

# CONTINUOUS, REAL-TIME ASSESSMENT OF EVERY STUDENT'S PROGRESS IN THE FLIPPED HIGHER EDUCATION CLASSROOM USING NEARPOD

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## ABSTRACT

*The flipped classroom has developed a solid following, but implementing it in the higher education setting, where class sizes can be quite large, still presents formidable challenges for the venturesome instructor. While recently published results tend to focus on class sizes of 25-35, this paper introduces a novel approach that effectively scales to class sizes of 50-60 and possibly more. In addition, the in-class real-time assessment of student performance, integral to this model, provides a motivation for students to complete the pre-class work thus insuring the effective use of active learning elements during class time.*

## INTRODUCTION

Today, students bring smartphones, laptops and tablets to the classroom to keep up with friends or alleviate boredom and less often to enrich learning. Some colleges and universities are now providing tablets to students, but adding technology components is not new. About 15 years ago our institution required laptops for students in all MBA programs. This sounded like a good idea, but the faculty made little effort to incorporate the technology into the educational experience and students rightfully complained about the unnecessary expense. It is important that technology is used to enhance learning and not just be a flashy new gadget. Augmenting learning with personal technology was and continues to be a difficult challenge at many schools.

Late last year, our Physical Therapy (PT) Program decided to provide iPads to all students. Even though much has changed in the last 15 years, finding a way to effectively incorporate them into the classroom continues to elude even the most dedicated, tech savvy instructors. This paper details the successful implementation of tablet technology into the classroom by an instructor determined to find a better way by combining the flipped class model, with active learning and continuous real-time assessment.

A review of the literature reveals that while there is no one size fits all path to successfully incorporating technology into a content rich higher education learning experience, there are a number of promising techniques for capital-

izing on new technologies in the classroom. While the concept of the flipped or inverted classroom has been in the literature for over a decade, the popularity and recent growth in short format video on demand narrowcasts (vodcasts) has added a new tool to engage students outside the classroom.

Vodcasts are not a guarantee that students will complete the pre-class work necessary to free time for the introduction of active learning into the classroom. Some students prefer audio only podcasts, while others prefer the more traditional textbook readings and written assignments. And there will always be those students who will not do any pre-class work no matter what techniques are used to make it more palatable.

The results reported here are significant for two reasons. First, 49 student attended the course, a very large class size in the context of the recent research on active learning. Second, the in-class assessment was at the individual level and in real-time. The near immediate feedback enabled the instructor to quickly adapt the content delivery to maximize learning outcomes.

To achieve the overall goal of integrating technology into the PT course in a meaningful way, efforts detailed in this paper were directed to:

1. Flipping the classroom experience and eliminating in-class lectures.

- Identifying in-class activities requiring students to interact with the tablets (not just view content).
- Devoting most of the in-class time to student analysis and discussion of patient case scenarios.
- Pinpointing content and application problem areas for students, whether for a few students or a large percentage of the class.

### FLIPPED CLASSROOM AND ACTIVE LEARNING

The flipped or inverted classroom has been described by numerous authors, (Gannod, Burge, & Helmick, 2007; Lage, Platt, & Treglia, 2000; Steed, 2012) but generally follows the description recently detailed by the Educause Learning Initiative (Educause, 2012).

The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. The video lecture is often seen as the key ingredient in the flipped approach, such lectures being either created by the instructor and posted online or selected from an online repository. While a prerecorded lecture could certainly be a podcast or other audio format, the ease with which video can be accessed and viewed today has made it so ubiquitous that the flipped model has come to be identified with it.

The primary goals of the flipped or inverted classroom are to reduce or eliminate the "passive" traditional lecture and to free class time to add active learning elements. Much has been published about the benefits of active learning, but little is reported for class sizes over 30. Working on a NSF grant, Prince synthesized research that spanned over 20 years (Prince, 2004). His article contains 57 references from a wide range of disciplines. Even though the research is persuasive, some students still prefer the traditional lecture format (Butt, 2013). For this paper, we draw upon Prince's definition of active learning, specifically:

Active learning is generally defined as any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing. While this definition could include traditional activities such as homework, in practice active learning refers to activities that are introduced into the classroom.

