Evaluating the Impact of an Interactive Classroom Application on Student Learning Outcomes

M. Beránek, G. Feuerlicht, V. Kovář, L. Petkovová, V. Vacek
Information Technology Department, Unicorn College, Prague, Czech Republic

Abstract – Interactive learning environments are becoming an integral part of university education and there is increasing evidence that interactive learning has the potential to improve learning outcomes. Recently we have introduced the Nearpod interactive learning platform into several of our courses. While our experience with using an interactive learning platform is still relatively short, it is evident that interactive classroom environment can make the learning experience more rewarding for the students and at the same time lead to improved learning outcomes. Our results indicate that the effectiveness of using an interactive learning platform varies depending on the type of course and on attendance pattern.

Keywords: Interactive Learning, Interactive Classroom, Learning Outcomes, Nearpod

1 Introduction

The impact of Information technology (IT) on teaching and learning at all levels of the education systems has been profound. The emergence of Learning Management Systems (LMS), Course Management Systems (CMS), Interactive Whiteboards (e.g. SMART Board, e-Beam, Smart Pen) and mobile devices (e.g. iPads, etc.) have transformed the way we teach and learn [1, 2]. Using electronic media enables frequent updates of educational materials with new versions instantly available to students, making printed books effectively obsolete. Interactive delivery of rich multimedia course content that includes audio and video using e-learning platforms is becoming an integral part of university education [3, 4].

Numerous publications deal with problems related to quality of the educational process and new approaches that aim to improve the effectiveness of higher education [5, 6, 7, 8]. At the same time governments are continuously reforming higher education attempting to manage rising costs and improve the accessibility of university education to a wider range of the population. As the new generation of Internet savvy students enters the higher education system, they often find traditional methods of delivery of courses using lectures with a heavy assignment load difficult to adjust to, resulting in poor educational outcomes and high attrition rates. Furthermore, there is evidence that while students are spending increasing amounts of time online, they are devoting less time to university related activities.

A recently published survey of more than 1,200 students at technical universities followed over a period of ten years (2005 to 2015) indicates that the average time students spent online each day increased from 2 hours in 2005 to 5 hours in 2015, with a corresponding reduction of time spent on university related activities, from 7 hours to 4 hours per day [5] (table 1).

<table>
<thead>
<tr>
<th>Activity</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep, rest, travel</td>
<td>9.5</td>
<td>9</td>
</tr>
<tr>
<td>Meals</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Personal interests and sports</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Part time jobs</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Online: web, chats, etc.</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>University related activities</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

As illustrated in Figure 1, there was a steady increase in the time students spent online and a steady decrease in the time devoted to university related activities.

Figure 1: Change in students’ daily activities over a 10-year period: 2005 to 2015

It can be argued that as more student activities take place online, university education must follow this trend to remain attractive and relevant.
Unicorn College (UC) is a leading private university based in Prague, Czech Republic that offers Information Technology (IT) and Business Administration courses to local and international students. Most of our students (60%) are employed in the IT industry and study part-time, and find balancing of university and work commitments challenging. Over the past two years we have been focusing our efforts on reducing failure rates, in particular during the first year of study. We have incorporated lecture podcasts, industry case studies, and interactive learning applications into our courses with the objective of increasing student engagement in the courses and improving our ability to identify potential situation that could lead to students dropping out of the course. We have been experimenting with using various types of learning platforms, including podcasts and interactive learning tools for several years in our college [5]. More recently we have been using the Nearpod learning platform to provide rapid feedback and the ability to evaluate students’ understanding of the material that is being presented during lecture and tutorial sessions. We have reported preliminary results of our efforts to support student learning using Interactive Textbooks, Podcasts, and Nearpod in our courses [5]. We have modified our courses and our teaching methods to take better advantage of these modern technologies.

In this paper we report on the impact of implementing interactive classroom on learning outcomes, and on students’ perception of the benefits of using an interactive learning platform. In the following section (section 2) we review related literature. In section 3 we discuss the implementation of an interactive classroom application in our college, and in section 4 we present the results of the student survey. In section 5 we present our conclusions.

2 Related Work

Improving learning outcomes using Information Technology to provide instant feedback and to facilitate more interactive learning environment has been an active area of research for more than a decade. In early work Anderson et al. [9] use a PC-based tablet system that facilitates active and collaborative learning in the classroom. The system was piloted in eight Computer Science courses at the University of Washington, and the authors report that the students have responded very positively to the system and that using the system increased student engagement. The inclusion of student artifacts improved the classroom discussion of possible solutions. Beuckman et al. [10] have developed and deployed a Web-based classroom interaction system in introductory physics lectures to facilitate real-time two-way student interaction with the instructor using PDAs (Personal Digital Assistants) and demonstrated learning gains. Blodgett [11] evaluated an interactive student response system implemented in a traditional college algebra class and used attitude surveys to show that the students thought that they were learning more, but that the empirical evidence on academic achievement did not support this opinion.

