have a positive effect on students' preparation for class (Burchfield & Sappington, 2000; Johnson & Kiviniemi, 2009). In this study, I investigated the effectiveness of a broader set of class activities, such as plenum discussions or group work. The results show that these activities have a beneficial effect on reading time too, however, this effect was not statistically significant. It might therefore be advisable to confirm the results reported here in a follow-up study with a larger sample. In this study, I have chosen class activities that are closely aligned with the intended learning outcomes in the course, which I felt would have been difficult using quizzes only. The initial research hypothesis was that the mere timing of these activities would have a beneficial effect. Although this cannot be concluded for sure from the current results, it may have been a contributing factor.

As can be seen in Table 1, planning the activities early in class kept preparation on the high level in Group 6, whereas the same activities later in class led to a decline in the amount of preparation. In this context, early class activities induce more "learning between classes" (Rienecker, von Müllen, Jørgensen, & Ingerslev, 2013). According to this view, it is critical to note that most of the time that can be used for learning occurs between classes, not in class, so it is vital to use this time effectively to increase academic achievement and to reach intended learning outcomes. Completing reading assignment is then just one of many forms of student learning between classes.

If this indeed holds true, scheduling planned activities early in class may have additional positive effects that, even if they are rather small, require no additional time spent from the teachers to prepare for the classes. It should also be noted, though, that learning between classes is limited by the amount of time available to the students. According to the students in this sample, time available for studying between

classes is severely limited, restricting the amount of time spent on learning between classes—even if students wish to spend more time on preparation[1].

Limitations:

Although it was possible to follow advisable rules for testing effectiveness of an intervention, important details had to be neglected, mostly for practical purposes.

1) Data was collected anonymously due to privacy concerns, so that the preparation strategies could be evaluated on group level only. This means that variation cannot be attributed to individuals (within-subjects-design), leading to a substantial loss of statistical power[2].
2) No power calculations were performed prior to the study because the number of students in the study was constrained by practical limitations (i.e., classes assigned to me by the study administration). This number was quite low, so the study is likely underpowered.

Summary

The results of this project point to some effectiveness of class activities on time spent on preparation prior to attending class. Such activities increased the time spent on preparation by about 2 hours per week. This effect was not statistically significant, possibly due to the study being underpowered. It seems advisable, therefore, to include such activities to increase the time spent on preparation prior to attending class. It should also be noted, however, that the overall time pressure that is frequently reported by the students seems to be a big obstacle preventing students wishing to spend more time on preparation to do so.

References

Burchfield, C. M., & Sappington, J. (2000). Compliance with required reading assignments. *Teaching of Psychology,* **27**, 58–60.

[1] Assuming a working hour equivalent of 27.5 h/ECTS means that the entire course (20 ECTS) corresponds to a full-time job for 14–15 weeks. Put differently, a 30 ECTS semester corresponds to about 56 working hours per week.
[2] Broadly speaking, the statistical power of a study refers to the probability of obtaining a statistically significant result if there is indeed an effect. Power depends on sample size and effect size, amongst others.

Clump, M. A., Bauer, H., & Bradley, C. (2004). The extent to which psychology students read textbooks: a multiple class analysis of reading across the psychology curriculum. *Journal of Instructional Psychology*, **31**, 227–232.

Heiner, C. E., Banet, A. I., & Wieman, C. (2014). Preparing students for class: How to get 80% of students reading the textbook before class. *American Journal of Physics*, **82**, 989–996.

Marcell, M. (2008). Effectiveness of regular online quizzing in increasing class participation and preparation. *International Journal for the Scholarship of Teaching and Learning*, **2**, Article 7.

Rienecker, L., von Müllen, R., Jørgensen, P. S., & Ingerslev, G. H. (2013). Aktiviteter i og uden for undervisningen. In: P. S. Jørgensen, L. Rienecker, J. Dolin, G. H. Ingerslev (Eds.), *Universitetspædagogik* (pp. 229–250). Frederiksberg, Denmark: Samfundslitteratur.

Sappington, J., Kinsey, K., & Munsayac, K. (2002). Two studies of reading compliance among college students. *Teaching of Psychology*, **29**, 272–274.

Schneider, M. & Preckel, F. (2017). Variables associated with achievement in higher education: a systematic review of meta-analyses. *Psychological Bulletin*, **143**, 565–600.

Tabachnick, B. G., & Fidell, L. S. (2014). *Using multivariate statistics* (6th International Edition). Essex, UK: Pearson.

Appendix A: Intended learning outcomes

From: UPCH course catalogue

Kognitionspsykologi teori og metode

Målbeskrivelser

Efter endt kursus skal den studerende:

Viden

- kunne redegøre for og have indsigt i udvalgte kognitionspsykologiske teorier, begreber og empiriske undersøgelser i artikler
- kunne demonstrere kendskab til udvalgte kognitionspsykologiske metoder og empiri, deres styrker og svagheder relateret til deres udsagnskraft

Færdigheder

- kunne identificere centrale elementer ved den udvalgte kognitionspsykologiske litteratur, herunder grundbøger og udvalgte forskningsartikler
- kunne analysere kognitionspsykologiske teorier og metoders fordele og begrænsninger, med henblik på deres mulige anvendelse og generaliserbarhed

Kompetencer

- kunne udføre kognitionspsykologiske eksperimenter og undersøgelser under anvendelse af kognitionspsykologiske metoder
- kunne vurdere og selvkorrigere eget metodisk-empirisk arbejde i lyset af metodens foreskrevne principper, genstandens egenart og etiske rammer