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In this issue:

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INFORMATION SYSTEMS EDUCATION JOURNAL

Editors

Flipping Excel

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Abstract

The "flipped classroom" model has become increasingly popular in recent years as faculty try new ways to engage students in the classroom. In a flipped classroom setting, students review the lecture online prior to the class session and spend time in class working on problems or exercises that would have been traditionally assigned as homework. The ability to easily create and consume multimedia on personal computers, tablets, smart phones, and personal media players, and the increased availability of web-based tools for collaboration and communication are two factors that contribute to the popularity of the flipped classroom. This paper presents an implementation of the flipped classroom pedagogy in a first-year introductory Information Technology course, specifically focusing on how these techniques were used to facilitate students' experiences learning Excel concepts.   A survey given to students in three sections of the course suggests that students found the instructional methods captured their interests, challenged them, and contributed to their learning.

Keywords: flipped classroom, inverted classroom, Excel, active learning, undergraduate education

1. INTRODUCTION

The flipped (or inverted) classroom has become a popular pedagogy in secondary and tertiary education for teaching science, mathematics, and other courses. In a flipped classroom, students watch or listen to recordings of class lectures on their computers, tablets, smart phones, or personal media players outside of class, leaving class time to engage in learning activities that might otherwise be assigned as homework. (Knewton.com, 2011)

Bergman and Sams (2012) are often credited with operationalizing the flipped model in their high school science classroom in 2007 when they recorded narrations of their PowerPoint presentations as podcasts for students who missed class. The use of electronic equipment to record classroom lectures, however, has been found as early as 1977. Gibbons, Kincheloe, and Down (1977) reported that tutored videotape instruction through the use of "unrehearsed,

unedited video tapes of regular classroom courses, which can be produced at very low cost" (Gibbons, Kincheloe, & Down, 1977, p. 195) enhances student learning. Among their reasons cited, students can review the tapes at their own pace and listen again to those sections that present important or complex concepts.

Day (2008) introduced the term "web lectures" to refer to "multimedia presentations that integrate talking head and torso video, audio, lecture slides, table of contents, and navigation controls, which are made available via the web (streaming or download)" (Day, 2008, p. 3). The subject of the web lecture is not rehashed in the classroom but rather extended or applied to allow for new learning opportunities.

This paper reports on an implementation of the flipped classroom in an introductory Information Technology classroom through the use of student-generated screencasts (screen video recordings) that demonstrate spreadsheet

techniques and concepts. A student survey suggests that students embraced this instructional model and the classroom interactions it enabled. This paper focuses on developing techniques for structuring a flipped classroom to teach spreadsheet concepts and shares student reactions related to engagement after participating in this active learning experience.

2. VARIATIONS IN IMPLEMENTING THE FLIPPED CLASSROOM

Several recent studies (Day, 2008; Strayer, 2007; and Demetry, 2010) have focused on the effectiveness of the flipped classroom on student learning and the additional opportunities for collaboration and problem solving that it enables.

The literature shows several variations in how individual instructors flip their own classrooms. Many instructors record their own lectures (or have them recorded), while instructors of mathematics, science, history, finance, and other disciplines frequently make use of some of the 2600 videos from Khan Academy[i] as resources for their flipped classrooms. (Houston & Lin, 2012) Rather than providing video lectures, Demetry (2010) provides lecture notes for students to read lecture notes at home prior to the class session. This helps meet the goal of increasing "time on task" to complete course-related activities. Student teams check in by responding to "clicker questions" to report their progress as they work on the exercises.

Day and Foley note that web lectures are "purposefully kept at around 20 minutes in length to help maintain the attention of the viewer." (Day & Foley, 2006, p. 196) They remark that the same material would likely take twice as long to deliver in the classroom because there are no interruptions for questions or announcements.

Given the documented effectiveness of the flipped classroom model on learning across disciplines and grade levels and the variety in methodologies for implementing it, these research questions emerged for creating a flipped environment in the Information Technology classroom:

- Will students find peer-generated screencasts an effective method for demonstrating spreadsheet concepts?
- Will students of a variety of academic abilities embrace the flipped classroom model?
- Can a flipped classroom experience also encourage students to use web-based collaboration tools?

