STUDENTS’ PREFERENCES AS TO PROGRAMMING LECTURE FORMATS: LIVE LECTURES WITH CLICKERS OR RECORDINGS

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Abstract

Lectures have a long tradition and they still play a significant role in teaching and learning, especially with large groups. In this paper, we describe the organization of lectures in the first-year university introductory programming course. During the lectures, clickers (student response systems) were used as an active-learning component to increase classroom engagement and motivation. However, the use of any other electronic devices (especially laptops) was prohibited. All live lectures were recorded. As a matter of choice, students could study the material on their own outside the classroom watching the recordings and answering some questions about the lecture. Students could use the recordings as supplementary material after attending the live lectures as well. In this study, we conducted a survey on students’ preferences as to the lecture formats and possible reasons. A mixed-method approach was used; both quantitative and qualitative data were collected from 227 students at the end of the course. A significant number of the respondents chose to attend the live lectures rather than watching the recordings or doing both. The perceived advantages of the live lectures include the clickers, the lecturer, and the forced attention to the material due to the prohibition of electronic devices. The recordings were preferable due to the flexibility in schedule and pacing. Additionally, the relationship between the preferred lecture format and the academic achievement was analyzed.

Keywords: undergraduate programming education, live lectures, recorded lectures, students’ preferences.

1 INTRODUCTION

The traditional teaching approach, based on lectures, has been used for centuries at universities. Recently, there has been growing interest in learning computer science and programming at universities [1]. Due to a large number of students, lectures are widely used for teaching programming courses [2, 3]. However, education researchers have found that much of the difficulty students have learning science can be attributed to the passive role students play during traditional lectures [4]. With the proliferation of diverse educational technologies, more student-centered active learning approaches can be used in lectures. One of such technologies is student response systems, such as, clickers. It has been found that clickers are suitable for engaging students in classroom discussion, especially in large classes [5]. Another positive effect that clickers have is the improvement of attendance [6], which likely translates to improved exam performance [7]. However, the use of digital devices in lectures may lead to multitasking and impede the learning process. When students are given the opportunity to use laptops or smartphones during lectures, most of the students use them for purposes impertinent to the lecture, like surfing on lecture-unrelated websites and communicating through social networks and e-mails [8]. Such media non-lecture-related multitasking has been associated with negative learning outcomes [9, 10].

Nowadays a fair amount of universities offers students video-recordings in addition to live lectures, which makes the learning process more flexible. In general, videoing lectures gives positive benefits to learners, providing an extra resource complementing their studies and an opportunity to catch up with missed lectures [11]. However, Bishop and Verleger found in their survey of research [12] that students tend to prefer live lectures to video lectures. Some learners found recorded lectures as superfluous to their needs [13].

Previous studies state contradicting results about how lecture attendance affects students’ performance in the final examination. Some research found that students with high lecture attendance achieved, on average, higher marks [14, 15]. On the other hand, there are indications that lecture attendance and final exam performance are negatively correlated [16]. In addition, it has been reported that lecture attendance has no significant impact on academic performance [17].

This paper describes the organization of the first-year university introductory programming course, focusing on lectures. During the lectures, clickers were used to increase classroom engagement and
motivation. Meanwhile, all other electronic devices (especially laptops) were prohibited. The lectures were recorded and it was possible to finish the module by watching recordings outside the class and answering some questions about the lecture. Students could choose whether to attend live lectures, to watch recordings, or to do both. At the end of the semester, we wanted to know what the students thought about the lectures and how we should organize lectures next year.

The current study purposes to identify students’ preferences as to the lecture formats and possible reasons and analyze the relationship between the preferred lecture format and academic achievement. Based on this research aim, the questions that lead to this study are:

- What kind of lecture format do students use during the semester?
- What are the reasons given by students for preferring this format of lectures?
- What are the opinions of students about the use of clickers and prohibition of electronic devices in the lecture?
- Is there a relationship between the lecture format a student uses and his/her final mark in the course?

2 METHODOLOGY

2.1 Course background

This article addresses a programming course for first-year undergraduate students at the University of Tartu. This course is the first programming course and is taught during the first (fall) semester. The course is compulsory for all computer science, computer engineering, mathematics, mathematical statistics, physics, chemistry, and material science students. However, this course is also popular among other students. As a result, we have around 350-400 students.

