Evaluation of the flipped classroom at the Li Ka Shing Faculty of Medicine

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**Abstract**

The utilisation of video based materials prior to a teaching session with active problem solving during forms the basis of the novel flipped classroom instruction. Our study evaluated the use of this format during the teaching of rheumatology to third year medical students. 87/106 students evaluated this format through the use of a strongly disagree (1) to strongly agree (5) Likert scale and provided mean scores of 3.7 to 4.1 for statements allied to better understanding, preparedness, peer and teacher interaction, peer to peer problem solving, motivation, usefulness, achievement of learning outcomes and a desire for future classes to be delivered in this way.

From a qualitative perspective, students commented that this format allowed for active engagement, discussion, consolidation of knowledge, immediate feedback, application of theory to real life patient problems and the ability to watch and revisit the video material as necessary. Potential downsides included the lack of an electronic voting system, the perceived heavy workload and the fact that this form of interaction may not be best suited to East Asians.

The flipped classroom allows for worthwhile reflection of clinical knowledge and subsequent application. The findings from this initial study are encouraging and we plan to continue work on evaluating this format alongside other forms of delivery.

**Keywords:** Teaching and learning

**Article**

**Introduction**

Flipping the classroom involves the delivery of video based materials – or alternatives such as print materials or audio recordings – prior to a lecture or class session. The class session is then dedicated to more active learning techniques so that basic knowledge can be applied through problem solving or case-based scenarios.

Professor Eric Mazur of Harvard University is one of the best known proponents of this teaching method. In addition, Salman Khan of the well-known Khan Academy utilises videos to enhance the teaching and learning process.
There has been little evidence gathered on the utilisation of this teaching format in the medical education context. Prober et al at Stanford for example noted that the use of the flipped classroom during the delivery of a biochemistry course increased attendance from 30 to 80% (Prober & Heath, 2012). In addition Pierce et al observed that the use of the flipped classroom during the delivery of a renal pharmacotherapy module significantly improved students’ performance compared to performance of students the previous year that underwent the same module in a more traditional setting (Pierce & Fox, 2012).

Our study involved implementing the flipped classroom in the teaching of rheumatology to undergraduate medical students with an aim to assess its merits as an alternative form of pedagogy.

Methods

Third year medical students at the Li Ka Shing Faculty of Medicine, The University of Hong Kong (HKU) were invited to take part in the study. Students were sent video based materials on the subject of mono and poly articular joint disease one week prior to the teaching sessions. These videos were constructed by one of the authors of this paper - CSL, who is a Professor of Rheumatology and Clinical Immunology - with the assistance of DH, who is an instructional designer at HKU. The video for each session was divided into 10-15 minute sections and recorded using the software Camtasia. The teaching sessions took place on two separate mornings, each of one hour duration and were delivered by the same instructor. Mono articular cases comprised of osteoarthritis, gout, reactive arthritis and Lyme disease. Poly articular cases focused on rheumatoid arthritis, SLE, fibromyalgia and the benign joint hypermobility syndrome.

The class session targeted 106 students who were divided into groups of approximately 7, giving a total group number of 15. Each group was provided with coloured ‘A to E’ response cards. The session involved the delivery of four interactive patient case scenarios approximately 15 minutes in duration and student groups were required to respond to multiple choice questions based on the case. Students were allowed to interact with their peers to discuss the case and all groups were asked to demonstrate their answer choices by holding up the appropriate coloured response card at the same time. To encourage general participation initially, each case required groups to offer their opinion on certain aspects such as possible differential diagnoses or description of an X ray. Depending on the responses given, the instructor would provide the correct answer and the reasoning behind it. Each case also ended with a general teaching point to ensure further delivery of knowledge (see figure 1).

Case Mrs Y 23

• Presents to her GP with a 3 week history of generalised joint discomfort

• On examination you note striae, bruising and joint laxity with a mid systolic click at the apex
• PMH – Asthma
• FH – Father and Mother both alive and well
• SH – Non smoker and non drinker. Studying Economics at University
• Rx – Salbutamol inhaler
• Allergies – nil of note

Differentials?
Which of the following would help confirm a diagnosis?

A Beighton score and Brighton criteria
B Serum cortisol
C Serum CK
D Coagulation profile
E Beighton score alone

What is the most likely diagnosis?

