

STUDENT PERCEPTIONS AND ATTITUDES TOWARDS THE FLIPPED CLASSROOM APPROACH IN A PHARMACEUTICAL FORMULATION AND TECHNOLOGY MODULE IN NUS

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Recommended Citation:

Z.H. Loh & L.W. Chan (2017). Student perceptions and attitudes towards the flipped classroom approach in a pharmaceutical formulation and technology module. *CDTL Brief*, 20(1), 8-19.

INTRODUCTION

The NUS Pharmacy curriculum is geared towards producing well-trained community and hospital pharmacists who play active roles in managing their patients' health through the appropriate use of medicinal products. As medicinal product experts, pharmacists should leverage on their knowledge of product design to make the best treatment recommendations. However, in recent years, it was observed that students often could not draw the link between drug product design and use, despite a strong grounding on the former through compulsory formulation and technology modules. This may be attributed to insufficient opportunities for the students to discuss and apply the knowledge acquired. Hence, there is a need to improve knowledge integration in these areas.

It has been envisioned that adopting a flipped classroom approach may potentially bridge this gap (Tune, Sturek, & Basile, 2013; Freeman et al., 2014). In the flipped classroom approach, students undertake independent learning of prescribed materials, such as lecture slides, videos and reference books, outside of class. When they meet their instructor and peers face to face in the classroom, they engage in discussions of the material learnt. This leads to a change in the classroom dynamic, from being traditionally passive and teacher-centric to an active, student-centric learning environment with teachers assuming the role of facilitators. Some key benefits of the flipped classroom approach include allowing students to learn at their own pace and convenience, as well as providing more opportunities for student-teacher and student-student interaction, both of which promote higher-order learning (Moraros, Islam, Yu, Banow, & Schindelka, 2015).

The literature abounds with examples of how the flipped classroom approach has improved student learning outcomes in many disciplines (van Vilet, Winnips, & Brouwer, 2015; Strayer, 2012). To date, this approach to teaching and learning is relatively new to the Department of Pharmacy. Hence, this pilot study was carried out to explore the feasibility of implementing the flipped classroom approach in a

pharmaceutical formulation and technology module taken by 199 undergraduates in their second year of study. It was hoped that this approach would provide students the opportunity to effectively apply their knowledge of drug product design in actual practice. The ultimate aim is to develop independent learners with critical thinking skills.

The topic of “Suppositories” was selected for this pilot study. This topic focuses on the formulation, production and evaluation of suppository products. Short video lectures were developed to address these three aspects of suppositories, and the videos were subsequently uploaded to an online platform (IVLE) for students to view over a span of three months. To meet the objective of knowledge integration, the face-to-face sessions were designed to enable students to apply their knowledge of the formulation, production and evaluation of suppositories in the development of anti-malarial suppositories, demonstrated to be of value in reducing the incidence of malaria-related deaths in African children. As this was the inaugural attempt of implementing the flipped classroom approach in this module, a survey was carried out to evaluate student attitudes and perceptions towards this new teaching approach.

STUDY DESIGN

Video lectures

Six video lectures, each lasting between 10 to 20 minutes, were created using a screen recording software equipped with video editing functions (Camtasia[®] for Mac). A summary of the videos’ content can be seen in Table 1.

Table 1

Content of the short videos produced on the topic “Suppositories”

Title of video	No. of videos	Content
Introduction	1	<ul style="list-style-type: none"> • Definition and rationale for the use of suppositories • Advantages and disadvantages of using suppositories
Formulation	2	<ul style="list-style-type: none"> • Formulation of suppositories • Characteristics, advantages and disadvantages of different suppository bases
Production	1	<ul style="list-style-type: none"> • Laboratory scale methods for production of suppositories • Large scale production of suppositories (selected example)
Evaluation	2	<ul style="list-style-type: none"> • Different methods employed to evaluate the quality of suppositories

The total time of all 6 video lectures was approximately 1.5 hours. To improve student engagement and sustain their interest, timely animations highlighting important points, video snippets of practical experiments, music, as well as clear voice-over narration were incorporated in the video lectures. Students also received the lecture slides, complete with the video script.

Face-to-face sessions

The entire class, which consisted a total of 199 students, was divided into 7 groups, each group comprising a maximum of 30 students. Accordingly, 7 face-to-face sessions were scheduled, with each session lasting 90 min. These face-to-face sessions were organized as a follow-up to the video lectures, that is, students attended these sessions after the 3-month period allocated for them to view the video lectures. During this

3-month period, students attended traditional lectures for the other topics in the module, over and above the video lectures on Suppositories. There were no formative assessments conducted but consultations were readily available to the students.

