C21U's Guide to Flipping Your Classroom

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Introduction

This guide is for instructors who want to flip their classrooms. It compiles information from several sources to give instructors relevant information about flipping. The guide begins by defining a flipped classroom and discussing the pros and cons of flipping a class. Next, it provides more detailed information about how to design a flipped class and describes what has and has not been successful in the past. Additionally, the guide helps instructors evaluate their flipped class to make improvements and determine if it is more effective than their original class. To contact other Georgia Tech instructors who are interested in flipped classrooms or to ask questions and make comments about this guide, please visit the http://c21u.gatech.edu/forum.

1. The Basics of Flipped Classrooms

This section describes what a flipped classroom is and what it is not. It also describes the learning theory behind flipped classrooms, the prospective benefits and challenges of flipped classrooms, and different models of flipped classrooms. Whether you are trying to decide whether to flip a class or you have already chosen to flip a class, this section will help you understand what to expect during the process and also help you understand the terms associated with flipped classrooms.

1.1 What is a Flipped Classroom?

A flipped classroom (sometimes referred to as an inverted classroom) flips the traditional structure of a classroom. In a typical traditional classroom, students listen to lectures in class and perform other learning activities, such as solving practice problems after class. In this traditional structure, students are taught content in class via lectures, and they attain deeper knowledge after class via various forms of homework. In a typical flipped classroom, students listen to pre-recorded video lectures before class and perform other learning activities in class. In this flipped structure, students are taught content before class via videos and readings, and they attain deeper knowledge in class via activities. In flipped classes, students may also have homework problems to solve independently after class.

Many variations of learning environments are used in current classrooms, and many of the terms used to describe these learning environments (e.g., blended and hybrid) are used inconsistently in the literature. For the purpose of this guide, a flipped class is defined as a specific type of a blended learning environment. This guide defines blended learning by two criterion: instructional guidance is delivered through both an instructor and technology, and knowledge is acquired through both information transmission and praxis. A flipped classroom fits this criteria because content is delivered (information transmission) through a computer and praxis is achieved through in-class activities with an instructor.

Though other types of instruction are valid, they do not meet this criteria and will not be discussed in this guide. For example, pure problem-based learning (PBL) allows students to acquire knowledge through practicing problems solved in class with an instructor. Students might also use computers or other media to research relevant information for problem solving. However, it is not a flipped class because it does not include the information transmission component. Another example is a class in which students read assigned journal articles before class and then discuss them in class. That is also not a flipped class because students are not receiving instructional guidance on the readings.

1.2 Learning Theory behind Flipped Classrooms

This section identifies learning theory that supports flipped classrooms from a pedagogical standpoint.

How People Learn (National Research Council, 2000) states that to develop competency in a subject, students must develop factual knowledge, understand that factual knowledge in the context of a conceptual framework, and organize knowledge in a way that allows them to transfer and apply it. By allowing students to use knowledge in class with feedback from peers and the instructor, flipped classrooms help students correct misconceptions and organize new knowledge effectively.

Based on this theory, there are 4 key elements of the flipped classroom identified by Vanderbilt University's Center for Teaching (Brame, 2013):

1. Provide an opportunity for students to gain first exposure to content prior to class.
2. Provide an incentive for students to prepare for class.
3. Provide in-class activities that focus on higher-level cognitive activities.
4. Provide a mechanism to assess student understanding.

By providing these 4 elements, you are offering a flipped classroom that supports student learning.

1.3 Prospective Benefits and Challenges of Flipped Classrooms

In flipped classrooms allow instructors to help students complete more challenging learning activities and provide tailored instruction based on students' weaknesses. This strategy can lead to both benefits and challenges for students and instructors.

Benefit: Improved learning outcomes

In a 2010 meta-analysis of 45 studies (http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf), the Department of Education concluded that blended learning (including flipped) is considerably more effective than strictly face-to-face or online learning.

Benefit: Improved insight into student learning

Prerecording lectures frees up class time for instructors to interact with students. Additionally, by utilizing quizzes to access mastery, instructors can quickly evaluate students' understanding of a topic both as individuals and as a class. These advantages allow the instructor to provide targeted instruction and more quickly identify misconceptions.

Benefit: Student-paced lectures

Students have the ability to rewind, pause, and speed up lectures, giving them more control over the pace of instruction. The lectures are also always available, so students can access the content when they want, even if they have to miss class. Additionally, students may re-watch lectures as needed.

Benefit: More personalized learning

Between self-paced lectures at flexible times and one-on-one interactions with instructors in the classroom, flipped classrooms allow learning to be more personalized to each student. Flipped classes

can also support different learning styles. For example, because lectures are self-paced, students can use them in various ways to match their learning styles.

Benefit: Reaching more students

Moving lectures outside of class might require less class time per student allowing instructors to teach larger classes. For example, if a class of 50 students meets three times a week (e.g., Monday, Wednesday, Friday) to listen to lectures and then worked on problems at home, then a flipped class of 150 students could be split into three groups of 50 that each meet once a week (a group of 50 meets on Monday, another group of 50 meets on Wednesday, and the last group of 50 meets on Friday) to ask questions and receive an hour of help with problem solving but without changing the ratio of students to instructors.