A Fibromyalgia
B Joint hypermobility
C Polymyalgia Rheumatica
D Benign joint hypermobility syndrome
E SLE
Figure 1 – Case history of a patient with the Benign Joint Hypermobility Syndrome

At the end of the two separate sessions, students were asked to complete a questionnaire rating their response to statements on a 1-5 Likert scale (strongly disagree 1, disagree 2, neutral 3, agree 4, strongly agree 5) and to detail their views in relation to two free text statements assessing the positive and negative aspects of the session. The qualitative data was then thematically analysed.

Results

106 students took part in the teaching sessions. 87/106 students completed the questionnaires (response rate 82%).
Table 1 below indicates the quantitative data obtained from statements used to evaluate the teaching session

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Having access to lecture video/screencast/PowerPoint PRIOR to</td>
<td>4.13</td>
<td>0.70</td>
</tr>
<tr>
<td>attending the teaching session helped me to understand the key concepts/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>issues addressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I felt better prepared to participate in the teaching session /discussion</td>
<td>4.03</td>
<td>0.77</td>
</tr>
<tr>
<td>as a result of having access to lecture material PRIOR to attending the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>session</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The teaching session provided opportunities to extend my understanding</td>
<td>3.80</td>
<td>0.80</td>
</tr>
<tr>
<td>of the key concepts, ideas and issues through peer interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The teaching session provided opportunities to extend my understanding</td>
<td>3.91</td>
<td>0.79</td>
</tr>
<tr>
<td>of the key concepts, ideas and issues through teacher interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The teaching session provided opportunities to engage in active</td>
<td>3.83</td>
<td>0.77</td>
</tr>
<tr>
<td>problem-solving with my peers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The access to material BEFORE and the in class activities motivated</td>
<td>3.75</td>
<td>0.81</td>
</tr>
<tr>
<td>my interest in the topic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The session inspired me to pursue further learning in the subject</td>
<td>3.72</td>
<td>0.80</td>
</tr>
<tr>
<td>8. This teaching format is more useful/effective as compared to the</td>
<td>3.83</td>
<td>0.84</td>
</tr>
<tr>
<td>conventional lecture style</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Overall the model of delivery was effective in supporting me to</td>
<td>3.97</td>
<td>0.72</td>
</tr>
<tr>
<td>achieve the learning outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Would you like future class sessions to be delivered in this way</td>
<td>3.75</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Table 1 – Quantitative session evaluation data

From a qualitative perspective, students described the following aspects as positive outcomes of the session:

- *Time for discussion, videotaped lecture facilitates discussion*
- *Really encourages us to actively engage in the interactive activities*
- *We are allowed to play back the video and review anytime*
- *Case discussions with lecturer helped to further consolidate our learning*
- *Able to explore more key concepts and explore knowledge beyond lecture notes*
- *Watching the video beforehand means we will not miss anything*
- *Flexibility in schedule of watching lecture at time of maximal focus*
Supplementing the lecture with cases is a good way to reinforce memory

No need to force individuals to answer questions by passing microphones because it induces unnecessary stress which impairs learning

Gives us time to think of questions to ask lecturer if we view the video beforehand

I like how it involves peer interaction and increases interaction between students and teachers. I also retain more of the lecture as the flipped classroom session left a deep impression of the concepts on me

Provides a chance for students to review the pit falls of our understanding

Case discussion with immediate feedback

Real life cases were more clinically relevant for us and it was useful to learn about investigations and management that might not be mentioned in lectures

Questions can provoke thinking

Found that even after lectures at home still unable to answer some questions but the discussion process in cases helps to do so

More relaxed way to learn and interact

Motivates me to prepare for the lecture beforehand, enjoyed the interaction and active thinking process in case discussion

By having MCQs and no pressure even if the answer is not correct is also very good and allows us to think and answer more freely

Less positive outcomes were detailed as follows:

Electronic voting system should be explored so that each individual can participate

Heavy workload for students, despite interesting content

Maybe a reference for the colour code of the MCQ answer cards so that those who are not holding the cards know what answers are being given

It is a cultural problem that this kind of interactive session does not have optimal participation – treat the Chinese

Discussion

The study demonstrated a largely positive outcome with regards to the use of the flipped classroom. Mean item scores ranged from 3.72 to 4.13 for all items. The scores for items 1 and 2 are in parallel with work by Pierce et al who noted that 96% of students agreed or strongly agreed that viewing pre-recorded lectures prior to class was important (Pierce & Fox, 2012). In addition from an actual knowledge gain perspective, Marsh et al demonstrated that prior access to lecture material such as handouts of slides was associated with less note taking, less time needed to prepare for a final test and better performance on the test (Marsh EJ, 2009).

