Notebook or Facebook? How Students Actually Use Mobile Devices in Large Lectures

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Abstract. In many lectures students use different mobile devices, like notebooks or smartphones. But the lecturers often do not know to what extent students use these devices for lecture-related self-regulated learning strategies, like writing notes or browsing for additional information. Unfortunately mobile devices also bear a potential for distraction. This article shows the results of observational study in five standard lectures in different disciplines and compares it to students' responses on computer use in lectures. The results indicate a substantial divergence between students' subjective stances on how they use mobile devices for learning in lectures and the actual observed, often lecture-unrelated behavior.

Keywords: Lectures, mobile devices, media use.

1 Mobile Devices – Learning Opportunities or Distractions?

More and more students use mobile devices in lectures, either actively, i.e. for writing something down, or passively, i.e. with the mobile device being switched on and stared at, but without any other notable human-machine interaction. To what extent using mobile devices in lectures fosters learning is highly debated. On one hand, mobile devices could support students in their self-directed learning [1] as students get the chance to search for answers or to take notes on the slides. On the other hand, there is a chance of distraction, when students use the mobile devices for lecture-unrelated activities like posting on Facebook or sending Emails to friends [2, 3].

Unfortunately, lecturers do not know what their students use the mobile devices for since their screens are too small to observe or turned away from the teacher. With very little research on this issue there is hardly any understanding on whether notebooks should be allowed, banned or more actively integrated into lectures. To reduce distraction and to make full use of enhancing learning experiences in lectures through notebooks, gathering information on "lecture-related" and "lecture-unrelated" activities with notebooks seems an important first step.

In this article, we discuss general principles of active learning and how technologies can foster those principles in lectures before taking a look at how students actually use mobile devices in lectures and what students think or say they do with mobile devices in large lectures.

2   Active and Self-directed Learning

The lecture format is often criticized for fostering passive behavior and for being inapt for maintaining student focus [4]. Findings of lecture research show that students are required to listen and make notes most of the time [5]. Ideally, students engage in a series of cognitive and metacognitive activities in a focused and active way [6], such as processing and linking what is being taught to prior knowledge, elaborating the learning material with examples, taking notes and monitoring these learning activities to ward off distractions and to continuously examine one's understanding [7]. But, there are also other, lecture-unrelated activities like talking to the neighbor, doing homework or sleeping which can be observed in lectures. Students sometimes have difficulties to identify and focus on the most important aspects of a lecture [7]. Especially students with little prior knowledge and dysfunctional learning strategies find it hard to continuously focus on the most important aspects of a 90 minute lecture.

There is a chance that mobile devices increase that problem and distract students. Both, passive and active use of mobile devices may consume learners' cognitive resources and draw attention away from what is being taught. Passive use may convey stimuli that "catch the eye"; active, lecture-unrelated use may indicate that learners are pursuing other goals than learning [8]. Even with the intention to use the notebook for learning purposes there is a chance that part of the students' attention is consumed by online activities, e.g. by visual indicators of friends being online. So, in order to ignore or minimalize the effects of these kinds of distractions, it seems important to know how students monitor their own learning [e.g. 9, 10].

3   Mobile Devices to Foster Learning in Large Lectures

Mobile devices could foster self-regulated learning, but advanced technology is often paired with simplistic pedagogical models [11]. There is a risk that students use their mobile devices for lecture-unrelated activities and therefore attempt to multitask during the lecture. Based on the idea that the primary task in lectures is to process new information, multitasking here means to apply some of the cognitive resources to additional tasks. As the working memory is limited, lecture-unrelated multitasking in particular could have a negative impact on learning [12].

Fried [2] tested 137 psychology students over 20 lecture sessions with surveys regarding their use of notebooks in class and distraction in lectures and compared them with the results of the American College Test (ACT) and high-school rank (HSR). Her goal was to show that multitasking distraction by notebooks during lectures would lead to lower learning results in the standardized tests. Almost two thirds of the students (64.3 %) reported to use their computers at least once during the sessions and multitasked an average of 17 min per session (75 minutes). Using notebooks correlated negatively with students' focus and test results. Fried discussed the limitations of the findings, given that only self-reported responses where included, based on the assumption that due to social desirability effects students would underreport the number of minutes students spend on multitasking.

