

Title: Using the cloud-based audience response system Nearpod to enhance engagement in lectures.
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OVERVIEW
Overview, Aims and Context (the rationale including underpinning pedagogy) Bonwell and Eison (1991) provide a working definition of active learning as being anything that " <i>involves students in doing things and thinking about the things they are doing</i> ". In this study we describe the use the audience response technology, Nearpod, to enhance interactivity and promote active learning in lectures.
Description Significant opportunity now exists to utilise technology in the classroom in a blended approach to active learning. Solutions such as the audience response system Turning Point have been successfully employed in increasing student motivation (Cain et al., 2009) and help students determine their level of understanding compared to their peers (Efsthathiou & Bailey, 2012). In the teaching of chemistry audience response systems have been used to create a positive learning environment (Vital, 2012) and to facilitate students in large classes identifying points of confusion in the lecture they had received (King, 2011; Cotes & Cotuá, 2014). Recently Shea (2016) has reported on new generation, cloud-based response systems, which offer additional opportunities for active learning, in a science context. A variety of such tools for learning now exist in the form of apps that may be downloaded to student-owned smartphones and tablet devices and some of these have been evaluated (Bryfczynski et al., 2014; Donnelly et al., 2016; Schaller et al., 2015; Wijtmans et al., 2014). In this study we incorporated one of these tools, Nearpod (Moore, 2016) into lectures delivered to pharmacy and bioscience at Ulster University with the goal of increasing student engagement and active learning.
Design The theoretical underpinning of the study followed a model of active learning (Bonwell & Eison, 1991; Prince, 2004). The focus was providing core lectures in mass spectrometry theory and practice to undergraduate bioscience and pharmacy students in a manner that would increase student engagement. While this pilot study is specific to one aspect of science, the use of Nearpod is readily transferrable to a number of discipline areas. <u>Background and Enrolment</u> We implemented Nearpod in a second-year undergraduate module PHA302 Pharmaceutical Analysis in the School of Pharmacy and Pharmaceutical Sciences. The study took place in the 2015/16 academic year with 35 students enrolled. As the module is also delivered to students from other courses (BSc and MSc in Pharmaceutical Sciences), the potential in-class attendance was 42. All students were invited to take part in the Nearpod session and the subsequent evaluation. Nearpod was also used to deliver lectures to first year undergraduate students in the School of Biomedical Sciences at Ulster University on BMS101 Bioanalysis for Nutrition and BMS106 Bioanalytical Chemistry

modules. The total enrolment here was 125.

Both modules focus on analytical techniques used in the pharmaceutical and bioscience disciplines. The principal investigator delivers mass spectrometry material in these modules and had previously incorporated a traditional audience-response system approach to gauge student learning. However, cloud-based audience response systems provide opportunity to make the learning much more interactive and engaging by including activities beyond multiple-choice questions. The lectures constitute approximately 16% of the PHA302 module and 8% of the BMS106/BMS101. Other contributors to the modules did not use Nearpod.

Lecture Planning

For the lectures delivered as part of this study, the following approach was adopted. Key theoretical concepts were delivered in didactic format via Nearpod, followed by a series of multiple-choice questions or polls. This allowed revision of the material just delivered and allowed the lecturer to address any issues raised requiring clarification.

A drawing activity was introduced to test if students understand that an organic, volatile acid was preferred to help promote ionisation in electrospray mode. This gave opportunity for students to actively participate by drawing and submitting the structure. A similar activity was used to test if students could provide a representation of a time of flight mass spectrometer or a quadrupole ion trap mass spectrometer and the stable flight path of an ion trapped within it. These latter activities could not be facilitated using traditional means apart from inviting students to draw the structure on paper and submit to the lecturer in class, or by using a whiteboard; an approach that would be very cumbersome in large lectures.

Other activities, facilitated by the open-ended question tool, allow students to type a response, or leave comments / feedback at the end of the session. These comments are anonymous to other users and may be used by the lecturer to collect feedback on topics or issues requiring further explanation.