Challenge: Asynchronous lectures and discussions

Students view lectures and post on discussion forums in their own time, so if students have questions about content, they might not be able to get timely responses from an instructor.

Challenge: Motivating students

In a flipped classroom, students typically have more responsibility for their learning. Though this can help students feel more in control of their learning, it can also lead to challenges with time management and motivation. As an instructor, you should recognize that doing something different in a course rather than offering standard lectures, homework assignments, and quizzes can create anxiety on the students' part.

Challenge: Technical Problems

Using technology comes with technical problems. Have a plan for how to address technical problems in terms of how to fix problems and how problems may affect students (e.g., deadlines).

Challenge: Additional Resources

As with designing any new class, redesigning a class to be flipped takes time. Because of this time commitment, it is recommended that you always flip an existing class that you are familiar with teaching rather than create a new class that is flipped. Allow yourself at least a couple months to explore possibilities and design your flipped class before trying to implement it.

Challenge: Contradicting Culture, Policy, and Accreditation

Flipping a class might go against your students' and your colleagues' expectations. Make sure you have pedagogical reasons for flipping that you can explain to others and that you redesign your class in a way that fulfills policy and accreditation regulations.

1.4 Models of Flipped Classrooms

This section describes different models of flipped classroom. They are NOT mutually exclusive. These models can be used collectively to create a model that works for your particular course.

1.4.1 General Models

Enabling, Enhancing, and Transforming Blends

These models represent various degrees of blending (i.e., not necessarily flipping) a classroom from McGee and Reis (2012). Though the models are based on blended classrooms in general, how the model applies to a flipped class in particular is discussed.

Enabling Blends

Enabling blends do not change the pedagogy of a class, but increase the number of ways students may access the instructional materials. Enabling blends focus on addressing issues of access and convenience. For example, they are intended to provide additional flexibility to the learners or attempt to provide the same opportunities or learning experiences but through a different modality. One example of an enabling blend is an instructor posts lectures online so students may either attend lectures or view them online. This particular model does not meet the criteria of this guide for a flipped classroom though it might be the best option for your class.

Enhancing Blends

Enhancing blends allow for incremental changes to the pedagogy but do not radically change the way teaching or learning occurs. For example, if an instructor had a PBL course, they could put additional content delivery resources online. By providing content to students online instead of coaching them to find and organize information independently, the class is no longer a PBL course, but is instead, a flipped classroom.

Transforming Blends

Transforming blends are blends that allow for a radical transformation of the pedagogy, a change from a model where learners are only receivers of information (e.g., through lectures in class) to a model where learners actively construct knowledge through dynamic interactions (e.g., learning activities in class). These types of blends enable intellectual activity that is not practical when class time is devoted to lectures. To be a flipped classroom, the transmission of information must be moved to an online environment and learning activities must be used during face-to-face class time.

Instructor- and Student-Led Models

These models represent different types of flipped classroom from Coursera's (http://coursera.org/) "Flipped Classroom Field Guide" based on who determines the content of the course.

Instructor-Led Model

In an instructor-led flipped class, the instructor is typically involved in every aspect of the course. Outside of class, students watch lectures pre-recorded by the instructor and complete other activities (i.e., readings) assigned by the instructor. In class, students participate in learning activities coordinated by the instructor (e.g., group discussions, problem solving, and projects).

Student-Led Model

In a student-led flipped class, the instructor's involvement in the day-to-day running of the course is relatively low. The instructor acts more as an organizer or guide in the learning process, providing resources and support necessary to allow learners to direct their own learning (e.g., answering student questions online or holding office hours, providing feedback on student work, motivating students).

1.4.2 Real Flipped Classrooms

Many instructors in higher education have flipped their classrooms in the past several years. Below are some examples of flipped classrooms developed by Georgia Tech faculty. Additional information about real flipped classrooms from around the country may be found in Appendix A.

Professor Don Webster, Fluid Mechanics (CEE 3040) for Spring and Summer 2013

Reasons for flipping:

The motivation for flipping this course came from a desire to use in-class time in the most effective manner to introduce the subject and for students to achieve problem solving proficiency.

Before class:

Students watched lectures pre-recorded by Webster. The recordings were made using the Tegrity lecture capture system with simultaneous recording of a webcam video of the instructor and a virtual white board (Open Sankaré) on a tablet laptop. The lecture content was a mix of theory and example problem solving. The content was broken up into easily digestible modules ranging between 5 and 21 minutes with an average of 11 minutes. A total of 72 lectures were recorded over the course of the semester. The overall lecture time was reduced compared to a traditional delivery because some instruction was shifted to active problem solving activities and because the lecture modules were highly focused with no questions or interruptions. Many students came to class with notes they had taken while watching the pre-recorded lectures. Students also brought clarification questions to class. Student feedback about the video lectures was very positive primarily because they could control the pace of the content. They could watch the video lecture numerous times, rewind to re-watch a confusing section, pause to address an interruption, and even watch the video at an accelerated rate.

