Teaching genetics and genomics in eye care using flip classroom

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Description
Flip Classroom in Optometric Education

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Teaching genetics and genomics in eye care using flip classroom

Len V Koh

Abstract:

Purpose: To share my experience of applying ‘flip classroom’, a new pedagogy in optometric education.
Methods: Flip classroom is a novel teaching methodology in which the class time is used for discussion and application of new knowledge. The students take more active role in their learning by doing online learning activities before coming to class. In this article, core competency in genetics for health profession was taught using blended learning via flip classroom. Video-clips, online assessments and reflections, current event, vignettes and multimedia presentations were applied in the course.
Results: Student evaluations at the end of the course were largely good or very good for online activities, in class discussion, and final assignments. They also share some ways to improve the course such as splitting the class into groups for debate and loading online activities earlier during the week.
Conclusions: Students found ‘flip classroom’ more engaging and effective than traditional format and unanimously recommended the course to future students.

Background

Education in general and health care education in particular constantly search for novel teaching method to enhance learning and clinical competency. The advances in computing technology and the easy access of internet have ushered growing interests in exploring and finding effective ways to apply technology in education. When it comes to the topic of educational technology, most of us will readily agree that increasing number of students are required to purchase their computers prior to optometry school. Where this agreement usually ends, however, is on the question of whether 24-7 interconnectivity helps or hinders learning. Whereas some are convinced that traditional lecturing had worked well for
decades and remains the gold standard of teaching, others maintain that traditional lecturing is antiquated and ineffective way. In the modern age of advance computing technology, we have better way to engage our students and we should do better. My own view is every new and disrupting technology initially raises caution and doubt amongst the affected cohort because of its threat to the comfort of familiarity, however continual education research and publications are essential to yield the data overtime. Consequently, the cumulative evidence would convince more skeptics and attract more applications of new teaching format with technology to make it mainstream.

One example is the concept of blended learning. It is ‘blended’ because it combines multiple learning environments and activities. It is not new, but it has been done for decades before the advent of computers. For instance, chemistry lecture followed by hand-on experience in the form of experiments in laboratory. What is new with blended learning in the age of internet and social media is that it permits for permutation of multiple ways of using instructional technology in the pedagogy\(^1\). In other word, teacher can blend an online learning component with a traditional face-to-face (F2F) experience in class\(^2\).

Over the past few decades, there has been call to move away from the antiquated model of ‘a sage on the stage’, where the instructor stands in front of the class and delivers the knowledge of the day to a newer model of a ‘guide on the side’, where the instructor acts as a facilitator to promote student-centered and more active learning\(^3\). The use of blended learning approach fits well with the latter model, because students can learn on their own at their convenience via online learning activities prior to coming class for F2F discussion. In the previous publication, I have published my experience in using blended learning pedagogy to teach medical pharmacology to optometry students\(^4\), which is amongst only a few publications on blended learning in optometric education. In this article, I would like to share my experience of applying ‘flipped classroom’, a new pedagogy in optometric education, in teaching an elective course titled ‘genetics and genomics in eye care’ to third-year optometry students.

As a brief introduction, flipped classroom is a pedagogy which flips the traditional teaching format by expecting students to do preparatory learning online prior to F2F time in class\(^5\). The class time is used mainly for instructor-facilitated student activities. For example, students are assigned pretest and reading on a topic before class. Once the students get to class, the instructor will facilitate discussion or application in the class such as drawing a pedigree from a family history. To the best of my knowledge, this is the first publication of ‘flipped classroom’ experience in optometric education. Moreover, there was no result when I searched ‘flipped classroom’ in VisionCite database. This course has allowed me to be creative with my teaching capability to include various activities such as discussion on current-event issues, reflections on reading assignments or watching documentary, vignettes, paper project, and multimedia mini-presentations by students.

Methods

Genetics and genomics in eye care was an elective course for third-year optometry student given in the summer semester of 2014 with 20 students. Flipped classroom format was applied over 10 sessions for the entire course. This was a pass or no-pass course. Students were expected to pass all weekly online activities and a final presentation project to complete the course successfully.