3. FLIPPING EXCEL IN THE INFORMATION TECHNOLOGY CLASSROOM

IT 101 (Introduction to Information Technology and Computing Concepts) is an introductory IT course required of all first year students at Bentley University, a business university located in Waltham, MA, USA. During the Spring 2012 semester, the author taught three sections of the course to academically varied groups of students:

- a day honors section, for students enrolled in the honors program, chosen because of their high scholastic abilities;
- a day accelerated section, offered to students who self-selected to be this section because of their interest in technology; and
- an evening section, open to all full-time and part-time students.

The evening section had a mix of 35 traditional and older students and met once per week for 150 minutes, while the honors and intensive sections each had 24 students and met for two 75-minute sessions each week.

The course covers digital literacy topics, basic web development, maintaining laptops, wireless networking, and current web trends. Approximately ten of the 24 class meetings each semester introduce beginning and intermediate Excel topics, so when considering how to implement a flipped classroom approach in IT101, flipping Excel seemed to be a promising choice. For the day sections which met twice weekly, most Mondays were designated as Excel days, and Wednesdays were spent covering other course content. In the evening section, usually the first half of class was spent on other course content, and the second half of class spent on Excel topics in the flipped classroom approach. The only reason for teaching Excel during the latter half of a night class was a practical one: after completing the group exercise, students could leave at the end of class.

The content, structure, and exams for all three sections were virtually identical. The honors and accelerated sections had more involved assignments than the evening students, and these students often brought in external readings for class discussion. The graded Excel assignments were the same, both in class and out of class, for all three sections. The depth of discussion, number and variety of questions, motivation of students, and degree of help and explanations that the instructor provided varied greatly between the sections.

All students must complete exercises from a textbook companion web site to demonstrate their mastery of the course topics. Students submit their completed assignments online and, soon afterward, receive an automated report summarizing their scores and indicating which steps are correct. Students have up to five attempts to complete these exercises; their highest score counts toward their final grade.

Prior to the flipped classroom approach, the instructor would explain Excel concepts in class or demonstrate a tutorial from the textbook during class as students tried to follow along on their laptops. They would then go home to complete the mastery exercises.

In the flipped approach, when students watch the instructional videos before class, there is no in-class demonstration or lecture by the instructor. Students immediately get to work completing an in-class group activity. Also, the instructor is readily available to help students complete these exercises; whereas at home, students are on their own or need to visit the tutoring lab or the instructor at a later time if they require assistance in order to complete the assignments.

These guidelines influenced the implementation of the flipped IT 101 classroom, whose 75-minute sessions usually followed this structure:
- five minutes: welcome and announcements
- five minutes: quick quiz based on videos
- five minutes: explain in-class activity
- 40 to 45 minutes: complete the in–class activity in groups
- 15 to 20 minutes: debrief, where each group shares what they did, how they solved a problem, problems they encountered

This structure creates an active learning experience where "learners participat[e] in open-ended, learner-centered activities that involve practical, meaningful application of the concepts of interest; collaborative problem solving and opportunities for public/personal articulation and reflection are also important" (Day, 2008, p. 27).

Creating Screencasts
For this study, the instructor reached out to student tutors in the CIS department's learning lab to create two or three instructional screencasts per chapter for IT 101 students to watch. Tutors worked with the instructor to identify and discuss content for the videos. Their work as tutors during previous semesters or their own experience learning Excel themselves in IT 101 made them uniquely qualified to create the instructional videos. They were familiar with, and therefore able to address many frequently asked questions on Excel topics. There were no limitations as to style or format of the videos; students could be as creative as they wished. The only requirements were that each video included a common title graphic identifying its topic and a request to keep the length to between seven and ten minutes, as previous research in student-created podcasts has shown this duration to be within the attention span of first-year college students. (Frydenberg, 2008)

Students used a variety of free web tools to create their videos[ii], posted their videos to a common YouTube channel and embedded them on a web site available to all IT 101 students.[iii] Videos were usually posted the week prior to when students would complete activities based on them during class.

Quick Quizzes for Evaluation
Most classes began with a quick five-question, five-minute, multiple-choice quiz based on the week's videos. The instructor used Blackboard, a learning management system, to administer the quizzes online so that they could easily be timed, and automatically graded.