During class:

Students worked in pairs on 3-4 problem solving tasks in each class. To ensure students were paired with others of similar ability level, Webster allowed students to find a partner within a group of students with similar academic ability (based on GT GPA without revealing the method of grouping). Student groups did their work on individual whiteboards that were appropriately sized for a pair of students to collaborate. In class, students used laptops, tablets, and smart phones to access the electronic textbook, re-access video lectures, look up fluid properties, etc. During class, Webster and teaching assistants (TAs) answered students' questions. The professor had 2 TAs for a class of 40 in the Spring and 1 TA for a class of 24 in the Summer. If numerous students had the same question or misconception, then the professor would give a short lecture to clarify the content. During the class period, the final answers to the problems were posted, so students could confirm their answer. Students often either

transcribed their work on the whiteboard to paper, or photographed their work with a smart phone. Webster posted the solutions to the problems online after class as well. The problems solved in class were not graded, but course credit was given for attendance in order to ensure participation in the in-class problem solving activities.

After class:

Student completed a few homework problems each week individually and submitted them online for evaluation. The homework system was provided by the textbook publisher, and each student received a different set of input parameters hence requiring a unique solution. The homework system graded their answers, thus providing students with instant feedback. After 3 failed solution attempts (or a correct attempt) students could access the published solution. Because grading was done by the online system, the primary activity of the TAs was the in-class tutoring activity and office hours. All web-content (i.e., Tegrity lecture videos, link to homework system, and file shares) were consolidated and organized via the web app Net-texts.

General comments:

The flipped class format facilitated classroom contact with students more direct and individual-based, similar to tutoring. During the course, students solved 100+ additional problems (about double the number used in the traditional course), making the course shift toward active problem solving and increasing participation in class. Student feedback was exceptionally positive with every completed survey indicating that the student would recommend the course format to a friend. Only two of the 64 students (over 2 semesters) made negative comments about the extra time commitment required for the course.

Professor Bonnie Ferri, Circuits and Electronics (ECE 3710), Linear Circuits (Coursera MOOC)

Reason for flipping:

The motivation for flipping this class came from providing consistency of instruction and covered content for this high-enrollment course, which typically has nine sections of 45 students each and is offered every semester. Moving the content of the course to an online Coursera Massive Open Online Course (MOOC) insured that all students received the same breadth and depth of information. In addition, having one set of course content was meant to eliminate the idiosyncratic decision making on the part of instructors to include or exclude content.

Before class:

Students watched pre-recorded lectures by Ferri and Nathan Parrish. The lectures were 5-20 minutes long, covering theory, worked examples, and demonstrations. The lecture videos contained one or two formative assessments that students could use to determine whether they understood the content. These assessments were untimed and could be attempted up to three times to master the content before moving to a new topic. Students watched 60-70 minutes of videos per week. Students also

downloaded and printed notes to help them solve in-class problems and activity sheets to guide them through in-class laboratory activities.

During class:

At the beginning of each class, students were given a formative assessment to determine whether they had learned the major concepts from watching the assigned videos. In class, students experienced a mixture of recitation, active learning, problem solving, as well as performed hands-on exercises using their laptops and mini experiments using measurement devices. Students were encouraged to work with a partner, but it was not required. Across the sections, tests were completed on the same day and at the same time.

After class:

At the completion of each of the five course topics, the students completed online quizzes, consisting of 5-10 problems that were solved independently. Students were only allowed to attempt quizzes once, and they were given 20 minutes to complete each one. However, students were allowed to attempt homework problems up to three times, and they were not timed.

General comments:

The flipped classroom gave immediate feedback to both the instructors and the students about the information that students either mastered or continued to have difficulty understanding. The in-class problem solving sessions and the in-class laboratory demonstrations gave students practical applications of the content they learned by viewing the videos online before class.

Professor Magnus Egerstedt, Embedded and Hybrid Control (ECE 4555), Control of Mobile Robots (Coursera MOOC) http://users.ece.gatech.edu/~magnus/ece4555.html

Reason for flipping:

The motivation for flipping this course came from wanting to develop a MOOC and put lectures online to free up class time for hands-on activities.

Before class:

Students used the MOOC course to watch lectures, take quizzes, and complete weekly assignments. Part of the student's grade in the class was his or her certificate of completion for the MOOC course. Students were also required to develop code on a simulator before they came to in-person classes that involved robotics exercises.

During class:

On Tuesdays, the class discussed lectures from the MOOC. On Thursdays, the class completed in-class robotics exercises (seven over the semester). Egerstedt opened both classes by asking for questions; then he and two TAs offered help during in-class activities. The classroom had no desks to allow room

for the robotics exercises. Before students left, Egerstedt evaluated and graded the exercise that students worked on during class. Additionally, students completed a final robotics project as part of the course.

After class:

Students used discussion boards to trade tips, share questions, and chat about the course. Egerstedt and TAs monitored these forums.

General comments:

The flipped class gave immediate feedback to Egerstedt about his MOOC lectures. In general, it allowed more time for hands-on work with students.

