Can Digital Footprints Save the Physical Lecture?

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Keywords: E-learning, Digital Footprints.

Abstract: We argue that better use of "digital footprints" (data generated from students' learning activities) could be used to improve the traditional lecture. We point out some potentially important data sources, and briefly discuss how data from each of these sources can contribute to better learning. Finally, we argue that even if this development is possible, it will require changes – certainly changed priorities among faculty, but also probably recruitment of new types of expertise, for instance data scientists.

1 INTRODUCTION

The death of the traditional lecture has been announced at least since the Dearing Report was published more than 20 years ago. (Dearing, 1997). As the longest standing form of teaching, the lecture gets a lot of critic for being antiquated, partly because we still follow patterns from lectures from ancient times and ancient technologies, and partly because it is more about teaching than learning. However, why should lecturers change a winning formula?

We know by now that every student learns in a different way. Still, especially in higher education, we have standardized courses for big classes. For us as lecturers, high attendance is a measure of a good course. Everybody knows that the best lecturer gets the highest attendance, and praise from both students, colleagues and other staff. But is this really the best measure of whether a class is useful?

In a previous project (Bergfjord and Heggernes, 2016) we found that the use of "flipped classroom" methodology led to higher grades for the students. But for which students? Apparently, not the students attending class, but the students for which the class environment did not represent the best learning arena! We saw no difference in the higher grades, the bigger effect were on the lower grades. Somehow, by using videos, the learning outside the classroom improved. Also, in two informal surveys we recently conducted on which methods/tools the students found most useful in a course, the recorded lecture got the highest score, the students ranked (the availability?) of the recorded lecture more useful than attending lectures in person.

Each year when we start a new class, we have a brief discussion of the lecture as "quality time". Wikipedia refers to quality time as time spent with partners, friends or family that is in some way important, special, productive, or profitable. The discussion usually ends with an emphasis on productivity in reaching the goals of attending class. The goals for the students by attending class could be discussed at length, but a suggested goal is achieving the highest possible grade by a minimum of effort. Some students usually nod affirmatively. As a result, there is more focus on assignments and less on lecturing during the lectures, even for big classes.

We believe measuring and evaluating the activity both in and outside class could be improved in most traditional courses. Grades are still often given based on one or a few tests or term papers, usually at the end of the semester. This is comparable to a retail store that only recorded total sales for each product every 6 months and used those numbers to analyse their business. Furthermore, student evaluation of classes and teachers are collected mostly in the same manner. Research shows that there are lot of biases that influence the student's evaluation (see e.g. Seiler, 1999), and for voluntary evaluations, the response rates are often low.

The background for this position paper is hence the following: The lecture remains widely used, although much evidence suggests it is often not the best learning method. We assume the continued usage somehow implies that the lecture has some qualities, at least related to convenience and "bang for the

Heggernes, T. and Bergfjord, O.
Can Digital Footprints Save the Physical Lecture?.
DOI: 10.5220/0007762504610464
In *Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019)*, pages 461-464
ISBN: 978-989-758-367-4

buck". On the other hand, new technology gives us better opportunities to utilize data to measure and improve all types of learning, including learning from lectures.

Hence, our position is that better use of learning intelligence will give better insight into how to improve lectures, which in turn could save the traditional lecture.

Learning intelligence is a relatively new academic field. We are lecturers of business topics, and for most business topics, there is a lot of emphasis on collecting and using data as a basis for decisions. Yet, as stated above, we do not collect much data from our own classes as a basis for decisions concerning our pedagogics. Learning intelligence in higher education is still in its infancy (Viberg *et al.*, 2018). There are several definitions of learning intelligence, but we will base our discussion on the following: *"learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs"* (Siemens and Long, 2011).

