FLIPPING THE HYBRID COLLEGE ALEGBRA CLASSROOM USING MYLAB MATH

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Abstract

This paper discusses a particular flipped classroom structure in a hybrid College Algebra class that I have been successfully using for a few years. Also, the paper gives a short review of the technology used for this class. In addition, some survey results about the structure and effectiveness of this flipped course structure are shared. Moreover, it will be discussed how student feedback has been incorporated in the structure of the class.

Introduction

When I started my career, I thought that the goal of teaching in higher education was to prepare students with a solid base of mathematical knowledge so that after graduation they could enter the workplace more prepared with theory, knowledge, and with reasonable experience of the theoretical tools they would need to use. Soon, I came to realize that there is so much more to teaching in higher education. It is not just the content, but also the delivery. As a result, for quite a long time now, I started implementing various active learning strategies in my classes (i.e., Inquiry Based Learning; in-class group work, problem-solving activities, discussions, and presentations; lecture handouts that need to be filled in; voluntary out-of-class study sessions; out-of-class group projects; and recently flipped classroom). The recent research shows that active learning is an effective way to engage students in active participation in building their own knowledge [1, 4]. I have the opportunity to witness that through my above-mentioned activities that are designed to transform my students from passive listeners to active participants in class. I truly believe that those active strategies improve the student-learning experience and prepare them better for their futures and at the same time benefit me – by enhancing my teaching practices. In addition, enhancing a class with technology (as a hybrid) allows students more flexibility and better engagement with the concepts covered.

The recent popularity of flipped classrooms in undergraduate classes and research showing the effectiveness of it on student learning [2, 3] prompted my teaching endeavor in that direction. As a teacher, the most challenging tasks have been to make my College Algebra students responsible and active learners, spark their desire to learn, and increase their knowledge. Namely, I have been teaching College Algebra at Utah Valley University (UVU) frequently since Fall 2010. Most of the students in these classes are

not motivated, do not want to be in that class; for a large number of them this is the only or last math class they need to take, and the only goal for them is to pass the class with whatever minimum effort they can and fulfill their requirement. In addition, almost all of them are scared of math, have math anxiety, and think they are not good at it (unfortunately, a negative attitude toward math that we, as teachers, see and deal with it every day). Hence, when in the Fall of 2011, I was given an opportunity to teach a hybrid College Algebra class, I decided to try it in a flipped classroom.

Since then, I have been modifying the flipped classroom based on student feedback, making it a better and more effective environment for student learning.

Structure of the flipped hybrid College Algebra classroom

The College Algebra class at UVU is a four credit class. While the traditionally taught classes meet (face-to-face) four times per week and each class meeting is 50 minutes, the hybrid College Algebra class meets (face-to-face) just three times per week. The fewer number of face-to-face meetings was justified by the hybrid structure because students needed more time to watch the video lectures before they come to class. Note that when our department started implementing the hybrid College Algebra, the class met just twice a week for 50 minutes face-to-face, but we soon realized that the students needed more face-to-face time to catch up with the material. Hence, after a year or so of implementing it as such, we switched to three face-to-face meetings.

As I mentioned in the introduction, I started teaching hybrid College Algebra classes in the Fall of 2011, and since then I have been modifying the flipped/hybrid structure in my classes (Table 1 lists the hybrid classes that I have taught so far). Most of the modifications I implemented came from the helpful student feedback (that I collect at the end of each of the classes I teach). In addition, I used my observations about methods that give the most effective student learning results for the type of students we teach at UVU (who are mostly non-traditional students), as well as my reflections on the activities that I had used and their pros/cons for the particular UVU student body.