Associate Professor Jung Choi, Biological Principles (BIOL 1510)
http://bio1510.biology.gatech.edu/

Reason for flipping:

The motivation for flipping this course came from wanting to improve learning outcomes.

Before class:

Students worked through an "untextbook" that included links to a variety of sources covering the content. Embedded in this untextbook were videos lectures that were 5-10 minutes long and presented in a variety of styles (refer to http://bio1510.biology.gatech.edu/ for examples). Students also completed homework assignments through Mastering Biology which graded the homework automatically and allowed the instructor to review the results before class.

During class:

Students answered clicker questions at the beginning of class to practice knowledge retrieval and to address common misconceptions. Then, students applied learned concepts during in-class activities, usually in small problem solving groups. (In-class activities may be viewed at Choi's Biology Blog http://jchoigt.wordpress.com/intro-bio-topics/.) At the end of each class, students answered clicker questions to review results and check understanding of activities. Students also completed a group project video which they uploaded to YouTube for a grade.

General comments:

Some students did well in the flipped classroom environment, but some made negative comments about the amount of time they spent on the class. Choi found that students in the flipped class had higher scores than students in previous traditional classes on test questions at higher levels of Bloom's taxonomy (application and analysis). Additionally, there were no significant differences on test questions at lower levels of Bloom's taxonomy (recall and understanding).

In addition to these examples from GT faculty, there are many other professors who have flipped their classroom from various institutions. In Appendix A, we review the unique characteristics of some of those classes. The original sources are referenced if you would like to look up the full description of any of the classes.

2. Designing Your Own Flipped Class

This section will help you design the many aspects of your flipped classroom. It will also point you to the many resources available to help you design and maintain your flipped class. This section is structured to be used from the moment you decide to flip your class through the entirety of the class and should help you keep in mind the big picture while figuring out some of the details.

2.1 Structure of Flipped Classrooms

The structure of the course is what determines if it is a flipped classroom.

Before class:

Students watch video lectures or perform other activities to expose them to content.

> Tip: Breaking lectures into smaller conceptual chunks can help students manage content.

During class:

Students participate in active learning activities to deepen their understanding of the content.

> Tip: Brief quizzes to check for understanding helps students and professors identify misunderstandings and ensure that the student is prepared for class.

After class:

Students complete homework assignments independently to practice mastery of learned concepts.

> Tip: Because part of the students' homework is learning the content for the next class, assign students less traditional homework than in a normal class.

Intermittently:

Students complete assessments and provide instructor feedback about course and learning activities.

> Tip: Request student feedback before major assessments to address issues.

2.2 Questions to Guide Development

By answering each of these questions, you will create the fundamentals for your flipped class.

1. What should students and I get out of flipping the class?
2. What pedagogy and learning strategies will I use in my class?
3. What are the learning objectives for the class (i.e., what do you want students to be able to do with the information that they learn)?
4. How can I use learning activities to fulfill the learning objectives?
5. What types of activities are best performed inside and outside of class?

6. Will students work in groups or individually on activities?
7. What is the role of the teacher during activities?
8. What is the role of the student during activities?
9. What resources will be available to students inside and outside of class?
10. What is the structure of the flipped class (i.e., what do students do before, during, and after class)?
11. How often does the class need to meet?
12. How will students be assessed?
13. What technology will be used inside and outside of class?
14. How will technology be used to support learning?

2.3 Before and After Class

A common way to deliver content to students before class is through video lectures. The lectures may be recorded by the instructor of the class specifically for the class (e.g., Don Webster's flipped class), recorded by the instructor for a MOOC that the class uses (e.g., Bonnie Ferri's and Magnus Egerstedt's flipped classes), a collection of videos recorded by other people (e.g., Jung Choi's flipped class), or even a MOOC given by another instructor.

Consider how long students spend preparing for class before assigning them additional work to be completed outside of class. Make sure that you are not increasing the overall workload of the class. Assigning a few homework problems per week, a semester-long paper, *or* a project will likely not be too demanding on the student and improve their self-efficacy. Be aware that if students spend too long on outside of class assignments, they might be less prepared for in-class meetings and reduce the quality of class time.

2.4 In-Class Activities

Below are learning activities that you may use in your classroom to help students better understand the content and learn general and domain-specific skills. These activities may vary by class depending on what is most appropriate for learning during that class period.

Applications and Extensions

In applications, students apply what they've learned to solve problems or analyze scenarios. Applications allow students to think about concepts from various, practical points of view. For example, in a math course, ask students to apply formulas to solve problems.

In extensions, students derive theoretical extensions of the content that they've learned. These activities encourage students to apply concepts in a novel way and deepen their understanding. For example, if students are taught to solve a specific type of problem, add another component to the problem or change the problem in a manner that requires them to solve the problem in a different way.

Sequence of Questions

The instructor helps students break complex problems into smaller parts to solve systematically. For this strategy, it is important to: 1) pick the right problem; 2) break it down; 3) solve incrementally; 4) allow students time to think about the question; 5) don't assign too many large problems; and 6) ask students

to contribute more than simple recall of information. For example, a mathematical proof may be a good problem for sequencing.