For each face-to-face session (up to 30 students per session), students were further divided into 5 discussion groups, where each group had to work on assigned questions and give a presentation of their answers. Questions were set to enable students to apply the material learnt from the video lectures to the formulation, production and evaluation of suppositories for the treatment of malaria. The way each session was structured is detailed in Table 2. The same content was covered for all 7 face-to-face sessions.

Table 2
Example of the structure of a face-to-face session

Time	Content covered
0-10 min	<ul style="list-style-type: none"> • Introduction and objectives of the session • Background information about malaria and its route of transmission • Rapid disease progression in complicated malaria resulting in many deaths of children in rural villages of Africa • Current treatment options for malaria using oral anti-malarial agents and the limitations of oral therapy in complicated malaria
10-20 min	<ul style="list-style-type: none"> • Recent success of anti-malarial suppository formulations delaying progression of complicated malaria and preventing deaths • Application of suppository formulations to overcome the problems associated with oral anti-malarial agents • Limited research on the suppository formulations of anti-malarial agents despite its life-saving potential
20-30 min	<ul style="list-style-type: none"> • Discussion on a recent research article entitled: Self-microemulsifying suppository formulations of artemether (an anti-malarial agent) • Objectives of the study and experiments performed to evaluate the physical characteristics and drug release profiles of the 2 formulations of anti-malarial suppositories investigated • Some questions posed to students on the article: <ul style="list-style-type: none"> ▪ What is the meaning of self-emulsifying? ▪ How did the 2 different formulations of suppositories disintegrate and release the drug?
30-50 min	<ul style="list-style-type: none"> • Group discussions on the following questions (each group is allocated 1 question): <ol style="list-style-type: none"> 1) What are the advantages of developing suppository formulations of artemether? 2) How do you think the suppositories were prepared? Briefly describe the steps involved, starting from the raw materials. 3) What are the fundamental differences between theobroma oil and the emulsifying lipid base employed in this study? How does this impact drug release? 4) What is the apparatus suitable for the determination of the drug release properties of the suppositories? Briefly discuss how this test is carried out. 5) Which formulation do you think will release the drug faster? Why?
50-90 min	Informal group presentations of their answers and summary of discussions

Student survey

After each face-to-face session, a paper-and-pen survey comprising a total of 10 statements was administered to the students to obtain their feedback on specific aspects of the flipped classroom approach (Table 3). Students responded to the statements based on a 5-point Likert scale (“Strongly Disagree”, “Disagree”, “Unsure”, “Agree”, and “Strongly Agree”). Prior to attempting the survey, students were asked to indicate the number of videos they had watched at home. Students could also provide qualitative comments at the bottom of the survey form.

Table 3

List of statements in the survey form

Aspect of flipped classroom approach	Statements
Video-based teaching and learning	<ol style="list-style-type: none">1. The pace and content of the video lectures were appropriate for self-learning at home.2. Flipped classroom increased my workload as I had to learn the topic on my own and prepare for discussion.3. The flipped classroom approach allowed me to learn at my own pace and convenience which was beneficial.
Face-to-face session	<ol style="list-style-type: none">4. The flipped classroom approach reinforced the content covered in the video lectures and made me see how the knowledge is relevant and applicable in real life.5. The flipped classroom approach created opportunities for student-student interactions that promoted learning.6. The flipped classroom approach has increased my interest in the topic that was taught this way.7. I feel less engaged when topics are taught via the flipped classroom approach compared to the traditional method of teaching.
Overall view on flipped classroom teaching and learning	<ol style="list-style-type: none">8. I would like to see the flipped classroom approach in teaching be applied to other (only selected) topics in this module.9. Overall, flipped classroom approach was a positive experience for me and I reaped additional educational benefits compared to the traditional lecture.10. Overall, I still prefer the traditional lecture over the flipped classroom approach.

RESULTS AND DISCUSSION

Response rate and number of videos watched by students

In total, 195 students (or 98%) responded to the survey. The high response rate was likely due to the fact that the paper-and-pen survey was administered immediately after each face-to-face session. The 4 students who did not participate in the survey were either absent or left before the session ended.