Quizzes motivated students to watch the videos because each counted a small amount toward final grades. The quizzes also helped learners check their understanding of key concepts prior to doing the hands-on, in-class activity, and as such bridged the gap between the outside-the-classroom learning and inside-the-classroom application of that learning.

Four of the questions on each quiz were related to spreadsheet concepts or techniques explained in the video. One question was always based on the video itself, designed such that students watched the video would remember the answer. For example, in a video about creating graphs, the data being graphed included information about popular songs, and the student who created the video creatively included a short audio clip of the Macarena at the start of the video. A question on the quiz asked "What song was playing at the start of the video?" The assumption is that students who watched the video would remember this, even if they did not understand anything about the spreadsheet lesson that the video was trying to convey.

Collaboration and Just-In-Time Learning in the Classroom
Students worked in groups of three to six (depending on class size and configuration) to complete the in–class exercises. The two day-sections of the class met in an experimental collaborative classroom, where students sat in groups of four at large tables equipped with a shared computer and keyboard, and a large screen monitor, as shown in Figure 1.

Figure 1. Flipping in a Collaborative Classroom.

In the evening section, students met in a lecture style lecture classroom. They worked in groups of three, rearranging their chairs to see their partners, or forming clusters to support their collaboration efforts, as shown in Figure 2.

In cases where students could not see each other's screens, they use join.me[iv] to share their screens with each other. Students also used join.me to share their screens with the instructor's podium computer so that it could be projected for all the class to see as they discussed their accomplishments during the debriefing portion of the class.

Figure 2. Flipping in a Lecture Style Classroom.

During the in-class group activity, the instructor would walk around the room from group to group answering questions and providing assistance. Sometimes if several groups had the same problem or needed to learn the same concept, the instructor would call a time out and provide just in time explanations of the key concept needed to continue the lesson.

The Reader, the Doer, and the Checker
Each in-class activity was designed so students could take on each of three roles in their groups: the reader, the doer, and the checker.[v] The reader and the checker would load the description of the exercise on their laptops. The reader would read aloud the required task or step to the doer; the doer would try to do the step, and the checker would help the doer (if necessary, or able) and confirm that the doer completed the step correctly. Students alternated roles of reader, doer, and checker while completing the assignment so that each student could experience each of the roles at least once during the exercise. These roles provided a structure for the groups to begin their work together.

The rationale for creating these roles is as follows:
- by speaking the words aloud, the reader has the opportunity to use the language of Excel when communicating with the doer and the checker;

- the doer has to listen and follow the instructions, and isn't distracted by switching screens or looking on a printed sheet with instructions to see what to do next;
- the reader and the checker can provide assistance to the doer if necessary, and the checker is responsible for making sure the step looks good before the group continues to the next step.

The first task in each assignment instructed students to create a worksheet with the names of their group members. Instructions generally decreased in detail as the activity progressed in order to promote problem solving. In this way, steps are task-based rather than keystroke based, so students are learning how to solve a problem, without being caught up in the details of what to click or select next.

Students worked in the same groups throughout the semester and created a shared folder on Dropbox[vi] to easily access their group's work products. The in-class activities were not graded per se, but students received credit for completing them, and lost credit if they did not. Students who were absent had 48 hours to complete the assignments individually outside of class in order to receive credit. Students had to electronically submit their own individual copy of the file that their group created in order to receive credit. A portion of an in-class activity is shown in Appendix I.

4. RESEARCH METHODOLOGY

To determine the impact of flipping the IT classroom, the author offered a voluntary online survey at the end of the Spring 2012 semester to all 66 students (40 male, 26 female) enrolled in three academically diverse sections of IT 101 (22 Honors, 17 Accelerated, 27 Evening). All sections were taught by the same instructor using the same outside-of-class instructional videos and the same in-class activities. The survey asked students for their reactions after participating in ten flipped classroom sessions on learning Microsoft Excel concepts.

Student Reaction to the Flipped Classroom Approach
Students found the flipped classroom for teaching spreadsheet concepts to be challenging and engaging. They would like to see this methodology implemented in their other classes.