Experiential Learning

In experiential learning, students learn through immersive, hands-on learning experiences. Some examples of experiential learning activities are experiments, demonstrations, trips, labs, and debates. When planning these activities make sure that: 1) students are actively involved in the experience; 2) students have the opportunity to cooperate with their peers; 3) students have time to reflect on the experience; and 4) students have the skills to adequately complete the experience.

Discussion Activities

Class discussions may make course content more meaningful and relevant to students by helping them understand diverse perspectives, test assumptions, improve communication skills, and develop a better understanding of their own perspectives. To promote successful discussions, try: 1) setting clear expectations for participation and interaction; 2) beginning with thoughtful questions, quotes, current events, or controversial statements about content; and 3) keeping the conversation from digressing.

Small Group Problem Solving

Students solve problems in small groups with the help of instructors or TAs. The instructor or TA may also probe the students to explain their answers. Throughout the class or at the end of class, the instructor may review the solutions to the problems and provide formative feedback to the students.

<u>Forming Groups</u>

1. Clearly define expectations of group work.
2. Structure groups based on the needs of the project.
3. Create specific roles within groups.
4. Keep groups as small as possible.
5. Group members by ability level (e.g., equivalent GPA).

Peer Feedback

The benefits of peer feedback are two-fold: the evaluated students receive feedback about their work and the evaluating students learn from reviewing another student's work. Consider using peer feedback, especially in writing intensive or open-ended-question-intensive courses.

2.5 Assessing Learning Outcomes

Summative Assessment

Summative assessments are used to determine if students have achieved learning objectives. Summative assessments are assessments such as tests or papers given at the end of instruction on a topic to determine what the student learned. When you flip your class, your learning objectives might change. For example, a previous learning objective might have been focused on learning content whereas a new objective might focus on being able to solve problems. Just as it is important to make sure your learning activities correspond with your learning objectives, it is important to make sure your assessments correspond with your learning objectives.

Formative Assessment

"The central purpose of formative assessment is to contribute to student learning through the provision of information about performance" (Yorke, 2003; pp. 478). Unlike summative assessment, formative assessment occurs during the learning process rather than assessing the end result of the learning process. It is also important in formative assessment that students change their behavior based on feedback. Incorporating formative assessment is an important benefit of flipped classrooms because flipping the class frees up class time for interaction with the instructor and students receive more formative feedback about their performance before completing summative assessments. This sort of interaction can be easier on the professor too because feedback may be less formal and students may ask for clarifications or elaborations.

Classroom Assessment Techniques (CATs)

CATs are a type of formative assessment that provides students and instructors feedback about their learning and teaching, respectively. Effective CATs are typically learner-centered, formative, context-specific, and ongoing.

Commonly Used CATs

The Minute Paper

The minute paper is a short, informal writing assignment typically completed at the end of a class period to convey the knowledge state of the student. Students may take a few minutes to think about their responses, but they may only write for one minute.

Concept Maps

Concept maps are drawings or diagrams produced by students that illustrate connections between learned concepts. This exercise helps students integrate information, think holistically about content, improve memory and comprehension of content, and develop higher-level thinking skills.

2.6 Best Practices

This section adapted best practices for blended classrooms from McGee and Reis (2012) to apply to flipped classrooms.

1. Allow for variation in design and approaches

   Consider the learner, desired learning outcomes, and content to be learned when designing your course. What worked for another instructor in another class may not optimal for your class. Be flexible in the design of the course, especially with in-class time. For example, you might find you need to lecture in class more on some days than others, leaving less time for in-class activities. Get feedback from students and ideas from other instructors.

2. Align course components

   Ensure that content delivery, learning activities, and assessments complement each other. For example, don't emphasize active learning during classroom activities and then only use objective

assessments. Objective assessments determine a student's understanding of content, not the application of content. For active learning, projects or products (such as solved problems) are more appropriate assessments. Similarly, if your class activities focus on problem solving, make sure to discuss the problem solving process in your video lectures.

3. Moderate interactivity and expectations

   Make sure students know that you are a resource for their learning rather than a personal instructor. Encourage students to try to answer questions by themselves, or with their peers, before asking for your help. Though the flipped environment affords personalized interaction with students, allow students to struggle with content and problems independently before asking for instructor help so they do not become reliant on it.

4. Plan for in-class technology

   Though most of your attention is probably on the technology students will use outside of the classroom, consider what technology will be used inside of the classroom as well. For example, consider how to use students' laptops and phones to access online resources beyond the class lectures (e.g., lectures from other courses to refresh prerequisites or gain a new perspective on the content being taught).

5. Redesign the course

   When designing a flipped classroom, consider the needs of the learner and the learning objectives to identify how content and experience may be best gained. Not all content needs to be delivered from the same source in the same way. Select learning strategies to engage learners based on the experience they will benefit from most.

2.7 Potential Pitfalls

There are many common pitfalls in flipping classrooms (adapted from Coursera's Flipped Classroom Field Guide). Consider each potential pitfall to ensure you do not make the same mistakes as others.