The course has been based on Python in the last 10 years [18]. The aim of the course is to introduce the basic concepts of programming to students. The course consists of two forms of teaching: lectures and workshops. The students have one lecture (90 minutes) and one workshop (90 minutes) per week for 16 weeks.

Traditionally, all students in a course come together for a lecture in one classroom. As we have a rather large number of students (in 2019 we have 376 students registered for our course), they are quite diverse in terms of their background and abilities. This fall we offered two different formats of lectures for students to choose from. The first format is traditional lectures, where the lecturer gives the lecture in front of the class. During the lectures, we use clickers as an active-learning component to increase classroom engagement and motivation. However, the use of any other electronic devices (especially laptops) is prohibited. In addition to clickers, one five-minute pause is used as it was suggested that pausing facilitates student engagement [19]. The lectures are video-recorded and these videos are used in the second format of lectures. In this group, the students have to watch the video outside the class and answer some questions about the lecture. Students can use the recordings as supplementary material after attending the live lectures as well.

The workshops are conducted in smaller groups with the help of several instructors with around 20 students in one group. Although it was previously found that flipped classroom might not be suitable for a traditional large lecture course involving hundreds of students [20], we have integrated the flipped classroom and collaborative approach into workshops [21]. Additionally, we are using automated assessment for homework assignments to facilitate the work of instructors [22].

The course’s main grading categories include two tests and final course examination (each consisting of two individual parts covering underlying concepts, code understanding, and code writing). Weekly programming homework assignments and a project have their part in the grading system. Finally, attendance of lectures (or completion of exercises for video lectures) gives some points as well (7 out of 110). The students had to collect some points from homework and the project and had to pass the compulsory parts of tests in order to gain access to the final examination.

2.2 Participants and data collection

The sample was comprised of the participants of the programming course in the fall semester of academic year 2018/2019 (376 students). Only the students, who had completed the prerequisites for
the final examination, were invited to respond to a survey (322 students). In all, 227 students filled in the questionnaire.

The survey included three parts with questions. The first part was about learning activities, the second was about assessment methods. Each had three open questions. The third part was about lectures and is used in this study. The part about lectures was divided into 5 subparts. The first subpart had 3 multiple-choice questions about preferred lecture format during the first, second and last third of the semester. Other parts had in total 16 questions for answering on a 7-point Likert scale (ranging from a score 1 (“strongly disagree”) to 7 (“strongly agree”)) about different aspects of the lectures (like clickers, ban of electronic devices, etc.). In addition, each subpart had a field for comments. A field for general comments was provided as well.

The questionnaire was administered to students after the final examination in January 2019. The online form was made available for three days. Answering the questionnaire was voluntary. The students received one point out of 110 for filling in the questionnaire.

2.3 Data analysis

Descriptive statistics were calculated analyzing the Likert data. For comparing data between final marks of different lecture format groups independent samples t-test was used.

The students’ comments on reasons for preferred lecture format were analyzed by two researchers. First, one researcher looked through all the comments and found and counted all the possible reasons mentioned by the students. The second researcher looked only for the most often named reasons and counted them. The intercoder reliability was measured with a percentage agreement of .90 (the minimum reliability was .80).

3 RESULTS AND DISCUSSION

3.1 Preferred lecture formats

Based on the responses about preferred lecture format during the first, second and last third of the semester, six groups were identified (Fig. 1). The larger group contains the students who attended the live lectures during the whole semester and did not watch the recordings at all (‘Live attendees’, n=114, 50%). The next group includes the students who watched the video lectures during the whole semester and did not participate in the lectures at all (‘Recordings watchers’, n=16, 7%). The third group consists of the students who did not participate in any lectures and did not watch any recordings (‘Nonparticipants’, n=5, 2%). The students in the ‘Switchers’ group (n=39, 17%) changed their preferences during the semester, attending the live lectures in some part of the semester and watching the recordings in some other time. The students from the ‘Dual’ group (n=15, 7%) were doing both: they participated in the live lectures and watched the videos after that as well. It is worth mentioning that they were not doing this all the time, but sometimes. The last group (‘Backouts’, n=38, 17%) contains the students who decided not to participate in lectures and not to watch the recordings during some part of the semester. Mainly they backed out of the lectures and videos, but there were some students who did not participate in the first third of the semester and then joined the lectures or started watching the videos.