The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor.

For the flipped classroom to be effective there is a chain of events that must fall into place to enable active learning to be successfully deployed in the classroom. First, creating or selecting engaging and illuminating pre-class materials and assignments. Second, students must be motivated to complete the pre-class material. Last, the level of knowledge gained from the pre-class material is sufficient for students to fully participate in the in-class learning elements. As a result, there are many challenges to successfully employing the flipped class model.

### OVERVIEW OF THE NEW COURSE PEDAGOGY

Vodcasts, smartphones, electronic textbooks and tablet computers such as the Apple iPad, Google Nexus, Samsung Galaxy Note and Microsoft Surface are just a few of the latest advances providing opportunities to enrich student learning with technology. Technology can be a double edged sword since students may use it more for entertainment than as a tool for learning. Over 10 years ago we heard a professor at a large, nationally ranked MBA program claim that they had banned laptops in their MBA classes since students spent more time day trading stocks than using the computers for course related work.

Our flipped class initiative began when the faculty in the Doctor of Physical Therapy (PT) program decided to provide each incoming student with an iPad. The difference between the MBA experience 15 years ago and the PT decision can be traced to some enthusiastic professors. As with many initiatives in higher education, an advocate or evangelist picks up the baton and starts running with it. In this case, one of the PT professors searched for software that would enable her to integrate technology in a meaningful way. The Nearpod application was identified as particularly well suited and a few trial class sessions were designed with it.

The course selected for the experiment was Physical Therapy Management of the Pediatric Patient (PT 640) offered during the fall 2012 semester. It is the only pediatric course in the program and is taken by the second year students in the three year program. The course met twice a week for a full two hours. Enrollment for this offering was 49 students, but can go as high as 60 students.

The instructor had taught this course for 15 years using a traditional approach. Typically, students were assigned to read about four chapters before class in a textbook with 1400 pages. The course covered most of the textbook by

the end of the semester. During class, the professor lectured using PowerPoint slides to clarify content, with the hope of having time to present patient cases scenarios for students to apply the concepts. Student grades were determined by class and lab participation, quizzes and a final exam. As a result, a few students answered most of the questions posed in class. Many students were not confident or adequately prepared to participate in the more active elements and formative assessment was difficult.

The decision to provide an iPad to all PT students created the opportunity to try a new model. Based on the results of the initial trial, the Nearpod application was regarded as a good fit for the new pedagogy. In addition to providing active elements, Nearpod also provides a means for continuous assessment of student work in real-time during class. While iPads were the primary interface for both the instructor and students, laptops and smartphones can also be used by students to connect to the Nearpod session.

The next step in the revision of the course was to invert the material and move the existing PowerPoint slides to pre-class work. The PT students had become quite reliant on the slides and did not want to give them up. To further motivate the students to complete the pre-class assignments, the instructor created vodcasts by annotating the PowerPoint slides with video and audio of her lectures. The vodcasts were usually recorded in her office or at home. The vodcasts were then posted to a wiki for students to view at their convenience before class. The textbook was still required but student feedback indicated it was used more as a reference than as a primary resource.