Said one student: "I would absolutely recommend this [approach] for all future IT 101 classes. I also feel as if this style of learning would be complementary to any sort of introductory calculus class and/or writing and literature classes. I am a strong proponent of this style of learning and feel as if it can be even more effective than lecturing when used properly and in a structured manner."

Taking time to complete the in-class activities was beneficial to most students. When asked if they would have otherwise completed the in-class activities as homework in addition to the regular homework, most students, across all sections, said they would not, as shown in Figure 3.
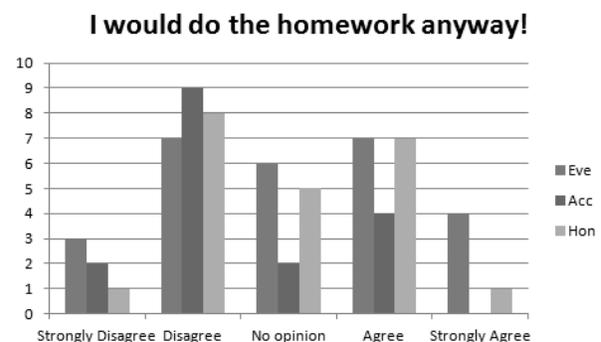

Figure 3.   Value of Completing Learning Activities in Class

It is surprising that most of the supposedly "better students" in the Honors and Accelerated sections would not do the homework and encouraging that some of the evening students are conscientious enough to say they would complete it.

Effectiveness of Role Playing

Figure 4(a).   Student learning through explanations.

The evening students, more so than honors or accelerated students, claim they learn better when someone explains to them what to do, as suggested by the results in Figure 4(a). This may be because the honors and accelerated students are used to reading more.

This result is in line with students finding that taking on roles of reader (explainer), doer, and checker, add value to their learning experience, as shown in Figure 4(b). These roles allow students to interact with spreadsheet concepts through speaking, listening and responding, and watching.
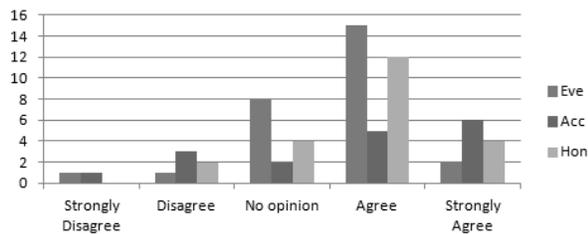

Figure 4(b). Effectiveness of Flipped IT Classroom Student Roles

Social Awareness in the Flipped Classroom

This implementation of the flipped classroom also promoted social awareness, camaraderie, and a spirit of cooperation among group members and their classmates, across all three different sections, as the survey results in Figure 5 (a-c) suggest:
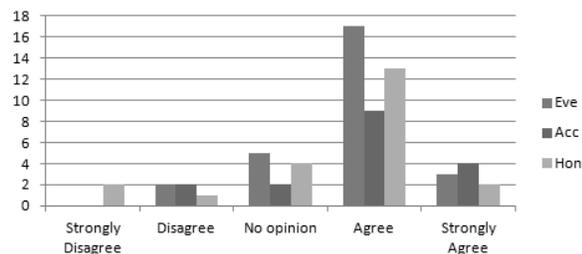
Figure 5(a). Interest in other group activities
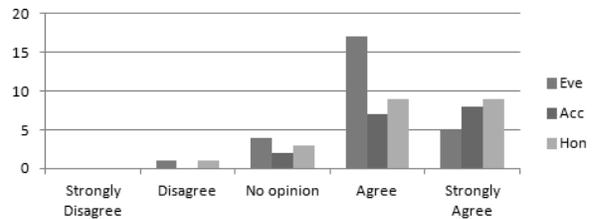
Figure 5(b). Flipping and Personalization
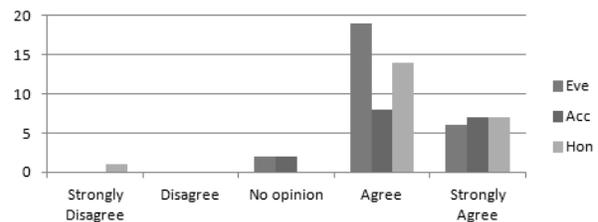
Figure 5(c). Social Awareness Factors in the Flipped Classroom

It is interesting to note that especially in the evening section, which had the largest class size (35), students found the flipped classroom a way to make the class seem more personal.