In the spirit of sharing and showing how flipped classroom was done, I include a snap shots of representative online learning activities in this course chronologically. Moodle, an open-source learning management system, was used to manage all course related materials online and available to students 24/7 at their convenience. Figure 1 shows the layout of the title and objectives of the course. The course objectives were based on the core competencies in genetics for health professionals published by the national coalition for health professional education in genetics (NCHPEG) in 2007\(^6\).
Genetics and Genomics in Eyecare

This course will cover the genetics core competency for optometrists. It comprises of simple and complex ophthalmic genetics and genomics.

At the end of the course, optometric clinicians will be able to
1) gather genetic family history information
2) identify and refer clients who might benefit genetic services or from consultation with other professionals for management of issues related to a genetic diagnosis
3) explain effectively the reasons for and benefits of genetic services
4) use information technology to obtain credible, current information about genetics
5) assure that the informed-consent process for genetic testing
6) appreciate the sensitivity of genetic information and the need for privacy and confidentiality
7) seek coordination and collaboration with an interdisciplinary team of health professionals

The course syllabus and a discussion forum for gathering student inputs were posted a week prior to the beginning of the semester (figure 2). Further, a survey of what students want to learn from the course is included as pre-session activity prior to our first F2F meeting.

Questions, Suggestions, and Comments

POST your question, suggestions, and comments HERE

What would you like to get out of this course?

OPT758-Syllabus

First meeting focused on the overview of genomics. Figure 3 presents the course content for the first meeting with an overview of genomics which was introduced by an expert in the field as a guest lecture. A short snippet of a few minutes of the popular movie, GATTACA, was played at the beginning of the first session followed by an overview of human genome project and genetics in optometry.
Overview of Genomics

Medical genetics of the near future....

Consider, is this our future?

Human Genome Project History
Genetics in Optometry

Figure 3: Course contents for the first week

Week 2 of the course aimed to review basic genetics knowledge (figure 4). Students had to read the posted materials and take the genetics knowledge quiz. They had three attempts to get better than 80% to pass the quiz. The classtime for week 2 was used to clarify basic concept in genetics and what was expected in the final paper and presentation project.

Knowledge Competency 1.1

Understand basic human genetics terminology

Genetics Primer
Glossary
eyeGene

List of possible ophthalmic disorders to do a paper project. You can also choose one off from the list.

Guide to write a project paper

Follow the guide and work on your ophthalmic condition of interest.

geneTest.org

Most of the resources for your paper and this course can be found via this website.

Genetics Knowledge Review

This test is to review what you know about genetics with 3IQ. You need to get better than 80% to pass!

Figure 4 : Course contents for week 2
Week 3 covered the importance of family history (FHx) and basic patterns of biological inheritance. The students had to pass the FHx-pedigree quiz online before coming to class. Coincidentally, Angelina Jolie’s story about her decision of having a prophylactic double mastectomy was on the news, so the students were assigned to read her article as well as a rebuttal article titled ‘what Angelina Jolie forgot to mention’. Additionally, students were expected to share their reflections from reading the articles (figure 5). The class time was used to allow the students to build their own family history using online freely-available software (https://familyhistory.hhs.gov/FHH/html/index.html) and discuss the relevant news of the week.

Students delved deep into genetic diseases of the eye in week 4 via assigned readings and video documentary (figure 6). They were expected to share their Knowledge Learn Question (QLK) on genetic testing for glaucoma and genetic eye diseases. KLQ is designed with three questions: What did you know before reading the articles or watching the documentary; what did you learn after reading or watching activities; and what questions do you still have after the activities. The F2F time in class was used to discuss genetic testing in primary eyecare.
The focus of week 8 was on ethical, legal, and social issues (ELSI) related genetic testing and recording of genetic information (figure 7). ELSI vignettes were used to put students in real life scenarios coping with potential discrimination in the workplace and life based on genetic information. (http://www.genome.gov/25019880).

Students were expected to share their KLQ reflections on at least one of the vignettes. The class time was use to debate on some of the ELSI vignettes. Examples of available ELSI vignettes are shown in figure 8.
Results

Application of online learning management system such as Moodle permits interaction with students even before the start of the semester. As in this course, I was able to survey my students on why did they enroll in the course and what did they want to learn from the course. The responses were diverse as illustrated in figure 9 and 10, respectively. These feedbacks allowed me to adapt to their interests that I might not have thought of when the tentative syllabus was developed.
The result of the genetics knowledge quiz confirmed that a number of students had to take the quiz more than once to achieve a passing score of 80% out of 31 questions, because 25 attempts were made by 20 students (figure 11).