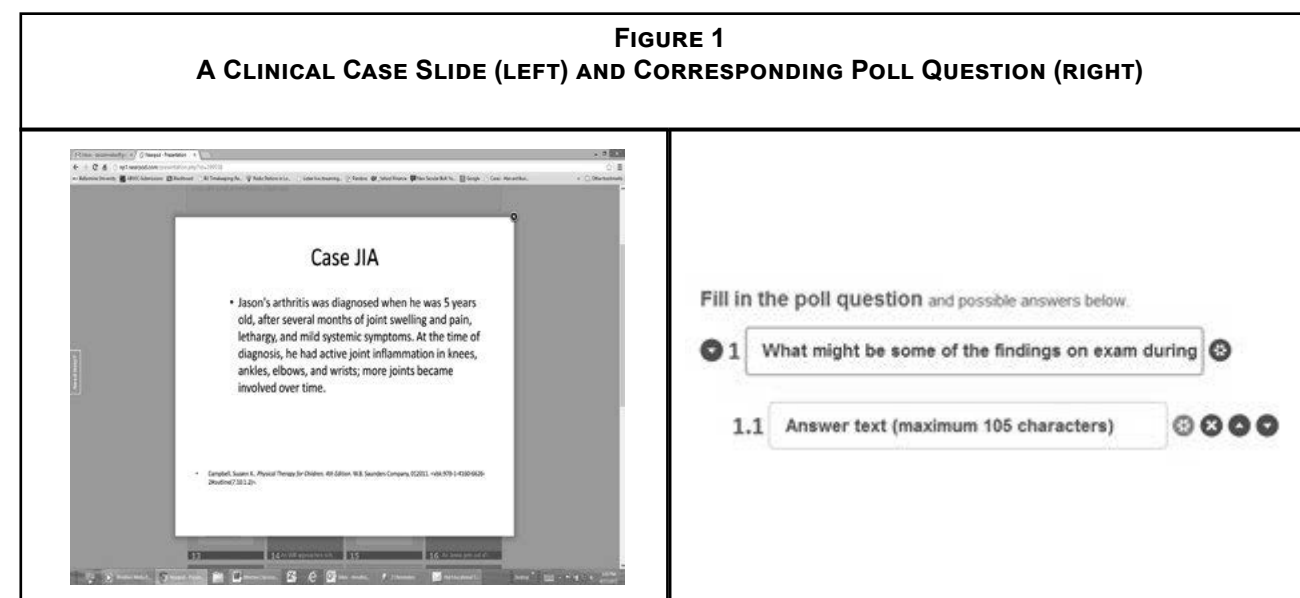
### THE NEW MODEL IN THE CLASSROOM

In the new model, as students arrive they connect to the Nearpod session. A list of each student connecting is continuously updated on the instructor's iPad. For the PT program, class attendance is mandatory. If a student decides to browse the web or read email during class, Nearpod notifies the teacher that the student has left the session. The entire Nearpod session is recorded, so the teacher can see who was and was not signed onto the session for later analysis.

The literature indicates that the typical flipped class begins with the instructor asking if there are any questions on the pre-work (Gannod et al., 2007; Lage et al., 2000). In the continuous, real-time model however, the student is presented instead with a slide briefly describing a patient "case" scenario. The case is then followed by an open-ended question or a multiple choice question requiring a student reply. An example of a case slide (left) followed by a poll slide (right) is shown in Figure 1 below. Each student's response is displayed on the teacher's iPad. The teacher is in full control of the session. Students cannot advance to the next slide until the teacher makes it viewable.

The teacher peruses the answers as they are displayed. A quick assessment is made to discuss the replies, question the class further, move to the next slide, or provide a mini-lecture explaining any misunderstood concepts. Students can only see the responses of other students if the teacher decides to share them with the full class. For multiple choice questions, a pie chart, aggregating the replies, can be shared with the whole class, if desired.

**FIGURE 1**  
**A CLINICAL CASE SLIDE (LEFT) AND CORRESPONDING POLL QUESTION (RIGHT)**



If a number of students answered incorrectly, the teacher asks the class (or even specific students) why they responded as they did. This enables the teacher to bring the rest of the class into the discussion. It also provides the ability to focus the discussion a particular concept or clarify a misconception. Since the Nearpod software records all student responses, which are downloaded as a spreadsheet following the session, the instructor is able to determine if a student is struggling with the material or may not be preparing fully for the class meeting. If so, a follow-up one-on-one meeting can be scheduled to remediate the problem.