One student remarked that the composition of the groups is important, saying "My group was very helpful and each of us contributed equally which is probably why I liked the group assignments so much. If I were in a lazy group, my opinion probably would have been considerably different.

Comparing Perception of Flipped and Traditional Classroom Experiences
As shown in Figure 6, the majority of students from all sections felt that the flipped classroom helped them learn the material better or much better than had they been in a traditional classroom.

A student remarked: "Figuring out the assignments as a group on our own was just so much more engaging and helpful in learning the material, that I really don't know how a traditional classroom lecture of the material would be able to compare."
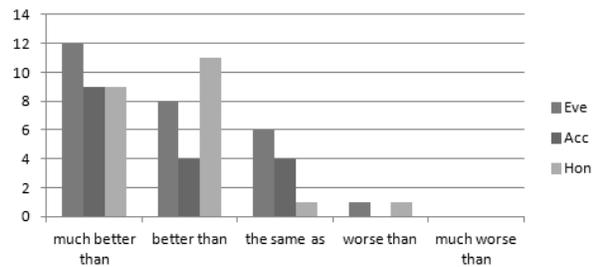
Figure 6. Student Perception of Flipped Classroom.

After completing their first flipped classroom activity, students were asked to email their responses to "How are you feeling right now?" to the Instructor. Many expressed sentiments of frustration and accomplishment, such as this:

> "There were parts of the assignment that were frustrating, but I think I got more out of it than I would have gotten out of a lecture because you had to actually know how to do the different steps and if you didn't know you had to learn it."

Instructional Screencast Videos
Across the different sections, there was not significant variation in why students watched the videos, as shown in Figure 7. The majority knew they would be quizzed and wanted good grades, others wanted to be prepared for the in-class exercises that followed.

As shown in Figure 8 the majority of students across all sections felt it was possible to convey a single concept in a video of seven to ten minutes.

Creating the videos for IT 101 students to watch turned out to be a worthwhile activity for the student tutors. One commented, "I had a great time working on the videos for the Excel tutorials! I not only had the opportunity to learn about new Excel concepts in detail but was also able to practice those I had already mastered through my own IT 101 experience."

The videos were also made available to sections of IT 101 taught by different instructors. There were 14 sections of IT 101 in the spring, most with 30 to 35 students, for a total of approximately 400 students taking the class across all sections. YouTube shows that some of the videos had as many as 240 views,

suggesting that over half of the IT 101 students across all sections that semester watched them.
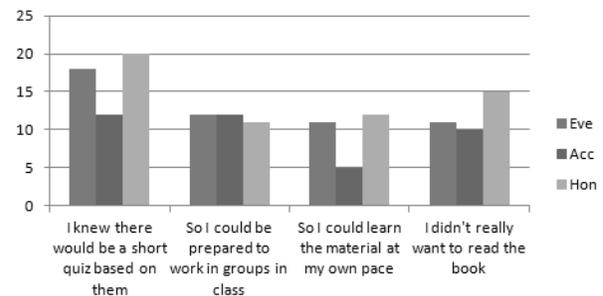
Figure 7. Reasons for watching screencasts outside of class.

Figure 8. Clarity of Screencast videos.

Role of Instructor
Many students noted the role of the instructor had changed from a lecturer to a mentor who walked around the room and was available to help each group to provide "just-in-time" information about specific concepts or skills on an as- needed basis.

There were six groups of four students in each day section, and as many as ten groups of three or four students in the evening section.

Several of the honors and accelerated students shared the sentiments of one who noted that putting the instructor in this role brought about "a more catered learning experience without ignoring any students, and the teacher was able to push the important material without wasting time on what could be called filler material."

An evening student commented that "due to the large number of groups [in his section of the class], this method [of the instructor rotating among groups] was somewhat inefficient, and

each group would have to wait their turn for assistance. Often groups may have had the same question."

5. LESSONS LEARNED

Key elements to this implementation to the flipped classroom were the screencasts to be watched before class, the quizzes which provided an incentive for watching them, and the in-class exercises and debriefing time.