Representative examples how KLQ was used to gauge how much did the students learn by themselves via online activities and what questions did they have after completing the assigned readings in this example on genetic testing for glaucoma and genetic eye diseases (figure 12). One of the important things from KLQ entries is that the instructor can take those questions that students still have in class discussion.
Figure 12: Examples of responses to “Share your KLQ on genetic testing for glaucoma, and genetic eye diseases”

For the final two sessions, students shared their three-minute presentation that they made via online podcast or video-cast in class so that their classmates could learn and appreciate what they had created. Additionally, they also submitted a short paper on the topic which could serve as a script for their multimedia presentation. Figure 13 showed the representative examples. Additionally, the presentations were published online and available for future review or share.

Figure 13: Representative layout of the paper projects with links to the 3-minute podcast or video-cast
Student evaluations at the end of the course were largely good or very good for online activities, in class discussion, and final assignments (figure 14). Select student testimonials for the course are summarized in figure 15. They were very positive to the new pedagogy and content for the course.

Figure 14: Student ratings on the course.
Students also shared some ways to improve the course as illustrated in figure 16. For example, splitting the class into groups for debate on relevant topic of the week. Further, assigned materials could be loaded up earlier in the week so that they had more time to complete the tasks before class time.
When it comes to the question of whether the students prefer traditional format which was given in their pediatric course in the summer as compared to blended format in this course. The majority of students preferred the blended format, but not by much, because 42% of them still liked the traditional format better (figure 17). The reasons for their preferences are shown in figure 18, for example traditional format has more structure, whereas blended format allows for independent learning outside of the class.

| Which format of learning do you prefer, traditional (Pediatric) or blended (Genomics)? |
|-----------------------------------------------|-----|-----|
| **Response**                                | **Average** | **Total** |
| traditional (Pediatric)                     | 42%  | 8    |
| blended (Genomics)                          | 58%  | 11   |
| **Total**                                   | 100% | 19/19|
Finally, the success of the course is confirmed by the evidence that all responders would recommend this course to future students.

Discussion

The arrival of public internet in the 1990s has made it possible for some universities to experiment with online distance learning. Over the ensuing decade the concept of online learning started to spread beyond just distance learning as a supplemental component to F2F learning in classroom. Nowadays, online learning is an integral part of a hybrid model or blended learning which is applied widely from universities down to elementary schools. For example, a recent survey of the U.S. school district administrators in 2007 found that 63.1% had one or more students enrolled in a fully online or blended course and 32.4% had one or more students enrolled in a blended course. Therefore, it is highly likely that many students have experienced online and/or blended learning prior to starting their optometric education. However, most of their classes are still taught in the traditional format of a ‘sage on the stage’. The reason for this may be that there has not been a lot of evidence confirming that blended learning is better than traditional format. As more blended learning pedagogy is applied and reported, there have been more instructors willing to give it a trial. For example, in 2009, the US Department of Education did a meta-analysis of 1,000 studies of online classes and found that ‘students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction.’ Additionally, ‘instruction combining online and face-to-face elements had a larger
advantage relative to purely face-to-face instruction than did purely online instruction. Therefore, the blended format seems to have a synergistic effect to learning over just lecture or distance learning per se. This could be explained by the reality that students may need the instructor as an expert to explain abstract and difficult concepts, or share clinical experience. On the other hand, students are fully capable of applying new concepts in a group after learning from the instructor, so a combination of both methods would be best to retain new knowledge and skills.

This course was developed in response to the call-to-action article published in the Journal of Optometric Education titled ‘Genomic – The Future of Eyecare’ in winter of 2004 outlining the needs to train doctors of optometry to be competent in caring for patients with eye disorders in the post genomic era.

Flipped classroom is a modified version of blended learning, a learner-center pedagogy, putting more responsibility on the students to do their learning independently before coming to class so that the class time can be utilized to discuss or apply new knowledge. After my experience of applying blended learning in Pharmacology, one of the things I learned was that students wanted credit for their times spent doing online activities, so for this one-credit elective course I cut the F2F class time from 55min to 35 min to credit for their time completing online activities. Students seemed to be happy with this arrangement based on personal communication.