Adding the Nearpod technology into the flipped classroom provides three distinct capabilities. First, it provides a means to continuously monitor student performance in real-time instead of the customary test or class participation approach. Real-time feedback is a key element in successfully deploying this model for larger class sizes. Second, it provides five “interactive features” on the iPad that facilitate active learning in the classroom. Third, it motivates students to complete the pre-class work since students are assessed on comprehension of the material in every class. As a result, about 80% of the students came to class prepared versus the approximately 20% using the traditional passive learning approach.

### OVERVIEW OF NEARPOD

The Nearpod app was developed by Panarea Digital in Argentina primarily for iPads. While we began with the free edition, now called the silver edition, it soon became apparent that the capabilities of this edition did not meet our needs. Since many of the PT classes have 60 students, the decision was made quite early to upgrade to the school edition. There is also a gold edition for those who don't need all the features of the school edition. The following sections assume use of the school edition, but for those who want to start with the free edition, we will discuss some of the limitations and differences in the next section.

Instructors now have two options for creating a Nearpod session, a Windows or Mac computer or directly on the iPad. There are two primary components for the instructor – create and assess. The create component of the site provides the tools to create an interactive Nearpod session for use in the classroom. The assess section provides reporting for every slide in every deployed session including who viewed it and the student's response on all interactive elements.

There are eight different “features” that can be added to a session. A description of the function each performs is shown in the table below along with a column indicating

its learning modality. The first item on the list is a “slide” which is actually a non-interactive feature, even though Nearpod lists it as an interactive feature. From the “active learning” perspective, the slide, slide show and video are passive elements, so only the last five are listed as active learning options.

The Quiz and Q&A slides can either be multiple choice or fill in the blank. Q&A elements, as with Polls, are graded as the students respond so the teacher can get immediate feedback on how well the class understands a particular concept. Quizzes are groupings of questions that the students go through at their own pace and are scored together at the end of the quiz. The teacher also has the option to share responses with the rest of the class.

Draw It provides some interesting features. There are two basic options, drawing on a blank screen or posting an image and allowing the students to draw on the image. The second option is particularly useful to see if the student can identify an element or elements of the image. For instance, the image might be a picture of a human skeleton. The teacher could ask the class to circle the location of the tibia. When starting with a blank screen, students can be asked to create a graph, chart or drawing.

When a Browse the Internet slide is shared with the class, students are redirected to the webpage specified in the interactive slide. Students are able to browse the site and can link to other sites if the option is provided. For instance, if the link is to Google, students can enter a search term then go to another site. We found in some cases they cannot return to the previous page. The teacher can move to the next slide however, and get the students back on track if this occurs.

sive link to an external site. A requirement of every session is that it must have a minimum of three non-interactive slides, the first two and the last one in each session.

While using Nearpod looks quite easy, there are a number of not so obvious steps that are detailed here to help minimize first time user frustrations. A good way to get started with Nearpod is to log on to their website, create a new instructor account and create a “trial” session to become familiar with the process and features. Each session contains a sequential series of features that look like PowerPoint slides. We will continue to refer to these as features, since one of the features is called a slide. As with any class, we recommend having a clear idea of goals and learning outcomes. Next, draft a rough storyboard of the session with the appropriate feature and ordering that best suites the activities and pace of the class.

The storyboard does not need to be perfect since features can easily be added, deleted and rearranged. To start creating a session, select create then “new presentation.” This is also the process for editing a previously created session. Two options are provided, “start from scratch” or “drag your PDF, image or zip file here.” A previously created PowerPoint (or a Keynote) presentation can be used as the starting point for the “drag option” provided it was saved as a PDF file. For the “drag option,” Nearpod will assume one slide per page in the PDF file.

When using the drag to start option, Nearpod creates a non-interactive slide for each page or image imported. A thumbnail of each slide is presented to the user and the slides can easily be rearranged as necessary. The thumbnail list only displays the actual image for the non-interactive slides. For the interactive slides, the corresponding feature icons are displayed. To view or edit an interactive slide requires double clicking on the thumbnail.