In a more recent work Jonsdottir and Stefansson [6] describe a system for web-assisted education that is used to deliver on-line drill questions suited to individual students. As system focuses on learning rather than evaluation, the students are allowed to continue requesting drill items until the system reports a grade that is satisfactory to the student. The authors provide experimental results to show that the students improve their knowledge while using the system. Jamwal [12] evaluated the impact of using interactive learning modules with classroom lectures compared to traditional methods of teaching and found that interactive learning modules were preferred by students over alternative methods of learning, and that students reported that quiz activities were helpful in learning the material and in correcting their mistakes. Baehler et al. [8] examined the effect of reducing the “seat time” of a large lecture chemistry class by two-thirds and conducting the class in an active learning classroom. The authors demonstrated experimentally that student-teacher contact could be reduced by two-thirds with students achieving learning outcomes comparable with the traditional classroom approach. Other researchers have used commercial platforms (Nearpod) to study the effect of interactive classroom applications on student learning outcomes [13, 14].

3 Introducing Interactive Classroom Applications in Unicorn College

In the Fall Semester 2015 we have conducted a pilot project using the Nearpod interactive classroom application (www.nearpod.com) for students in the first year courses: Business Economics (BE), Introduction to Accounting (IA) and Programming I (P1).

We have selected Nearpod for our teaching because of a number of features designed to support interactive sharing of content with student and effective control of the learning process including continuous feedback to students about their level of knowledge of the subject matter. Nearpod is a software tool which enhances student engagement with interactive content, enables the collection and sharing of student responses and tracking student understanding of the material in real time. During the session students can interact with the lecturer and submit responses through a range of mobile devices (e.g. iPads, iPhones, etc.) or using a computer. Lectures can create interactive presentations that contain different types of content including overhead slides, audio, video, and live Twitter streams. Learning activities include open-ended questions, polls and quizzes. Lectures can monitor and measure student responses on an individual or aggregate basis. Importantly, Nearpod enables import of teaching materials from existing PDF and PowerPoint slides avoiding the need to develop new teaching materials.

3.1 Using Nearpod in our Courses

Unicorn College has participated in the 1:1 iPad program [15] since 2012 ensuring that all students have iPads and can use Nearpod during lessons. During the pilot project Nearpod was used by a total of 168 students (72 part-time and 96 full-
time students). The average age of full-time students was 22.5 years and the average age of part-time students was 30.4 years.

We used different approaches for introducing Nearpod in different courses. In business courses (i.e. Business Economics and Introduction to Accounting) the lecturers used Nearpod at the beginning of the lecture to present lecture slides, and then at the end of the lecture for quizzes and open ended questions, and to provide feedback to students about their level of understanding of the presented material. Instant feedback and discussion of common mistakes motivated students to prepare for the lectures and to review previously learned topics. In the technical course (Programming 1), lecturers used Nearpod continuously during the lecture, running short quizzes and asking open-ended questions with the aim to maintain student engagement during the lecture and providing instant feedback. Students in the selected courses were divided into study groups and each group was given different quiz questions to avoid sharing the questions between groups.

### 3.2 Impact of Implementing Interactive Classroom on Learning Outcomes

Following the introduction of interactive learning using the Nearpod application into our courses in the Fall Semester 2015, we have investigated the impact of interactive learning by comparing the learning outcomes with results attained during previous periods (2012-2014) that did not involve interactive learning. We used two separate metrics:

i) percentage of students who successfully completed the courses (Figure 2, 3 and 4) and

ii) distribution of grades attained by the students (Figure 5, 6, 7 and 8)

Figure 2 shows relatively small increase in the successful completion rates for students in the Business Economics course, mainly for the full-time students.

Figure 3: Comparison of success rates for the IA course

More significant impact on successful completion rates is evident for the Introduction to Accounting course (Figure 3), and for the Programming 1 course (Figure 4). This can be to some extent explained by differences in the use of the Nearpod application in these courses as noted in section 3.1, and by related changes to teaching materials made in connection with the introduction of interactive learning.

As an alternative measure of the impact on student learning outcomes we have used the grades that students
obtained in the selected courses. Figure 5 shows a box plot illustrating a positive shift in student grades for aggregated results across all three courses (i.e. Business Economics, Introduction to Accounting and Programming 1).