Instructor Preparation

An instructor account was registered at www.Nearpod.com and the initial free account, which allows access for up to 30 students, was upgraded to the Gold account permitting 50 concurrent logins. Varying levels of Nearpod functionality exist depending on the licence purchased. Existing lecture material in PowerPoint format was uploaded to the Nearpod site and interactivity elements such as multiple-choice questions (where a score may be assigned based on answering correctly); polls (to gauge opinion and perhaps form the basis for discussion) and "Draw It" elements added using the online dashboard. In the "Draw It" activity, students can draw directly using the digital palette provided. Alternatively, a sketch can be drawn freehand on paper, a picture taken using the camera on the device and then uploaded. A final alternative is to search for an image on Google images, if the lecturer deems this appropriate. Figure 1 shows an example student-facing screen for the "Draw it" activity. In this case the structure of an organic acid was expected as the response.

When the lecturer receives images from students selected examples may then be shared with the rest of the class directly to their screens. Following the session the lecturer may review all of the student responses using the reporting functions in Nearpod. An example screenshot is provided in Figure 2. In the study described here, polls and "Draw It" activities were used primarily.

When planning a Nearpod activity some consideration needs to be given to the lecture location and the availability of Wi-Fi, especially if the session is to be delivered to large numbers of students. It is advisable to consult with the institution's IT department in advance of the lecture to ensure that the location has robust WiFi to cope with the anticipated number of simultaneous logins. In addition, Nearpod has a built-in network indicator to tell if connection with Nearpod servers has been established and the system is working correctly.

Student Preparation

Students were informed in advance that the lectures would be delivered using Nearpod and told to bring their own smartphones, tablet devices or laptops to class. They were asked to download the free Nearpod app, as this would enhance their experience of using the tool. For the BMS101/BMS106 activity, the number of students attending exceeded the number of available logins. In this scenario students were asked to share devices in small groups of two or three.

Delivering the Session

The lecturer generates a unique PIN code that is communicated to all students in the group so they can participate in the session. Students must provide a username to access the lesson and this information is available to the instructor in the reporting area of Nearpod so individual responses may be viewed. In our implementation of Nearpod we have found it helpful to project the student-facing view of the lecture on screen so that if students encountered difficulty accessing the presentation on their devices they are not disadvantaged.

As interactive elements such as polls or quizzes are presented to students they have opportunity to discuss these with peers and then select their chosen answer. The instructor may then share the responses to the group, which for polls and quizzes are presented as a pie chart.

For other elements such as open-ended questions or drawing activities, the instructor can monitor responses as they are submitted in real time using a gallery interface. Exemplar responses may be shared with the group to prompt further discussion.

Post Session

Following the teaching session the instructor may access detailed reports of all student interactions during the lecture and may choose to receive this by email as a PDF document.

For students wishing to access materials after class, this may be facilitated using a “student paced” session where students are provided with a separate PIN and then can access the material in their own time.

Evaluation

Evaluation of Nearpod was centred upon student evaluation of the tool to determine if it provided a more active approach to learning than a traditional didactic learning experience. Barriers to engagement were examined such as student-owned technology, sharing of devices and available WiFi.

Students were provided with paper-based questionnaires that explored their experience of using Nearpod and gave an opportunity for them to detail any problems encountered. There was a mix of free response and Likert-scale questions. Questionnaires were administered just after the Nearpod lectures had ended for BMS101/BMS106 students and at the start of the next semester for PHA302 students. All students who participated in the lectures were invited to attend a focus group where further qualitative information about their experience could be collected. Institutional level online module survey data was also monitored for comments regarding Nearpod.

Ethics

The project was reviewed by Ulster University School of Biomedical Sciences Ethics Filter Committee, project number FCBMS-15-072 and permitted to proceed. All students were provided with participant information sheets for the questionnaire and focus group data collection sessions. Students were informed that their participation was voluntary and that they could withdraw at any time.

RESULTS

Findings and Conclusions:

Questionnaire Data

A total of 63 questionnaires fully completed with Likert-type data were returned and analysed from the two cohorts of students; PHA302 (n=33) and BMS101/BMS106 (n=30). Of the 63 respondents 24 said that they had previously used a technology similar to Nearpod in lectures. The majority of students (37) accessed the lectures via the Nearpod app while 19 used the internet browser on their device; two students used both modes. Five students shared a colleague’s device to participate in the lectures.

All students agreed that Nearpod was an easy tool to learn to use, and 61 students would like to use it again. Seven students said they encountered technical difficulties when using Nearpod on their device.

Figure 3 provides an overview of the responses provided in relation to the perceived learning gains and interactivity opportunities provided by Nearpod. This indicates that students see Nearpod as promoting engagement, improving understanding of materials and enhancing discussion between students. Figure 4 reports on student satisfaction with the use of Nearpod. This is again positive with only a few students reporting dissatisfaction with aspects such as connecting to the institutional Wi-Fi network.