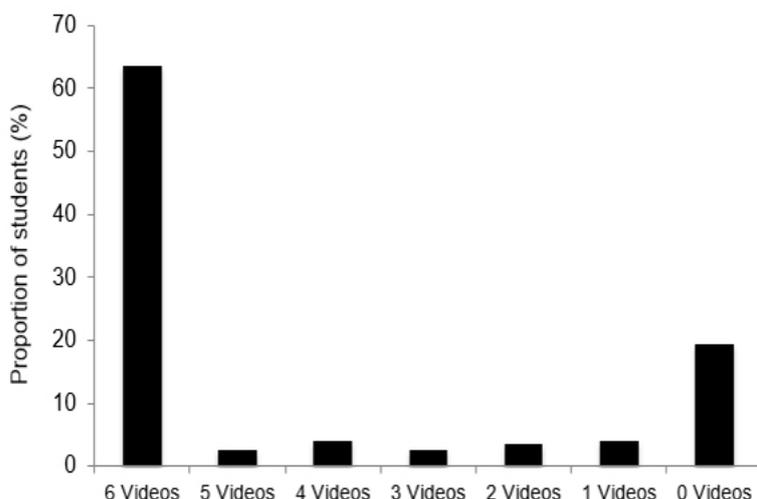


Figure 1. Bar chart showing the number of videos watched by the 195 respondents.

Overall, the number of videos respondents watched varied between zero to six, with more than half (63.6%) who watched all six videos (Figure 1). A small proportion of students (38 out of 195 respondents or 19.5%) indicated that they did not watch any of the uploaded videos. Amongst these respondents, 6 of them commented that reading the accompanying video scripts was sufficient, and one commented that he/she could not watch the videos but no reasons were provided. The remaining 17% of the 195 respondents watched between 1 to 5 videos.

After analyzing the survey results, it was observed that there was no correlation between the number of videos respondents watched and their responses to the statements in the survey. The data showed that the number of videos the respondents watched did not appear to have any bearing on their responses to the survey statements. For example, it did not mean that respondents who had watched more videos felt that the flipped classroom approach increased their workload and vice versa. Hence, the data presented in the next section (Figures 2a to 2j) represents the responses from all 195 respondents regardless of the number of videos they had watched.

In the following section, to keep things simple, the responses for “Strongly Agree” and “Agree” were summed up and discussed collectively as agreeing with the respective statement. Likewise, the responses for “Strongly Disagree” and “Disagree” were summed up and discussed collectively as disagreeing with the respective statement.

Feedback on video-based teaching and learning: Statements 1 to 3

Based on the survey results, there was positive student feedback towards the flipped classroom approach.

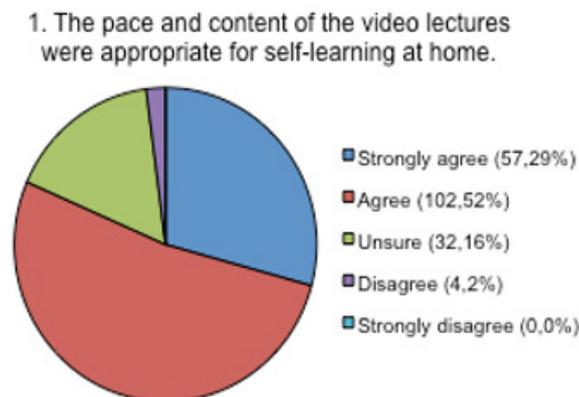


Figure 2. Responses of students to Statement 1 in the survey.

For Statement 1 (see Figure 2), 159 respondents felt that the pace and content of the video lectures were appropriate for self-learning at home [with 102 (52%) and 57 (29%) respondents indicating that they “Agree” and “Strongly Agree” respectively]. Meanwhile, 4 out of the 195 respondents (or 2%) indicated they disagreed and 32 (or 16%) indicated that they were “Unsure”. 26 out of the 32 respondents who had indicated they were “Unsure” about Statement 1 did not watch any of the videos at all, and as expected, they were unable to gauge if the pace of the videos were appropriate.

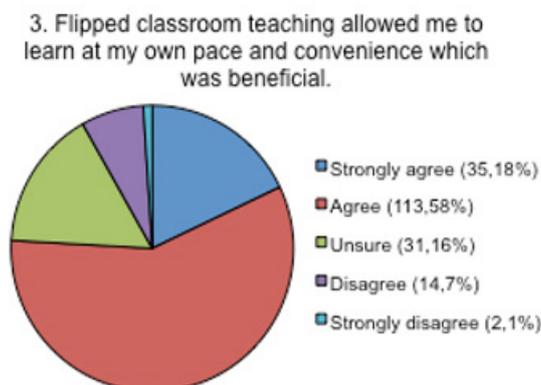


Figure 3. Responses of students to Statement 3 in the survey.