Figure 5: Comparison of the distribution of aggregated student grades

Table 2: Grading of results

<table>
<thead>
<tr>
<th>Grade</th>
<th>Scores (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>88-100</td>
</tr>
<tr>
<td>Good</td>
<td>75-87</td>
</tr>
<tr>
<td>Pass</td>
<td>60-74</td>
</tr>
<tr>
<td>Failed</td>
<td>0-59</td>
</tr>
</tbody>
</table>

Figure 6 shows a more detailed analysis of aggregated grades for all students in the three courses (we use the grading indicated in Table 2 to convert scores to grades). The use of interactive learning had a major impact on learning outcomes with the percentage of students who failed decreasing by 13% (from 56% to 43%) and the percentage of students who achieved the highest grade (excellent) increasing by 19% (from 7% to 26%). As illustrated in Figure 7 the reduction in the percentage of students who failed is most evident for full-time students where failures decreased by 23% (from 61% to 38%). For part-time students (Figure 8) the failure rate decreased by 6% (from 52% to 46%), and there was a significant increase in the percentage of students with excellent grades (from 8% to 29%). These results indicate that both full-time and part-time students have benefitted from the introduction of interactive learning using the Nearpod platform, with full-time students significantly reducing their failure rate, and part-time students reaching higher grades.

Figure 6: Comparison of aggregated student grades for all students

Figure 7: Comparison of aggregated student grades for full-time students

Figure 8: Comparison of aggregated student grades for part-time students

4 Student Survey

In addition to objective measures of the impact of introducing the Nearpod interactive classroom application into our courses (i.e. success rates and grades) discussed in the previous section, we have evaluated the effect of interactive learning as perceived by the students using an online survey. The survey was implemented using Google Forms (apps.google.com) and included 23 questions divided into three parts. The first part included questions about the student (gender, age, educational background, field of study, and form of study). The second part included questions about the platform and devices that the students use to access the Internet (i.e. desktop computers, laptops, tablets, and smartphones), and the third part included questions about their experiences with using the Nearpod application.
We have received 57 responses (61% from part-time students and 39% from full-time students) with 71% of the students enrolled in all three courses (i.e. Business Economics, Introduction to Accounting and Programming 1). A majority of the survey participants were male (86%), and the median age of the students was 21 and 29 years for full-time and part-time students, respectively. The average amount of time the students spent online each day was 6 hours for full-time students and 5 hours for part-time students. As illustrated in Figure 9 full-time students made more extensive use of mobile devices (i.e. tablets); this could be the result of full-time students being younger and more ready to use mobile devices [16].

Figure 9: Platforms used by students to study

Majority of full-time students (86%) and part-time students (94%) reported that using Nearpod resulted in a more enjoyable learning experience (Figure 10).

The instant feedback provided by the Nearpod application was rated positively by 90% of the students, 84% of the students found that the use of Nearpod helped them to remain active participants in the class, and 77% of the students felt that the use of Nearpod helped to identify problem areas that required additional study.

Figure 10: Nearpod helped me to enjoy the course

Figure 11: Students responses to survey questions.

Figure 12 shows the responses to a question regarding the effectiveness of the feedback provided by the lecturer using Nearpod, with 88% of students agreeing that the lecturers used Nearpod effectively for providing feedback. Only 9% of full-time students and 14% of part-time disagreed with this assertion.

Figure 12: Lecturer gave feedback effectively by Nearpod

5 Conclusions

While our experience with using an interactive learning platform is still relatively short, it is evident that interactive classroom environment can make the learning experience more rewarding for the students and at the same time lead to improved learning outcomes. Our results indicate that the effectiveness of using an interactive learning platform varies depending on the type of course and on the attendance pattern (i.e. full-time vs. part-time). We have found that the use of Nearpod platform has resulted in significantly improved learning outcomes in the programming course (Programming 1) and in the Introduction to Accounting course, but only minor improvements in the Business Economics course. This could be, at least partially, explained by differences in the style of use of the Nearpod platform in different courses. A more extensive study is needed to establish how interactive learning can be introduced into different types of courses to achieve...
the greatest impact. We have also found that full-time students tend to benefit from interactive learning, with significantly reduced failure rates (of more than 20%). Part-time students are typically more experienced, more motivated and have better ability to time-manage their university activities, so that the impact of interactive learning is limited when compared with full-time students that benefit from a more structured learning environment.

On the negative side, there is some evidence that better attendance of classes resulted from the improved ability of lecturers to monitor student participation; 59% of students reported that they used the Nearpod application mainly to receive attendance credits. Additionally, a small fraction of the survey respondents felt that they would have learned more without the Nearpod application.

Our plan is to expand the use of Nearpod interactive learning across other courses in our college and at the same time evaluate the effectiveness of interactive learning in individual courses.

6 References