As shown in the figure 1, by using blended format, the course began before the semester started because the layout, objectives and syllabus for the course were open to all students in the class. The course objectives were based on the ‘Recommended Core Competencies in Genetics for Doctors of Optometry’ published by ASCO in 2005, available from http://opted.org/files/Genomic_Core_Competencies.pdf. Additionally, a short survey was sent out to gauge student interests and the reason for the interest which served as a way to learn what the students wanted to learn and modify the course content as needed (figure 2, 9).

The first F2F meeting provided an overview of genomics and took up any question student had about the course. The guest lecturer started the session with a short clip of a movie GATTACA to emphasize the science fictional story in the movie is closer to reality than we know (figure 3). Further, the video also introduced students to the application of multimedia in the course.

Prior to second F2F meeting, students had to complete and pass the genetics knowledge quiz before the class. All the resources to help them learn for the quiz were posted a week ahead of the next meeting (figure 4). Students had three attempts to pass the quiz which was closed an hour prior to class time. All students passed the quiz, but a few had to do more than one attempt to achieve 80% of the 31Q in 45 minutes (figure 11).

In addition using video in classroom, other instructional resources were used in the course to keep the content fresh. For example, current news were used as a topic of discussion about genetics of breast cancer in Angelina Jolie’s story (figure 5) in week 3. Documentary on cracking the genetic code was assigned in week 5 (figure 6) with the requirement that students must post their reflection via Knowledge Learn Question (KLQ) method. The use of KLQ is a novel way to assess student’s knowledge on a topic because it covers what the student already knows before the activity, what the student learns from the activity, and what the student still has question on the topic. Further, KLQ can provide questions and topics for discussion in class (figure 12). The KLQ reflections were designed in a way that all students can see their peers’ feedbacks so that they can learn from one another as well.
When it came to topics of ethical, legal, social implications (ELSI) on genetics, ELSI vignettes were used to trigger discussion amongst the class (figure 7, 8). Vignettes are conducive to learning because they put the students into real life situations that they can relate to with the feeling that ‘somebody went through this and it could happen to me’.

The final paper and presentation project was also novel to the students because most of them did not have previous experience in making a podcast or video-cast (figure 12). It was fun and less intimidating than presenting in front of the class. Besides, they also got a chance to show their creative side to their peers.

Based on the responses to the course at the end of the semester, students rated the course highly and learned various core competencies in genetics from the course and (figure 14, 15). For example, some students liked the content and topic of discussion, whereas others found the final project stimulating (figure 15). Students also gave specific and constructive feedbacks on how to make the course even better for instance by conducting discussion or debate in groups or having student picked an interesting topic to discuss in class (figure 16).

Although the majority of students preferred flipped classroom pedagogy, a substantial number of students still liked the traditional lecture format (figure 17). One student liked a ‘more structure’ in traditional class and another liked writing test than writing response (figure 18). Nevertheless, blended format was appreciated for being more engaging and efficient. Lastly, the success of the course can be summed up by the unanimous recommendation to future students (figure 19).

<table>
<thead>
<tr>
<th>Would you recommend this course to future students?</th>
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<tbody>
<tr>
<td><strong>Response</strong></td>
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<td>Yes</td>
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<td>No</td>
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Figure 19: Student responses to “future recommendation?”

**Conclusion**

Even in the 21st century with availability of internet and abundant instructional technology, most of the courses in optometry are still largely taught in a traditional lecture format ‘a sage on the stage’. The probable reasons for continuing with traditional format are there has not been sufficient evidence of better effectiveness for blended learning or flipped classroom, and it is hard for instructors to get out of their comfort zone to try novel instructional technology because it takes more time and requires more support to start.

Flipped classroom using a blended format as presented here can work well for many courses in optometric education. The strength of this course is that I was able to apply multiple ways to keep the
class interesting and engaging. Further, I learned that students like to be active and participative in their learning rather than sitting passively and listen. The limitation of this study is that flipped classroom is a novel teaching method in health care education, none in optometry, so there is not much evidence on its effectiveness. However, there has been a trend of increasing application and publication on the topic in recent years in pharmacy\textsuperscript{10} and nutrition education\textsuperscript{11}.

In this article, I shared all the experience from the course and presented snap shots of what I had done in hoping that some of you would gain enough confidence to take a plunge by designing your own recipe using some of the examples shown. I am looking forwards to continuing the flipped classroom pedagogy with a few modifications based on the student’s feedbacks this summer in 2015. Further, I am available and glad to assist in any way so do not hesitate to ask and share what you have learned.

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References