Semester	# of classes taught	# of face-to-face meetings per week
Fall 2011	1	2
Spring 2012	2	2
Fall 2012	1	3
Spring 2015	2	3
Spring 2016	1	3
Fall 2016	1	3
Spring 2017	1	3

Table 1: List of hybrid College Algebra classes I have taught

The structure of the flipped classroom today consists of two parts – on-line and in-class learning activities – both shaped by the modifications made in response to student feedback and my observations. In both parts, I have been using different ways to motivate students to come to class prepared and to engage them in class as much as possible.

a. On-line learning activities (before each face-to-face meeting)

For the on-line part of the class, students use the Pearson's on-line system MyLab Math (http://www.pearsonmylabandmastering.com/northamerica/mymathlab/) that provides online homework, tutorials, and assessment tools.

Students are first asked to watch the chosen video lectures on a specific topic. Then they are asked to work on the on-line homework that is due half an hour before the class meeting (this is one way to make students come to class prepared). Another way I use to motivate students to come prepared for class is by making the video lectures a pre-requisite to access the homework. Note that I am flexible on this part. Namely, if a student wants to use the multimedia textbook and watch the videos provided there, or is familiar with the material covered in a particular video lecture, MyLab Math software allows for them to skip that particular video (by just opening and closing the particular video) and still get access to the homework. At the beginning I was concerned with this particular feature and asked the Pearson's team if they could change this so that students must watch the complete video before it is checked as complete. But I realized that students who would like to get access to the homework faster and skip the video lectures are typically not prepared to attack the homework. when they start working on the homework they soon realize that they need to go back either to watch the videos or work through the multimedia textbook. Either way, they were learning the lesson of the importance of the video lectures for solving the homework problems and later for working on the problem-solving questions.

b. In-class structure (during the class meetings)

The following is the statement that we have been using in our hybrid College Algebra classes:

> "Your on-campus instructor is available to help answer questions about those concepts that caused you difficulty at home and give you quizzes to help you stay caught up.
> Your on-campus instructor will not be giving complete lectures on any of the topics; rather (s)he will go over additional examples, answer questions, and present difficult concepts in a slightly different way, when needed, in order to facilitate your learning."

For my particular flipped classroom, I have modified this statement so that my class structure consists of 30 minutes of Q/A session and 20 minutes of problem-solving session. I do not lecture, but rather just help answer questions about concepts/topics that

caused difficulty to students at home. In response to student questions, I ask them questions back so that they actually answer their own questions.

Hence, during the Q/A session my role is to

- facilitate an active class environment by actively involving students in discussion and review of the concepts/topics that they have learned at home,
- encourage students to ask questions about the concepts/topics that caused them difficulties at home or homework questions that they had trouble with,
- lead them to answer their own or peers' questions,
- spark communication between students about the discussed concepts/topics.

I also encourage students to volunteer to present the answers to the questions that are familiar with; so many times we have students presenting the answers to the asked questions on the board.

After all questions are answered, students are given a group quiz during the problem-solving session. The group quiz is a unique way to involve students in collaborative problem-solving and active learning. The group quiz contains problem-solving exercises based on the material assigned for that day. I require (if possible) just two students to work together in a group (if not one group will have three students). In addition, the requirement is that they cannot work with a classmate that they have worked with before (or for a while). This requirement is implemented for several reasons. First, to avoid students who have not done their assigned work before class, to always work with students who always diligently finish their on-line assignments and come to class prepared. Second, to allow students to get to know each other, to form tight community, and to reach out to each other if needed (outside of class) for help on the material covered in that course. Third, to give them the opportunity to realize that there are other students like them who do well/not so well as they do, to recognize that other students are struggling on some of the concepts as they do, and to increase their confidence in their math ability while working with struggling students.

While working on the problem-solving exercises, students are asked to apply new knowledge of the particular topic discussed that class meeting, to practice the new concepts, to discuss the questions/problems on the quiz, and to help each other by asking questions and explaining the answers to those questions. In addition, students are asked to contribute equally to (writing up) solutions of the quiz problems. The goal of the problem-solving session is for students to learn from each other, to improve their math communication and writing skills, and to practice what they have learned.

This particular structure allows students to learn/review/practice the new concepts at least four times (while watching the video lectures, while doing the homework, during the Q/A session, and while working on the problem-solving exercises).