Statements three, four and five are in themselves self-explanatory. Students were allowed to interact in groups to problem solve patient cases and then subsequently with the instructor during question and answer feedback in a non-isolating fashion. Looking at the qualitative data illustrates the point further with a preference by students not to have to answer questions through forced microphone passing. This is also reflected in the comments regarding the fact that this form of MCQ allowed students to answer more freely with little pressure even if the answer was not correct.
The lowest three scoring statements included: ‘The access to material BEFORE and the in class activities motivated my interest in the topic’, ‘The session inspired me to pursue further learning in the subject’ and ‘Would you like future class sessions to be delivered in this way.’ An explanation for the scores for statement 6 and 7 could simply lie in the fact that some students may not be so keen on the field of rheumatology in general which could have impacted their responses. The score for statement 10 could be explained by referring to the qualitative data which demonstrated that some students felt that the flipped format increased their workload and that this form of interaction may not be best suited in East Asian class sessions. It has been noted that East Asian students have argued that remaining silent but listening attentively is another way to actively engage in class (Kim, 2008).

Analysis of the qualitative data demonstrates that the use of video materials prior to the lecture session allowed for increased student-centred learning by allowing them to watch the videos at a time of maximal focus and also allowing for the videos to be played back when required. Use of videos was also noted by students to allow for time to think of any relevant questions for the instructor before the lecture session. The literature details several studies on the use of videos in medical education. Chan LK et al for example noted positive results when using videos in problem based learning, with the majority of students and facilitators concluding that using videos can enhance students’ observational powers and clinical reasoning, helping them to integrate different information and better understand cases with an increased motivation to learn (Chan et al., 2010). Students also commented positively about the use of case-based discussions which enabled them to interact and engage well with their peers and the instructor through discussion. Instructor interaction provided immediate feedback and a chance for students to review any misconceptions in their understanding. Medical teaching today offers little in terms of feedback. For instance, it is still uncommon for students to receive feedback on undergraduate exam assessments apart from their overall grading. So even if students were to pass an assessment they would not know which areas they did less well in which in itself could impact on future patient management. Drawing parallels with the concept of team-based learning which is slowly becoming common place in medical teaching, the individual readiness assurance test or iRAT allows for immediate feedback through the use of the IF-AT or immediate feedback assessment technique. This technique enables students to scratch off the answer option and be informed immediately as to whether the answer is correct. Parmelee et al observed that the use of the iRAT enabled students to also contest answer options by raising the point for class discussion and teachers agreeable to hearing their choice of explanation (Parmelee, Michaelsen, Cook, & Hudes, 2012).

Our study also noted that the flipped approach allowed for increased knowledge consolidation by focusing on clinically relevant areas such as investigations and management as well as focusing on areas which may not be covered through didactic lectures alone.

Students also commented that the flipped approach allowed for a more relaxed environment for them to learn. This is in keeping with work by Cassady et al who noted that a relaxed learning environment can help to provide effective retrieval cues and improve learning (Cassaday, Bloomfield, & Hayward, 2002).

Limitations of the study included the way in which the flipped classroom was actually delivered with students commenting on their desire for an electronic voting system. Unfortunately the construct of the lecture hall was such that this provision was unavailable at the time the study took place. In addition one may highlight that item mean scores by themselves may not be so conclusive. On the one hand one may argue that if statement scores below 3 were obtained then the flipped classroom format could be regarded as being not so well received by students. Having said this however, it may be more conclusive to compare such scores with an alternative intervention. Such interventions could include comparing students perceived or actual knowledge gains during a flipped classroom and in addition comparing the flipped approach with a more traditional lecture hall session.

Conclusion

Our study has shown that in the main students positively received the flipped classroom form of pedagogy. It allowed for enhanced student to instructor interaction and better knowledge gains from a clinical perspective which of course is the basis of medical practice. We plan to undertake further studies to assess its merits including a comparison with alternative teaching formats and assessment of knowledge gained.
Declaration of Interest

The authors have no declarations of interest to report

Ethical approval was granted by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. Reference Number UW 13-127
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