At this point, any of the eight features can be added to the presentation with the caveat that the first two and last one must be a “slide.” When selecting elements, keep in mind that students can take a screenshot including ones they have drawn on (Draw-It). This can be a useful option for students who would like to keep a copy for future reference by “taking a picture” of the iPad or PC screen. This can also be a liability if the instructor plans to use the same session for another class.

Once the session is completed, it must be published. A published session is ready for use in class, but it is no longer editable. If changes need to be made to a published session, the published session is duplicated and the duplicate is edited. The instructor can delete any session that is no longer needed.

In the classroom, sessions can only be initiated by the instructor from an iPad, not a PC or Mac. After logging on

### CREATING AND INITIATING A NEARPOD SESSION

Before jumping onto the website and creating an account, there are a few limitations that while understandable, might be non-starters for some. There are three Nearpod versions, silver (free edition), gold and school. The silver edition can accommodate a maximum of 30 students simultaneously connected to a teacher session. For gold, the maximum is 50 students and 100 students for the school edition. Silver only works with iOS while gold works with iOS and PC/Mac. The school edition adds Android capability to the iOS and PC/Mac operating systems.

The maximum size of a session is 20 MB (silver), 40 MB (gold) and 60 MB (school). Since the session is “published” to the cloud, the positive aspect of this limitation is the reduced download time for each student when they connect to the site. Large image and video files are limited in size to 10 MB, but there is an option to create an exclu-

Feature	Description	Learning Modality
Slide	Upload a PDF or image file to add one or more slides to your current presentation (non-interactive feature)	Passive learning – all sessions must begin with two of these and end with one
Slide Show	Upload images or zip file to show pictures as a slide show	Passive learning, although allowing students to view slides at their own pace could be considered active
Video	Insert a video (in MP4 format and up to 3 minutes) in your presentation to play back on participant devices	Passive learning, although again, the students can start, stop, review and rewind as long as that slide is in active display mode
Q&A	Pose a live question, assess students and show results to the audience in real time	Active learning tool
Quiz	Provides a series of test questions for participants to answer at the own pace and track their progress	Active learning tool
Poll	Survey your audience and reveal poll results in real time	Active learning tool
Draw It	Ask your audience to draw on their device over a blank canvas or an image background, then select drawings to share with group	Active learning tool
Browse the Internet	Share web pages with users	Active learning tool

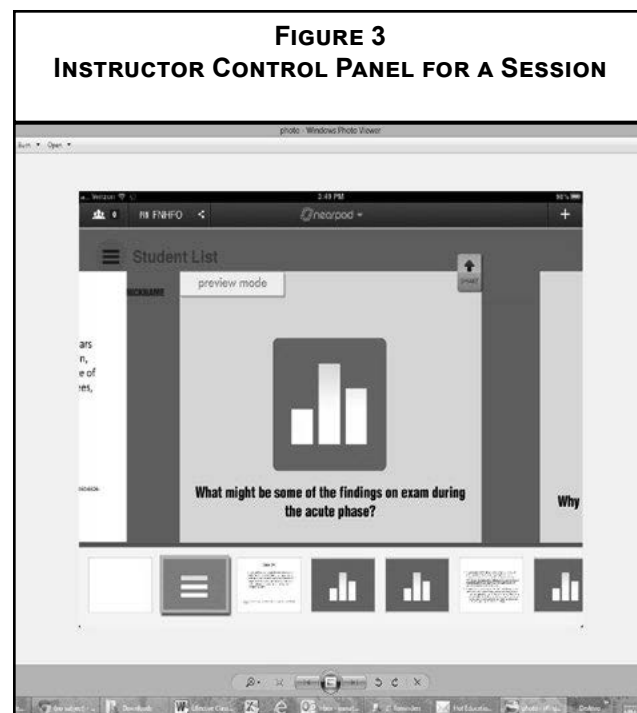
(Figure 2) and selecting a session, the teacher is presented with the session screen like the one shown in Figure 3. The five character “pin” code shown in the top left of the teacher control panel is provided to the students. The students enter the pin in the student box (Figure 2) and are connected to the session. Students using a PC/Mac or non-Apple smartphone join a session by starting a web browser and pointing it to [www.nearpod.com/web](http://www.nearpod.com/web).