1. Instructors don't "sell" the flipped classroom.

   It is important to be transparent about why you chose to flip the class and the benefits of flipped classrooms. You might want to avoid using the word "experimenting" when describing the class. Additionally, make sure students know how to use the online environment to avoid frustration.

2. Physical classroom is not conducive to flipping.

   Make sure the room you will be using for class can support the active learning activities you want to offer during class time. For example, Magnus Egerstedt removed the furniture from his classroom so that the students had room to operate their robots.

3. Students don't come to class.

While flipping a class can increase attendance, some students feel they do not need to come to class because they can access the lectures online. Make sure to explain the benefits of attending class, use in-class quizzes to boost attendance, or make class participation part of the grade.

4. In-class activities are not relevant to lectures.

   Make sure to match in-class activities to the content of pre-recorded lectures.

5. Instructors have difficulty accommodating the varying ability levels of their student during in-class activities.

   Students will complete activities at different paces. Creating small groups of students with similar abilities (e.g., similar GPAs) can help students work with others at their own pace. Consider if you will allow faster students to leave class early if they finish all activities before the end of class.

6. Instructors assign students too much work.

   Flipped classrooms are susceptible to becoming a "course and a half" because instructors do not adapt homework assignments to accommodate the extra homework that students perform during the video lectures. Use student feedback to ensure the course isn't too time-intensive.

7. Instructors are unable to successfully flip large classes.

   For large classes, instructors might need help to facilitate in-class activities. Using multiple TAs can address this issue.

8. Instructors don't realize the amount of preparation necessary for the class.

   Some instructors mistakenly think that taking a "guide on the side" role instead of a "sage on the stage" role reduces the amount of preparation needed for in-class activities. Developing learning activities and preparing to guide students through those activities takes time.

9. Instructors don't collect feedback from students.

   There is not flipped formula that works for every classroom, and you can't get your flipped class perfect the first time. It is important to use feedback to evaluate newly-flipped classes. Use assessment performance as well as qualitative feedback from the students to evaluate the course both during the course and at the end of the course.

10. Instructors don't engage fellow instructors about their flipped experiences.

    Though flipped classrooms are not all the same, get pointers and ideas from instructors who have already flipped their classroom or are preparing to do so. Other instructors are often your best resources for designing and implementing an effective flipped classroom.

2.8 Tips from Flipped Instructors

This section discusses some of the experiences of instructors who previously flipped a class.

1. By redesigning a class into a flipped format, the students' and instructor's time is used more efficiently, and they can cover more content without using more time inside or outside of class (Mason et al., 2013).

2. The flipped format does not compromise student learning on fundamental topics, and it provides them more opportunity to practice other skills (Mason et al., 2013).

3. A successful flipped classroom provides students with adequate structure (Mason et al., 2013). Make it clear what students are responsible for before, during, and after class. Some students will resist the new format, but most students can quickly adapt if the instructor gives specific expectations early in the class. Using frequent quizzes are recommended to ensure students are prepared for class.

4. Pre-recorded videos don't have to have a high production quality. For videos of the instructor talking, it is okay if they struggle a little with explaining concepts. Instead of PowerPoint-like presentations, consider active or animated drawing instead.

5. There is no standard approach to a flipped course. What worked for someone else's course may not be ideal for your course. Design your course by drawing from other's ideas, but do not directly copy another instructor's course.

3. Evaluating Your Flipped Class

This section will help you evaluate your flipped class. While it is important to measure student performance, it is also important to measure the success of the flipped class to identify possible improvements and better serve future students.

3.1 Evaluation of Your Flipped Classroom

When examining the effects of your flipped classroom method, you will want to establish effective procedures for evaluating whether or not your teaching is succeeding. In order to do this, you must regard evaluation of what students' are able to do, what they have learned, what students perceptions of their course experiences when in your class, and how students behaviors change over time.

The following table contains evaluation tools that you may want to consider.

Evaluation Tool	**Example**
Course Documents	Use course assessments (e.g., exams) to capture the extent that students' learning of the content is occurring.
Survey/Questionnaire	Select a survey or questionnaire to capture greater depth of students' perceptions of the flipped classroom or aspects of the flipped classroom (e.g., to what extent does the flipped classroom help student learn the content; viewing online videos; group work in class).
Interview	Interview students throughout the semester to capture greater depth of their perceptions about what is or what is not working for them in the class (e.g., how their experiences in the flipped classroom compare with their experiences in traditionally taught classes).
Focus Group	Use small groups (4-6 people) to capture greater depth of students' perceptions about what is or what is not working for them in the class (e.g., how students' experiences in the flipped classroom compare with their experiences in traditionally taught classes).

Concept Inventory	Use a reliable and valid content (or skill) test as a pre- and post-test to see what effect the flipped class had on students' achievement (or skill development).
Computer Usage	Monitor students' usage of computer-based activities to get a sense of their interactivity with content (e.g., content being viewed on line), with the instructor (e.g., comments posted in forums/discussions), and peers (e.g., comments to help other students resolve course-related issues.