Also Kraushaar and Novak [3] found that distractive multitasking behavior has negative effects on academic performance. Kraushaar and Novak [3] studied the notebook use of 55 students in 30 standard lectures (á 75 minutes) of one course by using a questionnaire and installing spyware on students' computers. They categorized notebook use into productive (course-related) and distractive activities. The distractive activities were further divided into surfing, email, instant messaging (IM), PC-operations and miscellaneous. They confirmed that spending more time with distractive multitasking leads to lower academic performance. But for the subcategories this could only be found for using IM during the lecture. One possible explanation for this result is that the spyware did not register for how long the student actively used the distractive environment. While it is possible that some students just opened a page and started listening to the lecture again, synchronous social tasks like IM lead to more distraction as it requires continuous attention.

4   Research Questions

Even though former research indicated that multitasking with notebooks in lecture has a bad influence on learning performance [2] so far little is known about how frequently and which kind of mobile devices are used in standard lectures.

─ *RQ1*: Which kinds of mobile devices are used how often by students during large lectures?

So far, studies were mainly conducted in single courses over a longer time period with the students knowing that their use of notebooks is assessed by questionnaire or spyware [3]. There is need to complement this research with covert observational data, i.e. with students being unaware of the fact that their activities are being observed. There is also need to investigate to what extent mobile devices require all of students' attention or are rather used as a background medium as Kraushaar & Novak [3] suspect.

─ *RQ2*: Which kind of activities do students engage in with their mobile devices in large lectures?

As their impression on their time and aim of using mobile devices could give an insight of how well learners manage to self-regulate learning activities when bringing mobile devices to the lecture students self-reported data could show differences between what they think they do with mobile devices and what they actually do. If students have metacognitive deficits regarding self-assessing and monitoring their learning processes, there should be differences regarding their self-report on their intention and time spending on mobile devices to what will be observed during lecture.

─ *RQ3*: What reasons do students self-report for bringing mobile devices to the classrooms and how do they actually use mobile devices?

5   Method

5.1   Participants

We conducted the study in five standard lectures of education (two lectures), computer science (two lectures) and economics (one lecture) collecting data by questionnaire and observation. We gathered 664 student questionnaires of which 331 students reported using technology in the lecture. Some of them used their laptop as well as their smartphone.

Table 1. Observed and self-reported use of mobile devices in lectures

	Education Observed (n = 26) / self-reported technology usage (n = 62)	Computer science Observed (n = 38) / self-reported technology usage (n = 136)	Economics Observed (n = 27) / self-reported technology usage (n = 171)
Notebook	25 / 20	31 / 60	25 / 53
Smartphone	1 / 42	7 / 76	2 / 118

While all questionnaires were used to analyze if student used mobile devices, for further analysis we just report data of those students that stated using mobile devices. We also covertly observed a total of 81 students with notebooks and 10 with smartphones. Table 1 shows the distribution of mobile devices as observed across lectures in education, computer science and economics.

5.2   Procedure

Before the lecture started, the five to seven investigators chose their seats, so they could observe at least one, but most of the time two to four different notebooks or smartphones users. They sat next or behind the students they observed, so that they saw just the screen but did not get further information about the observed student. Also the investigators tried not to be seen during the observation in order to obtain actual student practices. When the lecture started, the lecturers told their audience that an investigation about lecture activities is taking place and that at the end of this lecture a questionnaire will be handed to them. The fact that an observation took place as well was only mentioned after the lecture. The investigators started making notes every 30 seconds on the prepared sheets when the lecturer started talking to the class.