The tutor-created instructional screencast videos were well received, as evidenced by the number of views they received on YouTube. The videos were made available across several sections of IT 101 (not just those of this instructor). Some of the videos received over 200 views. Given that approximately 400 students were registered for the class across all sections, this suggests that approximately half of the students saw at least some of the videos. The tutors who created these videos developed a list of best practices for doing so in the future. These include zooming in on just the section of the spreadsheet that is being featured so it is more easily visible, setting up as much as possible beforehand so that the video can focus only on key concepts, and creating a script to follow when recording the demonstrations.   Keeping the length of the videos short was also helpful in being able to locate the desired content. Some videos will be redone in future semesters to improve their quality.

Students seemed to relate better to videos created by their peers in the learning lab than to those that accompanied the textbook. Students found the professional videos to be much more thorough and lacking personality.

Several of the in-class activities required students to interact with open data sets that they found online.[vii] This allowed them to explore data on topics of interest and made the exercises more relevant. Data available from online data markets[viii] often are larger and more complex than sample files that accompany textbook exercises and can be well suited for activities on filtering, formatting, or sorting. Another student had his group look at data on the spread of HIV[ix], commenting that this data would also be useful in his sociology class. This data set, and most data from http://data.worldbank.org is nicely formatted for creating spark lines.

A smaller class size and a classroom with tables rather than rows of fixed seating is more conducive for implementing a flipped classroom. The ability for the instructor to circulate among the students is crucial to their success.

6. SUMMARY

The paper presents guidelines for and student reactions to one implementation of a flipped classroom for teaching Microsoft Excel. Students in three academically different sections of IT 101 experienced the flipped classroom. This approach provides an active learning exercise in class that engages students with the material, as well as each other. There were few differences across honors, accelerated, and evening students when it came to student perceptions of the flipped classroom, reasons for watching videos, and social awareness brought about by the implementation of the flipped classroom described in this paper. This suggests that this active learning approach is accessible to all introductory students. The only thing that differed was the instructor's involvement in providing assistance to the student groups.

The structure of the flipped IT classroom described in this paper and the in-class activities also enabled students to learn about web-based collaboration tools for file and screen sharing and online open data repositories. While the paper does not claim an increase in student learning over a traditional classroom, anecdotal remarks from students suggests that they learned the material through watching the instructional videos before class and completing in-class exercises and found the experience more engaging than listening to an in-class lecture.

6. REFERENCES

Bergmann, J., & Sams, A. (2012, April 15). *How the Flipped Classroom Is Radically Transforming Learning*. Retrieved June 1, 2012, from The Daily Riff: http://www.thedailyriff.com/articles/how-the-flipped-classroom-is-radically-transforming-learning-536.php

Brown, J. S., & Duguid, P. (1998). The University in the Digital Age. In B. L. Hawkins, & P. Battin, *The Mirage of Continuity: Reconfiguring Academic Information Resources for the 21st Century*

(pp. 39-60). Washington, D.C.: Council on Library and Information Resources.

Day, J. (2008). *Investigating Learning with Web Lectures .* Georgia Institute of Technology.

Day, J., & Foley, J. (2006). Evaluating Web Lectures: A Case Study from HCI. *Proceedings of CHI 2006* (pp. 195-200). Montreal: Association for Computing

Demetry, C. (2010). Work in Progress - An Innovation Merging "Classroom Flip" and Team-Based Learning. *Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference* (pp. TI1-3). Washington, DC: ASEE/IEEE.

Frydenberg, M. (2008). Principles and Pedagogy: The Two Ps of Podcasting in the Information Technology Classroom. *Information Systems Education Journal , 6* (6), 11.

Gibbons, J., Kincheloe, W., & Down, K. S. (1977, March 18). Tutored Videotape Instruction: A New Use of Electronics Media in Education. *Science, New Series , 195* (4283), pp. 1139-1146.

Houston, M., & Lin, L. (2012). Humanizing the Classroom by Flipping the Homework versus Lecture Equation. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2012* (pp. 1177-1182). Chesapeake, VA: AACE.