Qualitative free response comments received in the questionnaires corroborate the interactive nature of Nearpod and some of the technical aspects that proved difficult. Representative responses are presented in Table 1.

EVALUATION

Reflective Commentary

In our hands Nearpod has proved to be a valuable tool to increase interactivity in the classroom. In the 2016/17 we extended its use, particularly in larger classes (n~175 students) where stimulating engagement and promoting active learning can be a challenge.

There were some clear issues that arose in the result of this initial pilot study which we have reacted to for future iterations of using Nearpod. ODL at Ulster has opted for the Nearpod "School" licence and although this requires additional financing it provides a number of useful functions and flexibility. Firstly, an increased number of student logins is permitted, so students can now log in without needing to share devices. While sharing may increase interactivity and discussion within the class it is important that student privacy is not breached by previews of personal messages being shown to those sharing the device. It is also possible that in a small group scenario one person may dominate a discussion and therefore other group members may not feel comfortable in voicing their opinion. Licensing that allows students to login individually is therefore preferred.

Secondly, advanced features such as note taking are now possible so students may type their own notes as the lectures proceeds and then have a PDF document containing slides and notes emailed to them directly after the lecture. This provides an additional means of students reviewing material after the lecture has ended and compliments the Nearpod "student paced" mode of delivery which can be used outside of the classroom. Together these two matters address the issue raised by students in our evaluation, of not being able to revisit the material after the lecture has ended.

In our scenario there were no major issues with students using their own devices though a small number did encounter problems accessing Wi-Fi. Barry et al. (2015) have shown that careful design of learning activities to include mobile technologies can assist in constructive alignment with learning outcomes and thereby enhance the student experience. Using tools such as Nearpod increases the type of interactive activities that can be implemented in class. For example, by providing a free response question students may communicate specific queries or concerns they have about material; ask questions anonymously or provide comments.

Moving from a traditional didactic lecture to a more engaging interactive format requires a review of the lecture content. Contact time with students is a valuable commodity and should therefore be used to optimal effect, utilising active learning approaches to deliver and test key concepts. This will inevitably require strategic lecture planning to make room for learning activities while directing students to other resources that may be consulted outside the scheduled lecture.

Student Engagement (to be completed by the student partner):

All students who participated in the evaluation were invited to attend a focus group. Six students attended, (two male and four female) all from the year one BMS101/BMS106 cohort. The discussion was designed to gather information from the students regarding their use of Nearpod. A selection of responses is provided below.

Students were asked “What was your general impression of using Nearpod in class?”

All students described their general impression of Nearpod as being positive. They used various phrases to describe their experience including, “I enjoyed it because it’s interactive”, “the interactive questions were relevant to the content we recently covered and helped to reinforce our understanding of the topic” “it tests your knowledge of the subject and if I don’t know the answer to a particular question I then know that I need to focus on that area when revising”, “it makes you take part rather than sitting back during lectures”.

Students were asked “Did you encounter any technical issues when using Nearpod?”

All students agreed that the only technical issue was the limited amount of logins available. Fifty students were able to log in whilst the remainder of the class shared with those able to log in. One student suggested that the drawing tool could be more user friendly, whilst the remaining five students were pleased with it in its current form.

Students were asked “Are you happy to use your own device in class for activities such as Nearpod?”

All of the students were happy to use their own device during class. One student pointed out that they had a device that was unable to connect to the University’s Wi-Fi. This issue was rectified, however the student was concerned that there may be others that do not have the capability to connect to the Wi-Fi.

Students were asked “If you didn’t have your own device would you be happy to share with others sitting nearby in the lecture theatre?”

Five students were happy to share their device with other students during lectures, and described it as being another way to build cohesion and get to know classmates. One student said they wouldn’t mind sharing with someone they knew but were concerned that previews of personal messages may be viewed on their device.

Students were asked “Do you think that you learned more about the topic when presented using Nearpod than if a traditional lecture format had been used?”

All of the students stated that they believed they learned more when using Nearpod than the traditional lecture format. Nearpod was described as being “more engaging” and that it “kept my attention better than usual lectures”. Nearpod aided one student in recalling details about the topic whilst ordinarily they would have to revisit their lecture notes several times. Another student agreed and stated that “because [I am] involved in the class a lot more than normal I take more notes”

Students were asked “How might lectures with Nearpod be improved for the future?”