5.3   Instruments

Observation. A lecture of 90 minutes was divided in 180 segments, so that every 30 seconds the observer took a look at the observed mobile device and marked the observed activity. The activities were classified into lecture-related activities, like making notes or seeing lecture slides and lecture-unrelated activities like using social

networks, seeing online web-sites with non-course materials and watching videos (see Table 2). Also when students downloaded something or the screensaver was activated, it was noted down on an observer sheet, but these kinds of ambivalent activities are not further discussed in this paper.

The activities were further divided into "active" and "passive". When students typed something, obviously read an online article or used their mouse on a web site the activity was marked active as the focus was on the mobile device at that time. Passive use was coded whenever the focus was on the lecturer and his presentation and there were no activities on the mobile device, i.e. the device was switched on, but not interacted with. So, the distinction between active and passive use of mobile devices does not concern whether a device is switched on or off, but whether the student is interacting with and focusing on the device (active) or the lecturer, someone else or something other than the mobile device (passive).

Table 2. Categories of observed activities

Lecture-related activities	Lecture-unrelated activities	ambivalent activities (not reported)
Slides	Lecture-unrelated websites	Browsing the internet for unidentified information
Taking notes	Lecture-unrelated documents	Downloading something
Lecture-related websites	Social networks	Doing some exercises
Lecture-related documents	Email	Browsing the University website
	Chat	Desktop/screensaver
	Games	
	Newspaper	

As informing the students about the observation beforehand could influence their behavior, we told them after the study and used the DGPS recommended practice on ethics as a guideline. Also, we made sure that no connection between the questionnaires and the observations can be established, as the observers did not note down personal aspects like names, numbers etc.

Questionnaire. The questionnaire was designed to get a more accurate impression on students' use of mobile devices as well as their own impression what they used them for. The students should indicate which mobile devices they used and which lecture-related or –unrelated activities they engaged in, like searching further information on the lecture, taking notes, playing computer games or surfing social networking sites like Facebook. This was indicated by a five point scale with values from "not at all" to "very much". In addition, students were asked to indicate for what purpose they used a specific tool. The answers to these open items were coded and categorized into the same categories as the observational data and then divided into the subcategories of "lecture-related" and "lecture-unrelated" activities. New categories were defined if

the answers did not fit into one of the predefined categories, e.g. for yet uncharted forms of distractions or communication. After categories had been established, inter-rater reliability was being assessed.

6   Results

With regard to *RQ1* on which kind of mobile devices student use in large lectures, the questionnaire data indicate that half (49.85%) of the audience is using a mobile device at least once in a lecture. The number varied during the lectures as sometimes students came later or left early so not all students who attended the lecture filled out a questionnaire (n = 664).
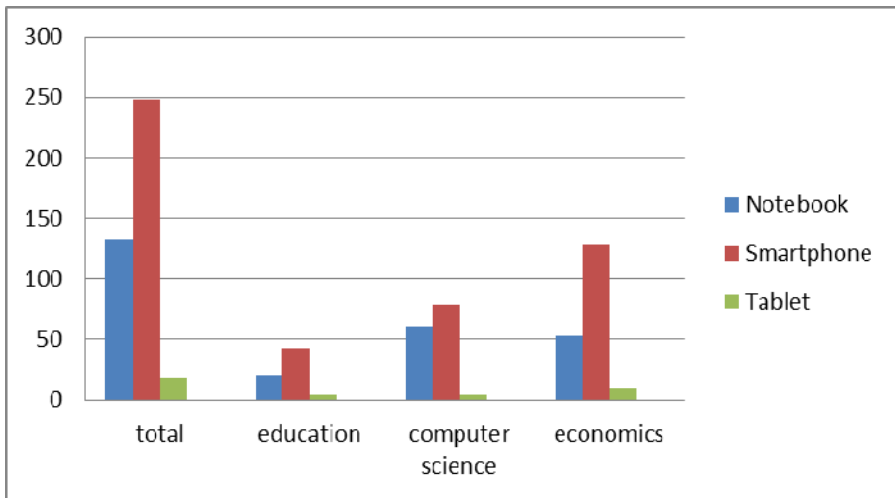

Fig. 1. Self-reported use of mobile devices in lectures (questionnaire data)

The usage of smaller devices couldn't be counted as it is hard to see smartphones when you are not close to them. But the observed use of notebooks indicates that the frequency of using devices as participants indicated (n = 133) (see Figure 1) is consistent with what was observed by the researchers (n = 112). Also here the number varies between different measurement points, as some students store away their device for some time during the lecture. This result was also found during the observation of the 81 students with notebooks.