To help students outside of class, I frequently organize out-of-class meetings (study sessions). Those study sessions are voluntary – and every student in my class can come (for the whole session or part of it) and participate during those sessions. During these sessions students ask questions and solely answer and present solutions on the board. They brainstorm ideas and are highly engaged in discussions about the solutions presented. I am always present at these study sessions, but rarely get involved in the presentations and discussions. The only times I do get involved is when students are really confused about a concept or they are stuck on a problem and have not discussed an idea that would lead to a solution. In those cases I try to give them hints so that they can continue with their discussion/presentation. One of the benefits of those study sessions is that they are more informal and offer a less stressful environment for students, which lead students to be more open and willing to participate, to ask more questions, to make mistakes and learn from them, and to be involved in the discussions and presentations.

The flipped classroom method gives opportunities for students to learn/review the new material a few times during the out-of-class and in-class work, to collaborate, and increase their logical and critical skills they need post-graduation, and allows me to better and more immediately assess their learning.

Technology – why use MyLab Math?

I understand that technology is an important learning tool to support problem solving and to promote understanding [5], and I am open to trying and using different types of technology in my classes. In addition, recent studies indicate the important role of technology in college education [5]. As a result, I have used various technology tools to enrich student learning in my classes throughout my teaching career. But this was my first use of technology in a hybrid setting.

At UVU, we use *College Algebra* textbook by Ratti and McWaters for many of our hybrid College Algebra classes. Note that there are many technology softwares that can be used for this type of setting and probably one can find pros/cons for any of them. For me personally, what I loved about MyLab Math was that it works well with flipped classroom and synchronous learning structure. Namely, MyLab Math provides video lectures and on-line homework that are aligned with the used textbook. The opportunity to choose the videos that are closely connected to the material in the book, and assign homework problems that are similar to the problems/exercises in the book was something that I very much liked and appreciated. Creating assignments using the Assignment Manger was easy to use (and the help of the Pearson team was very valuable). The opportunity to create prerequisites was also a great feature of MyLab Math.

In addition, providing immediate feedback on the practice and homework problems, as well as needed help at each step of solving the problems is invaluable not just for students, but also for me – allowing me to spend more time helping students outside of class during the voluntary study session instead of grading homework problem sets.

Moreover, MyLab Math provides students access to interactive study aids and multimedia resources, including the multimedia textbook, (again aligned with the used textbook). The multimedia library and textbook were very helpful not just for me but also for the students – they are able to go back and review material at any point in time.

Furthermore, there are plenty of resources for instructors: PowerPoint slides, Instructor's Solution Manual, Testing Manual, etc. Moreover, MyLab Math has an Adaptive Learning feature that I have not actually used for this class. The reason is the way I structure my class. The idea is for students to have seen and worked through similar problems so we can all have a productive and helpful Q/A session in class.

Survey Results

As I mentioned before, at the end of each semester I give a short survey to my students that assess the structure and the effectiveness of this flipped/hybrid classroom and ask for feedback on the active learning activities and various learning methods used during the semester. Those are volunteer surveys so students can choose to respond or not respond to them. There are no benefits to students who choose to answer the survey questions, except that they help me to evaluate the class and the activities undertaken. In this paper, I will share the results of the survey's questions collected during 2015-2017 (the bolded semesters in Table 1).

First, it is worth mentioning and discussing the evaluation rubric I use for this class (see Table 2).

Exams	4 exams total given during a semester (15% each)	60%
Homework	Assigned for each section	5%
Quizzes	Given at each class meeting	10%
Final Exam		25%

Table 2: Class evaluation rubric

Note that most of the points to pass this class can be earned from the exams (four during the semester and the final exam). And I do point this out at the beginning of the semester (and later after the first exam). But I also stress the importance of the on-line homework. Those 5% might not look like much at the beginning of the semester, but ignoring the on-line homework means that a student would not be prepared to attack the problem-solving exercises, thus jeopardizing their quiz grade (10%). Moreover, that will lead to compromising their exam grade (60%) and later the 25% of the points that a student can earn for this class from the final exams. It is important for students to realize that each of the items in the rubric is very important and essential in their success and passing the class. And after the first exam, many students come to realize the importance of being prepared for each class meeting by doing the on-line homework, and the significance of the problem-solving exercises for their preparation for the exams. That really motivates them to come to class prepared and actively participate in it.