Students would like to see Nearpod available to every student. One student said that they would like to receive the lecture notes after the class, including the questions and answers that had been posed during the lesson. It was questioned whether the tool could be used remotely. One student said that in an ideal world they would be given a device to use Nearpod on such as a tablet.

Students were asked “Would you like to see Nearpod used again in your studies?”

All students would like to see Nearpod used again in their studies. Three students would like to see Nearpod used in other modules as well, particularly those involving complex [biochemical] pathways.

Learning Environment and Engagement:

The challenge of promoting active learning in STEM subjects can often be stifled by the physical spaces assigned to learning activities especially when there are large class sizes. Dugdale concludes that campuses need a “participatory architecture” to support communities of learning, harnessing the power of “existing physical place and the emerging virtual space” (Dugdale, 2009).

In tiered lecture theatres opportunities for group work and collaborative learning are limited, yet this setting is where a large number of learning activities still take place throughout the higher education sector. Feature-rich audience response systems such as Nearpod can assist in making learning much more active, even in large lecture theatre scenarios.

Impact

Our project as described here represents a viable means of utilising technology to enhance interactivity in lectures. Of particular relevance to science educators is the Nearpod drawing tool that allows students to submit sketches of structures, representations of equipment, mathematical calculations or annotation of figures / diagrams. It may also be possible to sketch a graphical representation of data and then submit these to the instructor who can readily share examples with the class.

In real time both staff and students are able to assess the level of learning that is taking place as a lecture proceeds. As the technology features a wide range of response types, communication between teaching staff and students is readily facilitated. Further explanation of topics requiring greater clarity can be given based on responses received during the class. As a majority of students have their own smartphones or tablet devices there is no need for additional hardware.

STRATEGIC DEVELOPMENT

Transferability

Nearpod and similar tools can be incorporated into any discipline where audience response systems can normally be used to assess learning or facilitate discussion between students especially in large lecture situations.

Dissemination (internal and external)

Conference Presentations / Lectures on the Use of Nearpod:

HEA STEM Conference, Manchester, January 2017

<https://www.heacademy.ac.uk/stem-conference-2017-session-7-abstracts>

Lecture on Nearpod delivered to students on MSc Blended and Online Education at Edinburgh Napier (via WebEx), November 2016

UK Bioscience Education Summit, University of Bath, September 2016

<https://share.nearpod.com/vsph/UcAdJ7fCMu>

Demo of Nearpod to collect staff feedback at School of Biomedical Sciences Strategic Planning Day, June 2016

Demo of Nearpod at Faculty of Life and Health Sciences Community of Practice Event, April 2016

CHERP Conference, Ulster University, Jordanstown, January 2016

Publication

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SUPPORTING INFORMATION

References (using Harvard style, list literature and other resources that influenced your work)

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Table & Figures

Table 1 Free response comments from students in questionnaires

<p>Positive aspects of using Nearpod in class</p>	<ul style="list-style-type: none"> • <i>Allows more interaction with the lecture material</i> • <i>I engaged better in the class</i> • <i>Very interactive, encourages you to pay attention and engage.</i> • <i>Interactive and can see notes up close.</i> • <i>Simplicity and convenience of presentation on phone.</i> • <i>Easy to use and fun way of learning.</i> • <i>Very engaging, helped me to really grasp what we were studying by doing questions at the end.</i>
<p>Aspects of using Nearpod in class that could be improved upon</p>	<ul style="list-style-type: none"> • <i>If you are using a phone device and have to share it can be quite small.</i> • <i>The amount of people being able to be connected at one time.</i> • <i>The ability to look back at previous slides.</i> • <i>It seemed unnecessary – most of what was done could have been done on paper or using the TurningPoint handset.</i> • <i>If we were able to take it home to use; this was changed so we could... which worked brilliantly.</i> • <i>PowerPoint lectures on BBLearn are still better for revision, however this is still good for involvement in a lecture.</i> • <i>Being able to edit notes, for extra material mentioned in lecture.</i>



Figure 1: Example “Draw it” activity on Nearpod where students can submit a sketch to the lecturer using the draw function, browsing files on their device or searching Google images.