The evaluation tools that you select should be done to minimize the burden placed on students to complete them.

Turning Evaluation into Research

If you would like to contribute to the research on flipped classrooms, then you will need to go above and beyond basic evaluation. Research typically involves comparing your flipped class to your previous class (i.e., flipping is the intervention or manipulation). The types of evaluations tools that you select should be geared to answer your questions related to your specific research goals. To conduct publishable research, you must always first obtain approval from GA Tech's Institutional Review Board (IRB) to use your evaluation tools and collect data from your students. In addition, if you want to publish your results, most research journals will expect you to relate your pedagogy with established theories or practices. A short sample of these can be found in Appendix B.

3.2 Evaluations of Others' Flipped Classrooms

Don Webster's Evaluation of His Flipped Classroom

Don Webster wanted to examine the extent that the flipped classroom had on his students' learning of course content. The participants included a group of 40 students that were taught using the flipped classroom method and another group of 30 students taught using the traditional lecture format. The data sources included

Course Documents

Three (3) midterm exams
One (1) final examination
Attendance

Concept Inventory

Fluid Mechanics Concept Inventory (administered as part of the course's final examination)

Interview

Students offered their perceptions in face-to-face informal meetings

Overall, preliminary results show that while the students' average scores were similar for both groups, the students in the flipped classroom scores were closer to their class's average score than did the

students in the traditionally taught class to their class's average scores. In addition, attendance in the flipped classroom was a significant predictor of achievement on the final examination.

Bonnie Ferri's Evaluation of Her Flipped Classroom

In this pilot study, Bonnie Ferri wanted to examine the extent that the flipped classroom had on her students' learning of content. In this case, she did not have a control group to use as a comparison. The participants included 130 students taught by three different instructors. The data sources included:

Course Documents

Five (5) online module quizzes
Two (2) tests
Attendance

Surveys

Weekly surveys (ascertained students' perceptions about course activities, time allocations, and comments)

Large Group Interview (ascertained for each of the three sections separately the students' perceptions about course activities that helped them learn the content, and changes needed to activities)

Computer Usage

Interactivity (students' engagement with the course content, the instructors, and their peers)

Overall, preliminary results reveal that there are aspects of the flipped classroom that the students feel are helpful in learning the content. Students' feedback about needed changes to course activities (e.g., shorter videos, more solutions to problems) are being used to modify the pilot version of the flipped classroom method for teaching circuits.

4. Resources to Support Your Class

Many resources on and off campus are available to help you design, implement, and maintain your flipped course.

Center for 21st Century Universities (C21U) http://c21u.gatech.edu/

Flipped Classroom Community on Campus

C21U works with many of the faculty on campus who have flipped their classrooms. Please join http://c21u.gatech.edu/forum to get connected with other faculty who are considering flipping their classroom or already have flipped. Other faculty can be a great resource for designing and improving a flipped class.

Instructional Design Help

C21U actively researches and evaluates both the latest trends and most proven theories in pedagogy and education. Though the center does not have the resources to provide instructional designers for each flipped classroom, faculty are available to spot check instruction and field problems that arise.

Instructor Guide for Coursera http://c21u.gatech.edu/coursera/guide

This instructor's guide is intended for faculty developing a MOOC using Coursera as a platform, but it has useful information about how to make lecture videos both from a technical and pedagogical standpoint that can be used whether or not plan to you use a platform like Coursera.

Center for the Enhancement of Teaching and Learning (CETL) http://cetl.gatech.edu/

Teaching Resources http://cetl.gatech.edu/resources/teaching

CETL provides many of the fundamental resources for instructors at Georgia Tech. At their teaching resources page, you can find information about faculty support services, educational technology resources, policies and guidelines, and course content.

Teaching Tips http://cetl.gatech.edu/resources/tips

CETL collects best practices from Georgia Tech faculty and TAs to build a bank of information about varied aspects of education ranging from designing a course to assessment.

Teaching at Georgia Tech: A Handbook for Faculty, Instructors, and Teaching Assistants

http://cetl.gatech.edu/sites/default/files/resources/Teaching_at_Georgia_Tech_2012.pdf

The guide "was created to support all of Georgia Tech's instructional staff in their various teaching roles." It isn't particularly for flipped classrooms, but it has good information about teaching in general and teaching at Georgia Tech specifically.

Georgia Tech Professional Education (PE) http://www.pe.gatech.edu/

Georgia Tech PE has been a partner in developing Georgia Tech's MOOCs. They have resources to help in the production (e.g., facilities to make high quality pre-recorded lectures) and instructional design.

Office of Information Technology (OIT)

OIT offers various technology-related services for faculty. http://oit.gatech.edu/audience/faculty

OIT also offers support and help both inside and outside of the classroom.
http://oit.gatech.edu/service/tsc/technology-support-center

Conclusion

We hope that by using this guide, your flipping experience will be easier and better informed. By reading this guide, you should have a better understanding of what a flipped classroom is and what are the benefits and challenges of flipping a class. The guide also provides detailed information about how to design a flipped class and how to benefit from the successes and mistakes of other flipped instructors. This guide should also help you evaluate their flipped class to make improvements for the next time you offer the course and determine if the flipped version of the class is better than the original version. If you have any questions or comments about the guide, please visit the http://c21u.gatech.edu/forum.