Next, I will address the survey results. The most interesting for me was the fact that most of the students that have been signing up for the hybrid classes they actually were not aware that they were signing up for a hybrid, nor what that means, as the results from statement 1 in Table 3 shows. Almost all students disagree with the statement that they wanted to be in a hybrid class. Usually that means that they signed up for the class because they had a very busy working schedule so the three face-to-face meetings worked better for them, or all the traditional sections were filled so the hybrid was the only option, or they just chose it because the time of the scheduled face-to-face meetings worked better for their schedule, etc. Even more interesting was the fact that over 85% of the students in their written comments indicated that they liked the hybrid/flipped structure even though they didn't know what they were signing up for at the begging of the semester.

	Semester and year taught	**Sp. 15**	**Sp. 15**	**Sp. 16**	**Fall 16**	**Sp. 17**
	# of students that took survey	**# 15**	**# 20**	**# 17**	**# 20**	**# 19**
#	**Survey Statement**					
1	I wanted to be in a hybrid class	2.14	2	2.29	2.6	2.58
2	Used the lecture notes	2.73	2.15	-	-	-
3	The lecture notes were helpful	3.6	3.47	-	-	-
4	Video lectures and HW were helpful	3.87	3.8	3.52	4.2	3.63
5	The in-class quizzes were helpful	4.1	4.5	3.88	4.4	4.15
6	I liked the active in-class engagement	3.87	4.1	4.23	4.45	4.15
7	The Q/A session was helpful	4.2	4.45	4.41	4.5	4.42

5-strongly agree; 4-agree; 3-neither; 2-disagree; 1-strongly disagree

Table 3: Survey results (IRB # 01244)

When I started teaching the hybrid courses I was making a one-to-two page long lecture notes with the important definitions/facts/results/formulas for each section covered. I posted those on the *Canvas* page for this class, and they were available for my students during the semester. The survey results (see results on statement 2 in Table 3) showed that most of the students did not use the lecture notes, even though the ones that used them couldn't decide if they were helpful or not (see results on statement 3 in Table 3). So after a few years of using them, in Spring of 2016 I decided to discontinue the use of the lecture notes. The decision was also supported by the richness of supporting materials that MyLab Math is offering for the students.

The survey results also showed that most of the students liked the active in-class engagement (ranked ~4.2 out of 5), and indicated that the Q/A session and the in-class quizzes were helpful (see results on statements 6, 7, and 5 in Table 3). About the video lectures and the on-line homework, the answers were mixed. Namely, many could not

decide if they helped them, but the number of the students that agreed with the statement prevailed over the number of students that disagreed. The mixed responses about the helpfulness of the on-line video lectures and the on-line homework were confirmed on the next question:

> "*Which of the following helped you to improve your understanding of the material covered during this semester*?"

where an average of 50+% of the students (for the on-line homework this percentage was a little higher) were choosing video lectures and on-line homework as one of the activities that helped them most improve their understanding of the material covered (Tables 4 and 5).