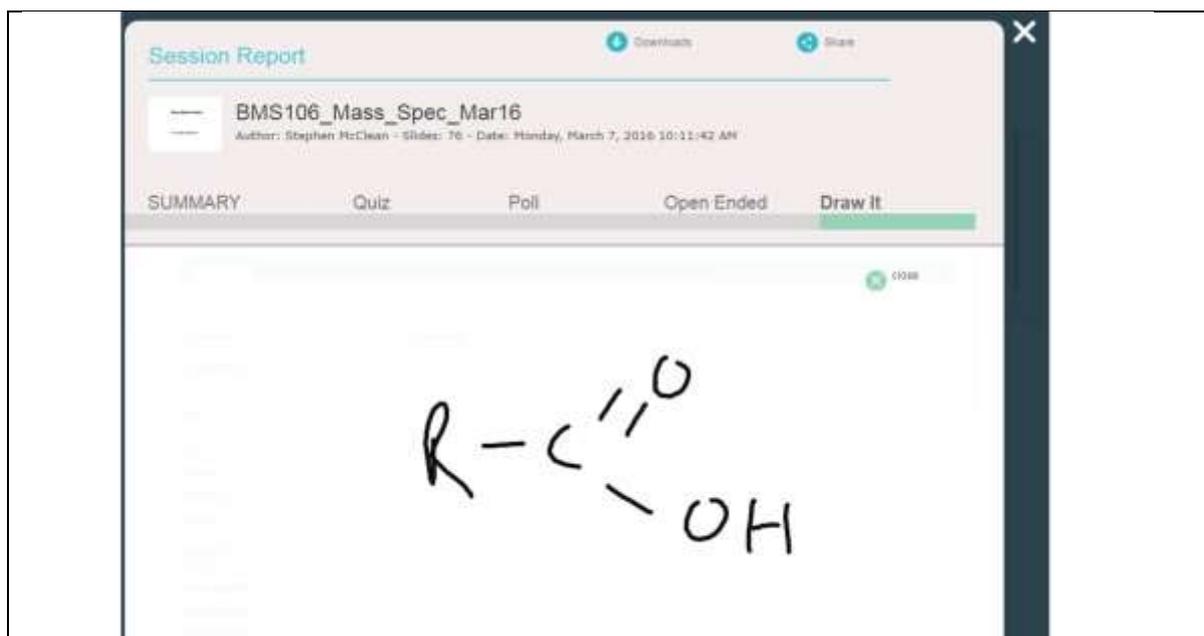


Figure 2: One aspect of the “Session Report” that can be browsed by the tutor after the session. Individual responses may be reviewed as per the screenshot above.

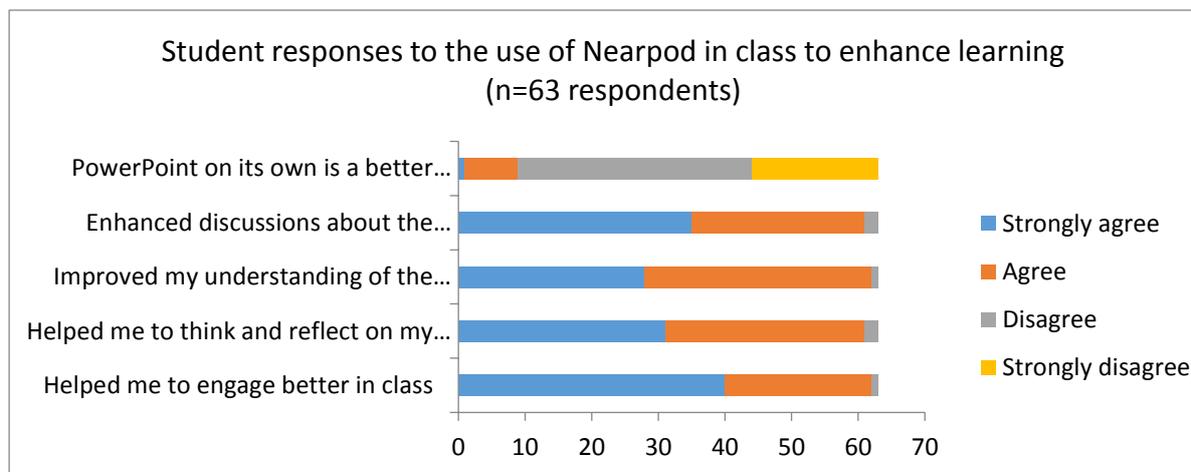


Figure 3: Student responses to the use of Nearpod in class to enhance learning; n = 63 respondents.

