ASSESSING THE IMPACT OF IN-CLASS LAPTOP USE ON STUDENT PARTICIPATION AND PERFORMANCE

Bogdan Daraban
Shenandoah University
USA

Abstract

In recent years, laptop use in the college classroom has become a topic of intense debate in the academic community and not only. While the consensus is that the learning process can greatly benefit from the use of technology, not everyone agrees that Internet connected laptops in the classroom are beneficial (Fried, 2008). In this paper, I use a unique panel data set to measure the impact of laptop use in the classroom on student learning and participation. Although estimation results indicate that both measures are negatively affected by laptop use, I conclude that laptop use policies should be based on careful cost-benefit analyses.

Introduction

The increasing number of institutions of higher education implementing ubiquitous laptop initiatives has led to the widespread use of laptop computers by college students (Brown, 2011). While the consensus is that the learning process can greatly benefit from the use of technology, not everyone agrees that Internet connected laptops in the classroom are beneficial (Fried, 2008). As a result, a wide range of practices can be observed across institutions and across faculty, in terms of laptop computer use in the classroom. For example, according to a recent article in *The Washington Post*, laptops have been banned in classrooms at George Washington University, American University, College of William and Mary, and the University of Virginia. At other institutions it is left to individual instructors to decide what the appropriate use of laptops is (de Vise, 2010). Laptop policies implemented by individual faculty, range from banning laptops altogether, to freely allowing them, with some allowing laptop use only during designated times (Neil, 2010).

The main concern of the critics of laptop use in the classroom is that it is distractive and it reduces student engagement and therefore performance. In addition, anecdotal evidence and student surveys (Fried, 2008) reveal that the learning process can be disrupted for fellow students seated in the proximity of laptop users. Despite the important pedagogical implications, as noted by Fried (2008), the debate has been mostly playing out in the popular media and not in the academic journals. Most papers discuss different approaches to embedding

laptops into the classroom (Barak, Lipson, & Lerman, 2006; Hall & Elliot, 2003; Hyden, 2005; Pargas & Weaver, 2005; Weaver & Nilson, 2005) or use subjective measures of performance such as student perceptions, engagement, motivation or faculty-student interactions (Demb, Erickson, & Hawkins-Wilding, 2004; Driver, 2002; Trimmel & Bachmann, 2004). However, very few tackle the most important question: What is the effect of laptop use on learning? The reason can be found in the difficulty posed by the empirical estimation of this effect. For example, Granberg and Witte (2005) and Wurst, Smarkola, and Gaffney (2008) find no statistical difference between the overall grades for laptop and non-laptop classrooms or cohorts. However, using aggregate level metrics for laptop use, rather than student-level use, can mask the real effects at work. Other researchers were able to obtain individual student-level data by asking students to self-report information on laptop use in the classroom. Fried (2008) found that not only did laptop use negatively affect student learning as measured by the course grade, but also the learning environment and the self-reported understanding of course material suffered. As Fried (2008) also recognizes, the self-reported nature of the data could have biased the results. Truman (2005) was able to mitigate this shortcoming by recording students' laptop activity through a computer monitoring software operating in stealth mode. Using regression analysis methods, he found that laptop use unrelated to the classroom is negatively correlated with grades in the IT component of the exam, but no significant effect for the management component of the exam was found. In order to remove the potential omitted variable bias in the regression estimates, both Fried (2008) and Truman (2005) needed to control for student characteristics that are correlated with learning outcomes. Such control variables include gender, learning style, intelligence and motivation, and other latent variables that are hard or impossible to observe. Certain instruments such SAT scores can be used to capture students' innate ability, but clearly these are imperfect and as a result causality can be hard to establish.

In this paper, I describe a new methodology that makes it possible to empirically answer the question of how student laptop use in the classroom affects student learning and participation. As explained in the next section, this method circumvents the limitations of the existing research, by making use of panel data estimation techniques.

Research Methodology

The study involved 45 students enrolled in a one-semester undergraduate introductory course in Economics. At the time when the data were collected, the institution did not have in place a ubiquitous laptop program, but one was rolled out in the following year. However, business students, who made up approximately two thirds of the class, were required to own a laptop computer. The course was mostly lecture based and access to Aplia was a requirement. Aplia is an online learning environment that provides students with active learning

modules such as live economic experiments, animated math tutorials and exercises, news analysis exercises, and student blogs for course work. In addition, students have access to the electronic version of the textbook. The technology provides an integrated online teaching and learning environment that allows active learning through student direct participation in the learning process, as well as interaction with their instructor and peers. Aplia assignments were worth 20% of the grade which ensured that all students had purchased the package. In order for students to participate in the online experiments which were run in the classroom, students had to use laptops. Other than that, laptop use in the classroom was not a requirement. In fact, the instructor repeatedly asked students to refrain from using laptops for purposes other than note taking or viewing lecture slides.