If we take a step back to briefly visit the business world again, the earliest definition of a business intelligence (BI) system dates back to 1958 (Luhn, 1958). The BI system is defined as a system that "*will utilize data-processing machines for auto-abstracting and auto-encoding of documents and for creating interest profiles for each of the "action points" in an organization*". Is auto-abstracting and auto-encoding even possible in an educational environment? As for the action points within an organization, we clearly see that lecturers, researchers, department heads, administrative staff and students would all be different profiles with different action/decision points.

A few words about data quality: It is well-known fact that even the best system relies on good data in order to produce good data out. Good intelligence requires good data. An important aspect of data quality is data granularity (Kimball and Ross, 2011). The granularity of data represents the level of detail in the data and is tied to how often data is collected. According to Kimball & Ross, good analysis requires that the most detailed grain of information possible is captured in computer systems. As seen over, the detail of both grades and evaluations is very coarse. Is it at all possible to get more specific information on learning activities?

2 PROPOSED SOURCES OF DATA

Every use of a digital resource from the students will leave a digital trail, either anonymous or traceable. More digital resources inevitably lead to more data. Below, we discuss potential data-points and their usage.

Sources of data mainly outside the classroom:

1. The Learning Management System (LMS)

At our institution, we use the Canvas LMS. Canvas has lots of functionality for setting up quizzes and assignments, learning activities that can produce good and relevant data. There is also a function called Course Statistics, where it is possible to view each student's activity on the platform. The detail of the information could have been finer (but there is a hack for obtaining more detailed data on the interactions between the students and the course material). For example, information on how many pages the student has accessed, and when, is available, but not which pages. On a course-level, frequently visited pages on the LMS can help identify difficult topics, and lead to a decision to repeat or present the topic a different way in lectures.

2. Other Platforms for Digital Learning Resources.

Video instructions are an important part of a flipped classroom approach to teaching. Our experience is that the most simple, convenient and effective platform for distributing videos is YouTube. There are good analytical tools available on the platform that are easy to use. A premise for the flipped classroom approach is that the students watch the videos before the lecture. The viewing numbers are live on YouTube, and easy to check before or during a lecture. Low viewing numbers will call for an explanation of the concepts or theories in class before starting on assignments, thus improving the quality of the lecture time.

In addition, the percentage of the video viewed, e.g., when in the video the students stopped watching the video could be valuable input, both for the physical lectures and when re-recording the videos later. Another similar platform is Soundcloud, which can be used to publish audio/podcasts. Listening statistics are available for each episode and can be utilized much the same way.

Sources of data within the classroom:

We think that all lecturers live for the discussions they have with students in class, we certainly do. As good as they can be, there are two potential problems with class discussions. First, often only a small part of the class will participate, and often the same students each time. This can lead to a somewhat limited number of perspectives in the discussion. Second, even if the discussions are documented in a lecture recording, the students participating are not wearing microphones, so viewers of the recording will not be able to hear the student part of the discussion. In lectures that are not recorded, the discussions will be unavailable for those students not attending the physical lecture, and at best very hard to recall for those attending and participating. (We suspect that most of these will have forgotten the whole discussion within days.)

If there were a way to structure and document those discussions, there would be two obvious benefits. For the student, the documentation would be useful for repetition. For the lecturer, the documentation would be available, and useful, when preparing for the next time doing the same course. It would be easier to assess if the questions were any good for making the intended point during the lecture and improving the structure of the lecture if necessary. We propose the following ways to gather data within the classroom:

1. Working on Assignments on a Shared Document

We have several years' experience using MS OneNote for this purpose. The platform is in no way perfect or without its technical flaws; in fact we have considered changing it several times. Still it is good enough to both document the discussions and capture more perspectives from the students. It is easy to access without logging into a service, but as many institutions now have Office365 for their students and staff, logging in is also an option that will make it easier to trace each student's activity.