With regard to *RQ2*, the observations indicate that students were engaged two times more often (51.70%) in surfing lecture-unrelated web-sites and documents than in lecture-related activities (see Figure 2). Whereas active use of mobile devices was stronger associated with lecture-unrelated activities (n = 4015), like communicating through Facebook, lecture-related activities was mostly passive (n = 1460), like looking at the slides of the lecture.
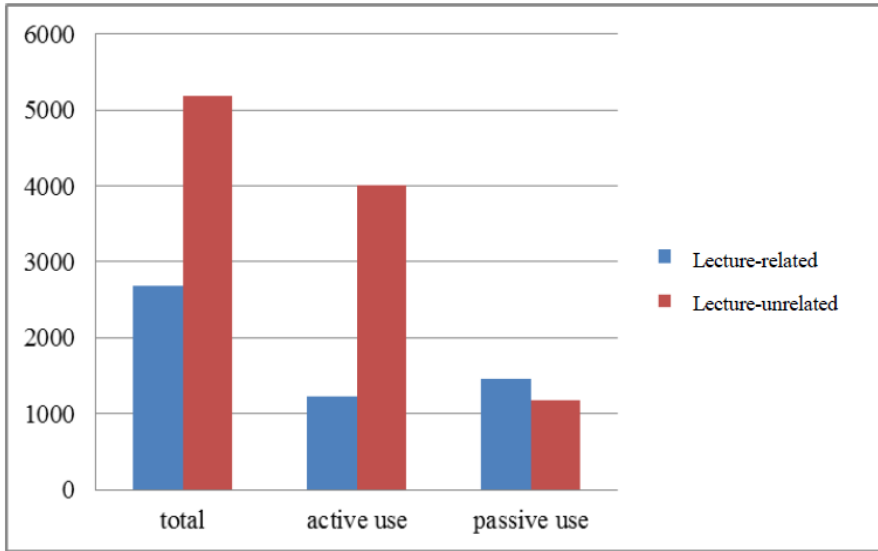
Fig. 2. Observed frequency of active and passive use of lecture-related and -unrelated activities (30 sec intervals)

We differentiated between several categories of active use of mobile devices. The most frequent lecture-related activities on mobile devices are taking a look at the presented slides and taking notes. Students rarely browse for lecture-related websites, however (see Table 3).

Table 3. Frequency of lecture-related and -unrelated activities during the lecture (30 second intervals)

lecture-related activities	
slides	351
notes	218
lecture-related websites	81

lecture-unrelated activities	
lecture-unrelated websites	1445
social networks	679
email	153
chat	76
games	839
videos	170

The most frequent lecture-unrelated activities revolve around surfing the web. Students frequently visit lecture-unrelated websites, like sports sites, different forums or search for downloading some content. Also the use of social networks was common during the lectures with most of the students being a member of Facebook. Some of these activities, e.g. visiting Facebook, implied switching between active and passive activities for some of the students. These students focused on the lecture, but checked the open Facebook page from time to time.

Other lecture-unrelated activities, like watching videos, were far more enthralling and time consuming as students constantly focused on the notebook screen. Wearing headphones during the lecture seemed to clearly indicate that phenomenon. For instance, one student started watching a TV show when the lecture began, then finished some lecture-unrelated homework and started watching another episode of said TV show before leaving the lecture early.