Over the course of the entire semester, when taking attendance, the instructor recorded whether each student had an open laptop in front of her. For 17 of the lectures given during the semester, students were tested on the material that had been presented in class, by using a personal response system (clickers). That way a unique longitudinal panel data set was constructed with observations on whether, for each of the 17 sessions, students had used a laptop computer during the lecture, how many questions they had answered (as a measure of classroom participation) and how many they had answered correctly (as a measure of learning). In general, attendance was taken 15–20 minutes into the lecture to ensure that students had settled into their usual classroom time routine.

The value of this panel data resides in the opportunity to link student participation and learning in the classroom to whether they had used a laptop computer during the lecture, by estimating the following fixed effects models:

$$\%\text{Correct}_{st} = \alpha_s + \delta_t + \beta_1 \cdot \text{Computer}_{st} + \varepsilon_{st} \quad (1)$$

$$\%\text{Attempted}_{st} = \alpha_s + \delta_t + \beta_1 \cdot \text{Computer}_{st} + \varepsilon_{st} \quad (2)$$

where the dependent variables are the percentage of questions that student *s* answered correctly in session *t* and the percentage of questions that student s answered in session out of all questions asked in session *t*. $Computer_{st}$ is a binary variable equal to one if student *s* used a laptop during the lecture given in period session *t*. α_s are student fixed effects that control for student characteristics that are hard to observe or measure, and that do not change over the relevant time period. δ_t are time fixed effects that control for variables that change over time but not across students (e.g., the degree of difficulty of each lecture).

Data and Estimation Results

Since not all students were present for all sessions during which data were collected, the data set obtained is an unbalanced panel with the time dimension T

= 17 and the sample size N = 45. Out of all 604 student-session observations, the laptop computer was used in 38.7% of the cases. In order to have enough variation in the pattern of laptop use by individual students, with 5 weeks left into the semester, the instructor banned the use of laptops in the classroom. On average, for all sessions, students answered correctly 61% of the questions asked, and attempted 78%.

Estimation results, presented in Table 1, indicate that, after controlling for student characteristics and lecture difficulty, on average, a student who used the laptop in the classroom had a lower score than a student who did not use the laptop by almost seven percentage points. The magnitude of this estimate is statistically significant but also relevant because it represents a drop by two letter grades. Moreover, the percentage of questions attempted was reduced as well by almost 5% indicating that laptop use can actually reduce student engagement.

Table 1: Time and Student Fixed Effects Estimation Results for Performance and Participation

	Percentage of correct answers	Percentage of questions attempted
Computer	-6.75*	-4.62*
	(2.46)	(2.06)
	[2.74]	[2.23]
	N*T=604	N*T=604

* - significant at the 5% level

Conclusions

The current study confirms the hypothesis that laptop use in the college classroom can be detrimental to learning outcomes. The panel nature of the data analyzed makes it possible to clearly identify a causal negative relationship from laptop use to student learning. This methodology that incorporates variation across students and across time obviates the need for imperfect instruments that attempt to measure student latent characteristics.

The implications of this study should be evaluated in the context of the limitations that apply to this kind of research, as identified by Fried (2008). First of all, the results are not applicable where laptop use in the classroom is essential to achieving the learning objectives for the course. For example, in a Statistics course where students are learning how to run regressions by using specific software, the benefits of using laptops is most likely greater than the costs imposed by illegitimate use. Another limitation specific to the current study is the fact that student learning was measured by testing students the very day of the lecture. Therefore, it could be argued that the results apply mostly to learning in

the classroom as opposed to outside the classroom. While it is conceivable that students can fill the gaps by studying on their own, most likely, the performance measure that I use is correlated with overall learning by the end of the semester.

Despite these results, I firmly believe that laptop technology both in and outside the classroom remain a great learning tool. I recommend that laptop use policies should be based on a careful cost-benefit analysis. While this analysis can take place at the institution level, one-size-fits-all policies are most likely to be inefficient, and therefore individual instructors should be able to decide for themselves. For that, we need to have a good understanding of both sides of the ledger. The current research shows how, albeit in a specific setting, the cost side can be estimated.

Surprisingly, the issue of laptop use in the classroom seems to be currently more intensely debated in the popular media, than in the academic journals. Hopefully, these findings will help reignite the discussion among those who are most directly affected.

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