Previous research indicated contradictory results on whether students prefer to attend live lectures or to watch online videos. Similarly to our grouping, Inglis et al. [15] described that the majority of students attend live lectures. However, Howard et al. [14] identified a predomination of video watchers. The other groups have been presented in previous research as well [15, 14].

3.2 Reasons for preferred lecture formats

The students had an opportunity to comment on the preferred format and the reasons for their preference. 135 students mentioned the lectures and 84 the recordings in their comments. Clickers were mentioned the most often as a reason to attend live lectures (18% of the respondents who mentioned the lectures). The students also reported that it is easier to concentrate in a live lecture, especially due to the prohibition of electronic devices (15%). Some students stated as a reason that lectures are interesting and useful (14%) and it is easier and more convenient for them to come to live lecture rather than to find time to watch the recordings (13%). Another category of responses mentioned the lecturer as a reason to attend live lectures: either the lecturer was nice and fabulous
(10%) or the students needed to interact with the lecturer for better understanding of the material (9%). Similar reasons have been identified in previous research as well [13, 14].

A large majority of the respondents who watched the recordings preferred the video as a way to avoid conflicts in their schedule (27%). Furthermore, the possibility to study at own pace (21%) and at a suitable time (18%) was appreciated. The students appreciated the ability to pause, scroll and skip some parts. A few students mentioned interesting reasons like the weather (‘As the snow came down and it was cold, I found that I would rather look at the recording at home and not go out in the cold weather.’), the narrow and hard wooden benches in the lecture hall (‘The video system is very good because the benches in Vanemuine Hall are uncomfortable.’) and the possibility to have lunch instead of attending the lecture (‘I could have lunch during the day on Tuesday, otherwise the 8-hour day would have been all in a row and in different houses.’).

It seems that some students are just used to live lectures at school and do not know that watching videos would suit them better. One of the ‘Switchers’ stated: ‘While I was making this change, I couldn't attend a couple of lectures. Watching videos at home, I discovered that watching recordings is more effective.’ Some students changed the format in the opposite way, from video to live lecture. The reasons for changing the format (both, from video to live and from live to video) included time planning, motivation, and discovery that the current format is not appropriate.

The students from the ‘Dual’ group used the recordings before tests and the exam to go over harder topics or when a topic from a lecture remained incomprehensible. Another reason was multitasking: ‘In the lecture, I did several things at a time, then watched the videos at a faster pace.’

There were 34 comments on nonparticipation in the lectures and not watching the recordings. The major reason for not attending the lectures and not watching the videos was previous knowledge (32%). This was the first course at the university and some students had learned programming at school or by themselves. Tiredness, lack of time and need to focus more on other courses were also mentioned.

Finally, one more comment from a student: ‘I think that it was the best lecture format from all courses because it gave everyone the opportunity to choose the way that is best for them.’

### 3.3 Opinions about the use of clickers and prohibition of electronic devices

The survey included four statements about the use of clickers (Fig. 2). The students’ attitude to the clickers was very positive. Some students even stated, ‘The clickers were my favorite part of the lecture.’ Almost all students agreed that clickers helped to prevent distraction during the lecture and raise interest in the topic of the lecture. The students also found that the use of clickers contributed to the development of critical thinking and encouraged to come to lectures: ‘The clickers are definitely one of the reasons why students come to the lecture - it makes you think.’ This is consistent with previous research claiming that clickers improve attendance [6] and engage students in classroom discussion [5].
Two statements from the survey were connected to the possible use of smart devices during the lectures (Fig. 3). The students were inclined to think that they would not use smart devices appropriately (to the lecture-related activities) were their use allowed. This confirms the findings that when students are given the opportunity to use laptops or smartphones during lectures, they use them for purposes unrelated to the lecture [8, 9].