The duration of playing online games varied between the different games. There were students taking a look at their online simulation games, e.g. Farmville, regularly in the lecture, while other students were playing installed games during the whole lecture.

With regard to *RQ3* on how students self-reported on how they use their mobile devices during a lecture, most students stated that they mainly use their notebook or smartphone for lecture-related activities like taking a look at lecture slides or taking notes (see Table 4).

Table 4. Observed vs. self-reported use of mobile devices

	Number of *observed* students actively using mobile devices during the lecture	Number of students *self-reporting* using mobile devices during the lecture
Lecture-related activities		
lecture slides	18 (19.6%)	46 (37.1%)
taking notes	38 (41.3%)	51 (41.1%)
searching	36 (39.1%)	47 (37.9%)
Lecture-unrelated activities		
social networks	44 (47.8%)	19 (15.3%)
chat	10 (10.9%)	4 (3.2%)
emails	22 (23.9%)	15 (12.1%)
communication		28 (22.6%)
unrelated websites	56 (60.9%)	
games	14 (15.2%)	7 (5.6%)
video	7 (7.6%)	0 (0%)
distraction		51 (41.1%)

The percentage of students observed taking notes is corresponding to the self-reported one. Also many students mentioned to search for additional information on the lecture to attain deeper understanding. The overall observed number of students doing further research on the internet is rather low (252) compared to other activities like taking notes (805) or social networks (960). But the number of students which report using mobile devices for looking at lecture slides differs from the observed number. Although 37.1% of the students report to display lecture slides on their screens, only 19.6% were actually observed doing so.

In general, the number of students observed doing lecture-unrelated activities is always higher than the self-reported one, although 51 students indicated that they use mobile devices for some sort of distraction in general.

7   Discussion

The study shows that half of the University students use their mobile devices in lectures. While most of the students use smartphones or notebooks, other mobile devices like tablets are not very common in lectures today. The observational data show that most of the students use their mobile devices for lecture-unrelated activities, mostly for surfing on lecture-unrelated websites; this is consistent with prior findings [3]. Other, highly frequent lecture-unrelated activities observed are communicating through social networks and emails. These kinds of lecture-unrelated activities pose a risk of distraction which could hamper learning activities and therefore impoverish learning results [2]. Analyzing active and passive use shows that most of the lecture-related materials, like online slides, do not foster active behavior, e.g. taking notes. In fact, lecture-related use of mobile devices is mostly passive. In contrast, lecture-unrelated activities, like using games or social networks, are typically active. Still, not all of the lecture-unrelated behavior was active. Obviously, students seem to manage some degree of multitasking with passive lecture-unrelated activities, which may not have adverse effects on learning [3]. Because of collecting the data in real classroom scenarios this study aimed to describe how students use their mobile devices. We are currently analyzing differences between students with mobile devices and those without. Some of this data will be presented at the conference. Also, future research may need to inquire how learners are actually dealing with these kinds of distractions successfully with regard to cognitive load and learning outcomes.

There are interesting divergences between observational and questionnaire data. Students may have no good explicit explanation for bringing computers to lectures or may hide their true, lecture-unrelated intentions. Chances are that due to weak self-monitoring strategies students do not entirely realize how much time they spend on lecture-unrelated activities. Perhaps they sometimes do not realize their shift of attention at all.

A lot of Universities install wireless Lan in their lecture halls to give students the possibility to use mobile devices for learning and research. Our results indicate that nearly half of the students accept that offer during lectures – most of them with their smartphone. Even though a lot of students use them not in the intended way, it may be

problematic to banish these small mobile devices from lecture halls. Instructional approaches are necessary to help students use mobile devices in lectures intentionally for lecture-related activities [2]. Our future research addresses this issue by suggesting to not ban, but design for involving the devices students bring to the lecture [13]. In such a scenario using an audience response system called Backstage, lecturers would ask students to answer questions as with proprietary clicker systems and allow for students to post lecture-related questions, comments and answers. In this way, students might be facilitated to more actively engage in and better monitor lecture-related activities.

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