Meanwhile, 148 respondents agreed with Statement 3 (see Figure 3), that the flipped classroom approach allowed them to learn at their own pace and convenience which they found beneficial [with 113 (58%) and 35 (18%) respondents indicating that they “Agree” and “Strongly Agree” respectively]. 31 respondents (or 16%) indicated they were “Unsure”, and 16 respondents (or 8%) disagreed with Statement 3.

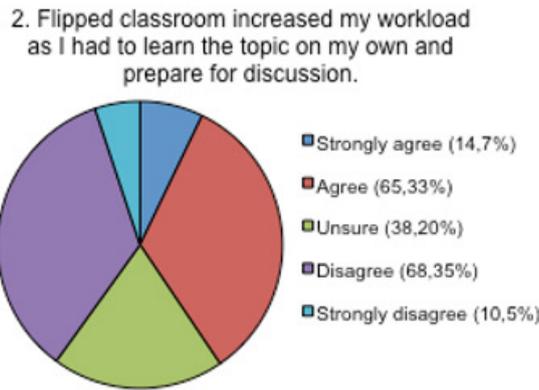


Figure 4. Responses of students to Statement 2 in the survey.

However, opinions were divided with regards to Statement 2 (see Figure 4), on the impact of flipped classroom teaching and learning on students' workload. The total number of students indicating that they "Agree" (65 respondents, or 33%) and "Strongly Agree" (14 respondents, or 7%) with Statement 2 was almost equal to the total number indicating that they "Disagree" (68 respondents, or 35%) and "Strongly Disagree" (10 respondents, or 5%). The remaining 38 respondents (or 20%) indicated that they were "Unsure" of the impact of flipped classroom teaching on their workload. There was no trend observed between the number of videos watched by the students and their responses to this question, i.e., it did not mean that students who watched more videos at home felt that their workload associated with flipped classroom teaching had increased.

Feedback on the face-to-face session: Statements 4 to 7

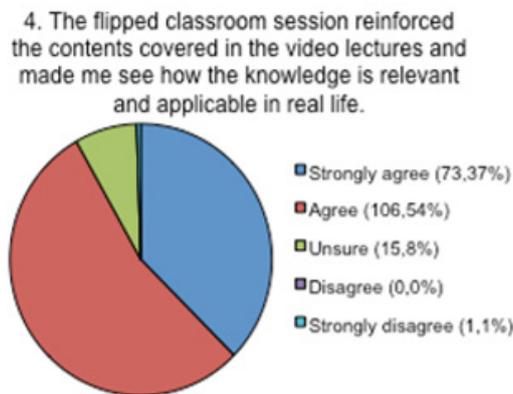


Figure 5. Responses of students to Statement 4 in the survey.

With regards to the face-to-face session, the general consensus amongst the students was that the session not only reinforced the content covered in the video lectures, but also made them see how the knowledge would be relevant and applicable in solving real issues related to practice. This was evident from students' responses to Statement 4 (see Figure 5), with an overwhelming majority of respondents indicating that they "Agree" (106 respondents, or 54%) and "Strongly Agree" (73 respondents, or 37%). Only 1 respondent disagreed, and 15 respondents (or 8%) indicated that they were "Unsure".

5. The flipped classroom session created opportunities for student-student interactions that promoted learning.

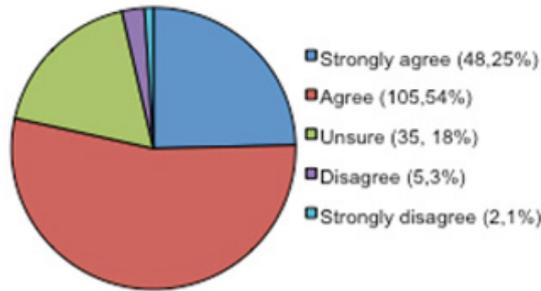


Figure 6. Responses of students to Statement 5 in the survey.

The face-to-face sessions were carried out in classrooms with the chairs and tables arranged for small group discussions. Based on personal observations, this classroom layout facilitated student-student interactions and promoted discussion and learning. These views were similarly echoed by the survey results for Statement 5 (see Figure 6), with the majority of respondents indicating that they “Agree” (105 respondents, or 54%) and “Strongly Agree” (48 respondents, or 25%) that the flipped classroom session created opportunities for student-student interaction that promoted learning. A total of 7 respondents (or 4%) indicated they disagreed (5 respondents, or 3%) and strongly disagreed (2 respondents, or 1%) with Statement 5, and 35 respondents (18%) indicated that they were “Unsure”.