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Appendix A

The following appendix highlights the unique characteristics of classes to provide ideas for your flipped classroom. The full description of each class can be found using the references given.

Unique Characteristics of Flipped Classrooms from Coursera's Flipped Classroom Reports

Reference the Flipped Classroom Field Guide by Coursera for full descriptions of any of these classes.

The entries are titled by the faculty member, university, and course name.

Adrienne Williams, UCI, Introductory Biology

Unique characteristics of class: Students were given a video outline to fill out while watching the videos. They were also given a lecture outline, and they would bring both of these outlines to class. Williams also banned laptops from class meaning students didn't have access to her lectures except for the notes that they took with the outlines.

Philip Zelikow, UVA, The Modern World: Global History since 1760

Unique characteristics of class: After moving lectures online, Zelikow used one class period each week to have a "history lab." For the labs, a research team was responsible for finding primary source documents for a world city at three discrete time periods. Students would then write survey papers and present them during lab to foster discussion about the similarities and differences between among cities and time periods.

Mohamed Noor, Duke, Introduction to Genetics and Evolution

Unique characteristics of class: Noor treated 1 out of every 3 class periods as "in-class office hours" to provide more individual support to the students.

Kristin Sainani, Stanford, Writing in the Sciences

Unique characteristics of class: Sainani sometimes used class time for peer grading activities which she reports were much more valuable than take-home editing assignments.

Unique Characteristics of Flipped Classrooms from "Blended Learning in Higher Education"

Reference Blended Learning in Higher Education by Garrison and Vaughan (2008) for full descriptions of any of these classes. To get these instructional materials online, click on the link below and search for the course CS0000 under the last name McCracken. The password is p3i9a2im.

http://eres.library.gatech.edu.prx.library.gatech.edu/eres

*Note: These courses are defined as blended course, and most of them do not meet the criteria for flipped classrooms based on this guide's definition. The unique characteristics described below could be adapted for use in a flipped classroom.

Introductory Political Science (Small Class)

Reason for blending: In-class discussions were dominated by the same 4 to 5 students, so an online discussion forum was added to allow all students to contribute to the discussion.

Unique characteristics of class: The number of lecture hours was reduced from 3 to 2 to give students time to use the online discussion forum to debate case studies.

Introductory Chemistry (Large Class)

Reason for blending: Feedback on student's labs and questions outside of class were handled by TAs. Large lectures and diminishing resources reduced interaction with faculty and active learning experiences. The goal of the redesign was to improve learning experiences and access to faculty.

Unique characteristics of class: The class replaced weekly wet labs with a wet lab every two weeks in the laboratory and a dry lab every other week online using software. During lecture, the faculty introduced concepts and explored their applications with students using clickers. Online tutorials complemented the lecture and provided additional resources for students.

Scientific Writing (Project-Based Class)

Reason for blending: The previous design of the class used instructor and TA time in such a way that it could only accommodate 20 to 30 students. The goal of the redesign was to increase the time available to individual consultation with students while easing the administrative workload for the instructor.

Unique characteristics of class: Originally taught with 3 lectures and 1 lab each week, the number of lectures was cut to include only seven lectures on the key aspects of scientific writing. The rest of the time was used for researching, writing, and review papers with peer and TA feedback and individual consultations with the instructor.

Appendix B

A short sample of pedagogical theories and practices.

Theoretical Terms

Constructivism

Constructivism is based on learners building new knowledge upon a foundation of previous knowledge. This type of learning requires that learners take information from other sources embedded within its own context and make it fit into a new context that has meaning to them (Hoover, 1996).

Mastery Learning

In mastery learning, students are given prompt feedback and allowed to re-attempt problems until they master the content or skill being taught. Only after they have demonstrated mastery do they move on to the next topic. Bloom demonstrated that this type of learning has better learning outcomes when compared to learning environments in which the student turns in homework, moves on to a new topic, and receives feedback on the old topic days later (Bloom, 1968).

Collaborative learning

Collaborative learning activities can have a number of benefits including additional feedback and motivation. Groups of students can also take on larger problems than individual students can. Additionally, collaboration helps student develop group skills (Dillenbourg, 1999).

Practice Terms

Community of Inquiry

Education should be based on inquiry, learning to investigate and solve problems and issues, not memorizing solutions. This type of learning requires learners to have the freedom to explore ideas, question, and construct meaning. It also requires discipline to interact academically with others in activities such as respectfully questioning, listening, explaining, and defending positions (Garrison & Vaughan, 2008).

Just-in-time teaching (JiTT)

For JiTT, instructors use student performance data to understand concepts with which students are struggling and give personalized attention to students. Commonly JiTT is based on assessments administered before class time, so the instructor can use class time to address common misconceptions and give individual help. Because JiTT relies on a relatively small time loop, students receive relevant feedback in a timely manner to minimize the development of misconceptions or falling behind in class (Astin, 1993).