Practically, students are given an assignment for discussion during the lecture, and a timeframe for solving and writing down the answer, usually 5 or 10 minutes. In OneNote they will create a tab (in OneNote this is called a page) with their names as a heading and write down the answer on the page. This answer will be available for all the other students, and the lecturer, to see. The answers then make the basis for the discussion, making it possible for the lecturer to reach out to specific students by name to start the discussion.

This way of data collection has proven to constitute a valuable archive for both lecturer and students.

2. Micro-surveys at the End of Each Lecture

Overwhelmingly long, non-compulsory evaluations are not very appealing to anyone. This also applies to students, and as mentioned before there are a lot of sources of bias and error that affect the outcome of those evaluations. The timing is one of them, right before exams is a stressful time for students that might affect the evaluation, and after the exam, the grading can affect the evaluations both positively and negatively. It is also hard to remember specific classes and topics, so what is measured is more a general impression. Thus, end-of-semester evaluation results might not be the best data for optimizing the learning and the environment in which it occurs. At best, the next class will reap the benefits, not the class doing the evaluations. We propose the following:

We designed a framework for micro-surveys to serve two purposes. First, to give the students a couple of minutes for reflection at the end of the lecture. Second, and most importantly for learning analytics, give the students a chance to evaluate the lecture in two quick ways: A 1 - 5 -star rating on how much understanding they have for central topics presented during the lecture, usually 4 or 5 topics, and a text field where they can write down what is most unclear to them after the lecture. In addition to this there is also a field where the students can give general comments to the lecture.

Many times, one or two of the topics will get a lower rating than the others. Repetition of these topics will be a good starting point for the next lecture, and the same goes for discussing some answers from the text field of unclear topics after the lecture. The answers in the text field will help uncover other topics for repetition than the pre-defined topics that are star-rated.

Practically, this short survey is done with Forms in Office365, and the students are given a link to the form in the last picture for the lecture notes, where it is also possible to access the survey on a mobile device via a QR-code. The results from the previous lecture will be presented in the beginning of the lecture notes for the next lecture. Again, the data collected makes it possible to improve the following

lecture(s) for the same students, as well as generally improving the course in following years.

3 THE NEED FOR A NEW SKILL-SET

It is of course possible to start with small sets of data for doing learning analytics. But data is getting bigger, and with bigger data sets comes the need for more advanced analytical tools. Using a hack, we were able to retrieve the total interactions between the students and learning material (on the LMS Canvas) in a course. The course had 100 students, the activity report was a .csv-file with over 8500 rows. A pivot-table in Excel, or a more powerful tool like Power BI will get a lecturer a long way in analysing these data, but there are also, as we have suggested, more data to be analysed. The amount of data will quickly become overwhelming, which will pose a barrier for using learning analytics in the first place.

Lecturers are pressed for time, there are high and growing demands on performance and documentation of teaching and research. For many, the time for analysing large amounts of educational data is just not there. Still, we think it is an important task.

For quick and easy data browsing, like using a shared document for assignment during class or a micro-survey at the end of class, the regular lecturer will, in our opinion be fine. For more thorough analysis, a data scientist will be in order. Far from all educational institutions see themselves as competing in a data-driven market, but the truth is that especially in higher education, they are. Competitors/substitutes to higher education like EdX and Coursera are basically in the technology sector and are analysing data on how students learn online. The next step for offline institutions will be hiring educational data scientists. That might not be an easy task: Data Scientists are in strong demand, and a data scientist with domain knowledge in education might be as rare as a unicorn.

4 CONCLUSIONS

The traditional lecture is widely used, despite its obvious weaknesses. This is likely to continue, as both teachers and students are conservative, and many consider the lecture to be a convenient alternative. On the other hand, there are large amounts of data available, which only to a limited degree are utilized. We discuss a few such data sources and show how better use of these can improve the traditional lecture, and thus contribute to its survival. At the same time, we argue that this will require a change of priorities for many faculty members, and maybe also for universities to start recruiting new types of employees, for instance data scientists specializing in gathering and analysing educational data.

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