The students also commented in the survey on the prohibition of electronic devices in the lectures. The opinions were very different, but the students seem to agree rather than disagree with the ban (58 agreed while 44 disagreed). One student wrote: ‘The focus in a lecture hall should be on the lecturer. Analogous is the use of smart devices during a theatrical performance; it is rude.’ The students pointed out the forced attention to the material due to the prohibition of the devices: ‘For me, the prohibition of smart devices was very helpful. I think I listened much more attentively thanks to this.’ However, some students found that programming is a very practical course and students should practice during the lecture as well: ‘I think it would be useful to write the program yourself in the lecture. At least I would have the intention to do this. When I was watching the video at home, I paused and tried myself right through the code snippet. I think I would have had the same intention in the lecture, even though I would use a computer for lecture-unrelated activities as well.’
3.4 Relationship between the preferred lecture format and academic achievement

To analyze the relationship between the preferred lecture format and academic achievement, summary statistics of the final marks for each group were investigated (Table 1). No statistically significant difference in student’s marks was found between live lecture attendees and recording watchers (t=1.4707, p>0.05). This is contradictory to previous findings which indicated that live lecture attendees achieve, on average, higher marks than video watchers [14, 15]. However, the students from the ‘Dual’ group had lower attainment than live lecture attendees (t=3.7597, p<0.001), ‘Switchers’ (t=2.4925, p<0.05) and ‘Backouts’ (t=3.6125, p<0.001). This is similar to the comment that ‘stronger’ students have a tendency to use a single resource [14]. There was no statistical difference in marks between other groups. A boxplot illustrates the final marks of students from different groups (Fig. 4).

Table 1. Summary statistics of final marks by preferred formats.

<table>
<thead>
<tr>
<th></th>
<th>Live attendees</th>
<th>Recording watchers</th>
<th>Nonparticipants</th>
<th>Switchers: live or recordings</th>
<th>Backouts: live, recordings, non-participating</th>
<th>Dual: live and recordings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>89.57</td>
<td>83.56</td>
<td>81.00</td>
<td>85.23</td>
<td>89.45</td>
<td>73.00</td>
</tr>
<tr>
<td>Standard error</td>
<td>1.44</td>
<td>3.65</td>
<td>9.64</td>
<td>2.27</td>
<td>1.97</td>
<td>5.30</td>
</tr>
<tr>
<td>95% confidence interval</td>
<td>(86.7,92.4)</td>
<td>(76.4,90.7)</td>
<td>(62.1,99.9)</td>
<td>(80.8,89.7)</td>
<td>(85.6,93.3)</td>
<td>(62.6,83.4)</td>
</tr>
</tbody>
</table>

Figure 4. Boxplot based on the median of student’s final marks by preferred lecture formats.

4 CONCLUSIONS

In this paper, we described the organization of lectures in the first-year university introductory programming course where clickers were used and all other electronic devices (especially laptops) were prohibited. The students were provided with the opportunity to watch recordings instead of participating in live lectures. The students could use recordings as supplementary material after attending the live lectures as well.

In this study, the students were surveyed about their preferences as to the lecture formats and possible reasons. A mixed-method approach was used; both quantitative and qualitative data were collected from 227 students at the end of the course. Six groups with distinct preferred format during different parts of the semester were identified. Half of the respondents chose to attend the live lectures rather than watch the recordings or do both. Some students changed the format during the semester,
some students backed out and some did not participate at all. The students appreciated the opportunity to choose the format that is best for them. The respondents indicated that they decided to attend the live lectures because of the clickers, the lecturer, the forced attention to the material due to the prohibition of electronic devices, or belief that it is an easier and convenient way to study. The recordings were preferred due to the flexibility in schedule and pacing. Additionally, the videos were used as a complementary resource before tests and exams.

Further, the relationship between the preferred lecture format and the academic achievement was analyzed. No statistically significant difference in student's marks was found between live lecture attendees and recording watchers. However, the students from the ‘Dual’ group had lower attainment than live lecture attendees, ‘Switchers’ and ‘Backouts’.

Since students approved the organization of lectures, we will continue with that arrangement in the coming years. The text comments provided by the students are very useful and will be taken into consideration for improving the course.

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REFERENCES