A screen, similar to the one shown in Figure 3, provides the instructor the means to control the flow of the session. Along the bottom are thumbnails of the slides that precede and follow the large slide shown in the center of the screen. At the top left of the large slide is a label stating “preview mode.” This label indicates that the slide is ready for display on student device, but it is not yet viewable by the students. When the instructor taps the “share” label on the top right, the slide is immediately displayed on all student devices. The teacher is in full control of what the students can and cannot see and when the students can view the content.

The top bar contains a number of useful items. From left to right, the first item is a count of the number of students who have connected and downloaded the session. The next item to the right is the pin code that students use to connect to the session. If the instructor touches the pin code, an email box is presented that contains the instructions on how to connect to the session, which can be sent to students. The plus sign to the far right brings up a menu that allows the teacher to log out of the app.

### INITIAL FINDINGS AND TECHNICAL ISSUES

The first few classroom meetings were quite an adjustment for students, but they adapted to the new flipped



approach and real-time technology fairly quickly. The initial novelty of the iPads in the classroom wore off after a few weeks and was replaced with “this is the new norm” and not grumblings or complaints. Having the weblink, which provides access for PCs and smartphones, was useful when iPads were left at home or not fully charged. Students were able to participate on laptops or desktops available in the back of the classroom.

The instructor observed that students seemed more motivated to complete the pre-class work. More students were using the textbook even though there were no required reading assignments. It is difficult to determine which contributed the most to student preparation, the vodcasts or the real-time in-class assessment, but about 80% of the students came to class prepared.

For this course there were three, 30 minute quizzes and an extensive final exam. Student performance on the quizzes was about the same as in the previous, traditional course model. Overall student performance on the final exam however, was much improved over courses employing the traditional model. The grade distribution was higher with considerably fewer students receiving unsatisfactory grades. Throughout the semester, fewer students fell behind or had trouble keeping up with the content. Our results are consistent with those published by Penn State (Young, 2011) stating:

Ken’s experience with ACCTG 211 is very telling. The class average has jumped from 60-70 percent

of students passing prior to implementing the changes to over 80 percent in the semester with this approach. The percentage of students earning As has increased from 12 percent to 26 percent in a single semester.

One of the more remarkable aspects of this new model is that it was effective for a rather large class of 49 students. We cannot predict the upper limit on class size, but we are comfortable that it will be able to effectively handle class sizes up to 60.

From a technical perspective, the most common problems were log on frustrations and some sessions freezing on a few iPads. It became apparent very quickly that the wireless coverage in the classroom was not adequate to simultaneously deliver the session to 50 iPads (49 students and one teacher), in a reasonable amount of time. The weak wireless coverage appeared to account for some of the iPads freezing. The IT department quickly installed more wireless coverage and that growing pain was alleviated. We strongly recommend having the classroom wireless coverage analyzed before attempting to implement Nearpod.

One further technical note regarding Nearpod is that it is not Internet Explorer (IE) friendly. In fact their website emphasizes the use of Chrome, Firefox or Safari for satisfactory results. There is a Chrome app available for students connecting with smartphones or Windows PCs. Having students download a browser should be a pre-class assignment since it would demand a lot of bandwidth if attempted during class.

Other than the items mentioned above, we are not anticipating any changes to the pedagogy for next semester. Integrating Nearpod did not add significantly to the prep time for a flipped class, but appears to substantially improve overall student preparation for class activities and performance on the comprehensive exam.

Future research will center on applying this new model on class sizes closer to 100, the current Nearpod limit. In addition, we plan to incorporate recent research (Chen & Sager, 2011; Njoroge, Norman, Reed, & Suh, 2012; Wergin, Tracy, & Dykstra, 2011), to better understand why quiz performance did not show much change while overall student performance on the final exam was significant and consistent with the Penn State findings.

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