Semester and year taught	**Sp. 15**	**Sp. 15**	**Sp. 16**	**Fall 16**	**Sp. 17**
# of students that took survey	**# 15**	**# 20**	**# 17**	**# 20**	**# 19**
Studying individually	9	8	9	12	12
Instructor's lecture notes	5	6	-	-	-
Video lectures	9	11	8	12	9
On-line homework	8	13	8	14	9
Exam reviews	8	11	13	16	14
Study sessions	8	8	5	14	10
In-class quizzes	5	13	6	13	12
Q/A sessions	10	18	13	19	17

- represents an activity that was chosen by the largest # of students
- represents an activity that was chosen by the second largest # of students
- represents an activity that was chosen by the third largest # of students

Table 4: Survey question results using number of students per response (IRB # 01244)

Semester and year taught	**Sp. 15**	**Sp. 15**	**Sp. 16**	**Fall 16**	**Sp. 17**
# of students that took survey	**# 15**	**# 20**	**# 17**	**# 20**	**# 19**
Studying individually	60%	40%	53%	60%	63%
Instructor's lecture notes	33%	20%	-	-	-
Video lectures	60%	55%	47%	60%	47%
On-line homework	53%	65%	47%	70%	47%
Exam reviews	53%	55%	74%	80%	74%
Study sessions	53%	40%	30%	70%	53%
In-class quizzes	33%	65%	35%	65%	63%
Q/A sessions	67%	90%	74%	95%	89%

Table 5: Survey question results using percentage per response (IRB # 01244)

It is worth mentioning that survey results (Tables 4 and 5) show that the Q/A part of the class time contributed the most toward the understanding and learning of the material covered. This was expected, as students would come to class knowing what they did not understand from the material in the video lectures and the on-line homework, so the discussion was aimed toward clearing and understanding those particular concepts.

What surprised me was that students ranked the in-class quizzes (as a learning method that was helpful for their learning) higher than the on-line videos and homework in Table 3, but were ranked lower in Table 4 (5). It is worth noting that in their written comments many students made remars about the problem-solving part of the in-class time (administered through the group quizzes) as one of the best methods that helped them understand the material.

There was no surprise about the high ranking of the exam reviews. The exam reviews were long ones and included problems of all types covered in the material tested. Students were asked to try and solve as many problems as they could before they came to the review session and on the day of the review (in-class and during the study sessions outside of class) they were asking questions about the problems that caused them difficulties. The written feedback also reflected their acknowledgment of the exam reviews being one of the methods that help them best prepare for their exams.

The survey contains a section where I ask them to provide any additional comments about this type of learning experience: what did they like/not like about the structure; in which ways the structure of the course helped them in learning the material (if applicable); any suggestions to improve the structure; anything to change or stay the same. I have been using this section in shaping the structure of the course as it is today. Students are very open and honest in providing constructive criticism in their written feedback. Below are some sample comments (IRB # 01244) that reflect what students liked about this type of structure:

> "I did not realize I was signing up for a hybrid course. I am glad I did. I enjoyed the course."
>
> "I liked the hybrid course, [it] made you responsible."
>
> "The question-answer part of the class was very helpful."
>
> "I didn't like the daily quizzes, but they help out [in learning]."
>
> "I didn't know it was a hybrid course but I really enjoyed it. I liked watching the videos outside of class and then just talking about what was confusing in class."

Similar feedback can be seen on the official SRI (Student Ratings Instructions):

> "The instructor tried to make the class very interactive and up-beat, where usually math classes are boring."
>
> "It was helpful with the way it was set up, being mostly self-taught; we were more open to be incorrect… It made for a good learning environment."
>
> "The in-class structure was nice and easily followed. And it really helped to make it to class every day."
>
> "Group quizzes in class were probably what best helped me to solidify the material."
>
> "Her quizzes did helped we liked how she would interact [with] everyone and that we had quizzes with a partner."

Most of the written feedback (on the surveys I give and the SRI written comments) reflect similar conclusions: most of the students liked the structure of the course, liked the responsibility that comes with this type of setting, liked the part that is self-taught outside of class, and then getting necessary help in class for the parts that were confusing, etc.

Conclusion

The flipped classroom and the group work has had a great impact on my students: they are not afraid to stand up and work a problem in front of their peers, present an idea, or make a mistake and learn from it instead of being frustrated about it. They become more communicative, develop their team-working skills, help each other, and work collaboratively on group assignments. I would strongly recommend to everyone to try a flipped classroom model and find the one that works best for their students and personalities.

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