Knewton.com. (2011, August 29). *The Flipped Classroom Infographic*. Retrieved June 1, 2012, from Knewton: http://www.knewton.com/flipped-classroom/

Mentch, M. (2010, May 6). *The Classroom Flip: Harnessing Technology to Support New Instructional Approaches to In-Class Activity Based Learning.* Retrieved June 1, 2012, from YouTube: http://youtu.be/mwY9WZS-Sng

Strayer, J. (2007). *The Effects of the Classroom Flip on the Learning Environment: A Comparison of Learning Activity in a Traditional Classroom and a Flip Classroom that Used an Intelligent Tutoring System.* Educational Theory and Practice. Columbus, Ohio: Ohio State University.

Waguespack, L. (2008). *The Tinkertoy™ Exercise for Motivating Formal System Modeling.* Information Systems Education Journal, 6 (46), pp. 3-9.

Editor's Note:

This paper was selected for inclusion in the journal as a ISECON 2012 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2012.

Appendix I

Sample In-Class Activity (Creating Charts)

Work together in small groups to complete this assignment. Take turns being the reader, doer, and checker. The reader reads an instruction aloud while the doer completes it in Excel. The checker helps the doer if the doer needs help and confirm that each step is completed correctly. Help each other out, look up how to do things in the book if you're not sure, and if you're still stuck, ask me!

1. Visit http://data.worldbank.org/. Navigate to Data, then Indicators and explore the data sets that are available.
2. Select a data set of interest that has at least 5 years' worth of values. For example:
    - Mobile phone subscriptions per 100 people
    - Internet usage
    - Vehicles per km/road
3. Download the data. Import it into Excel.
4. Create a worksheet named Group Members. Include the names of the members of your group.
5. Examine your data. If there are a lot of empty columns from early years, hide or delete them. Keep at least 10 years' worth of data.
6. Create spark lines for the data. Add spark line markers.
7. Filter the data to display only those countries that begin with the letter A.
8. Create a new sheet named "A countries."
9. Copy row 1 (the header row), and the all of the rows for all of the countries that begin with A to a new sheet.
10. Create a line chart showing all of the data on one graph, where each line is a different country.
    - Label the horizontal and vertical axes
    - The legend should go at the bottom
    - The legend labels should be the country abbreviations
    - Horizontal axis should show the years
    - Your graph should have a title
    - Find a thematically appropriate image for the background of your chart
    - Place the chart on its own worksheet
11. Change the filter to display another subset of the data that you choose.
12. Copy the header row and all of the data to a new sheet.
13. Create a bar chart for the last 4 years of available data. Add appropriate labels, legends, titles, and formatting styles to your chart. Place the chart on its own worksheet.
14. Place the file in a Dropbox folder shared with the members of your group so that each group member will have access to this file on their own computers. Each group member should submit the (same) file to Blackboard to get credit for completing this assignment.

Endnotes

[i] Khan Academy hosts over 2600 instructional videos at http://khanacademy.org.

[ii] Most student tutors used Screencast-o-matic.com (http://screencast-o-matic.com) to create their screencasts, and then edited their videos using Windows Live Movie Maker. Screenr (http://screenr.com) , GoView (http://goview.com) , and Jing (http://www.techsmith.com/jing.html) are also popular free tools for creating screencasts.

[iii] To view the instructional videos that student tutors created for this project, visit http://cis.bentley.edu/sandbox/index.php/resources/excel/

[iv] Join.Me (http://join.me) is a free screen sharing application.

[v] Waguespack (2008) describes the roles of guide, builder, and judge that students take on during in-class modeling experiments. He pointed out the similarities with the roles of reader, doer, and checker introduced here for completing small group exercises.

[vi] Dropbox (http://dropbox.com) is a free cloud storage application that allows users to synchronize and share files across multiple devices.

[vii] Open data refers to data sets available for reuse without copyright restriction. For example, the US Government set up http://data.gov in 2009 as a way to share government data and provide transparency. Several cities, states, and countries have followed suit with similar open data sites.

[viii] Providing Data as a Service is a growing industry as companies such as http://factual.com, http://infochimps.com, and http://datamarket.com manage and provide large data sets as raw data or via APIs for developers to include in mobile and web applications. Some data is also available for download in CSV or other formats that Excel can recognize and import.

[ix] http://data.worldbank.org/indicator/SH.DYN.AIDS.ZS