7. I feel less engaged when topics are taught via the flipped classroom method compared to the traditional method of teaching.

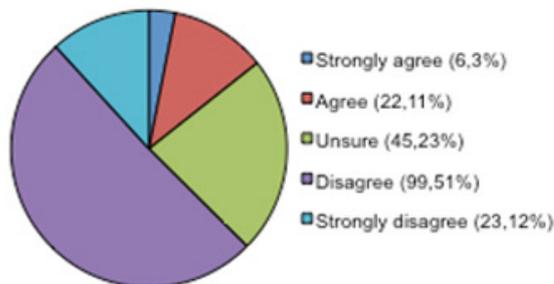


Figure 7. Responses of students to Statement 7 in the survey.

It was also gratifying to note from the survey results that the flipped classroom approach did not result in a compromise in student engagement compared to the traditional didactic lecture. This was based on the results for Statement 7 (see Figure 7), with more than half of the 195 respondents indicating that they “Disagree” (99 respondents, or 51%) and “Strongly Disagree” (23 respondents, or 12%). 45 respondents (or 23%) indicated they were “Unsure”, while the remainder indicated that they agreed (22 respondents, or 11%) and strongly agreed (6 respondents, or 3%) with Statement 7.

6. Flipped classroom teaching has increased my interest in the topic that was taught this way.

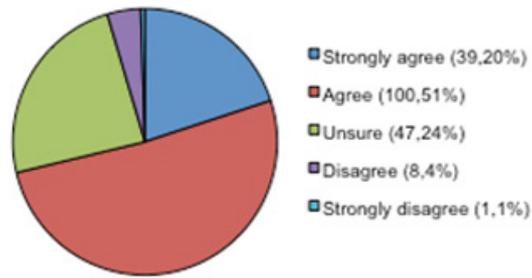


Figure 8. Responses of students to Statement 6 in the survey.

Most importantly, the flipped classroom approach had aroused the interest of the majority of students in the topic that was taught this way, with the majority of respondents indicating they “Agree” (100 respondents, or 51%) and “Strongly Agree” (39 respondents, or 20%) with Statement 6 (see Figure 8). 47 respondents (or 24%) indicated that they were “Unsure”, while the remainder indicated that they disagreed (8 respondents, or 4%) and strongly disagreed (1 respondent, or 1%) with Statement 6.

Reflections and overall view on flipped classroom teaching and learning: Statements 8 to 10

9. Overall, flipped classroom teaching was a positive experience for me and I reaped additional educational benefits compared to the traditional lecture.

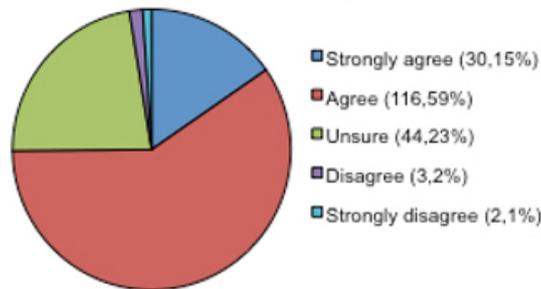


Figure 9. Responses of students to Statement 9 in the survey.

The survey results also showed that the majority of the respondents agreed (116 respondents, or 59%) and strongly agreed (30 respondents, or 15%) with Statement 9 (see Figure 9), acknowledging that the flipped classroom approach was a positive experience for them and that they had reaped additional educational benefits from this teaching method. Only 44 respondents (or 23%) indicated they were “Unsure” and the remainder indicated they disagreed (3 respondents, or 2%) and strongly disagreed (2 respondents, or 1%) with Statement 9.

8. I would like to see the flipped classroom approach in teaching be applied to other (only selected) topics in this module.

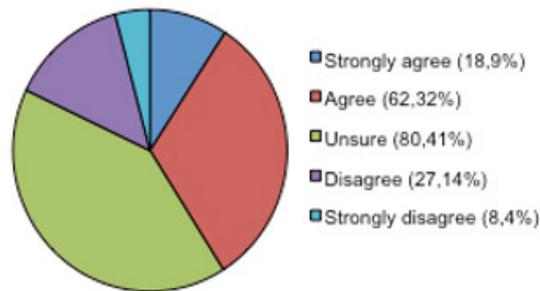


Figure 10. Responses of students to Statement 8 in the survey.

In spite of these advantages, when probed in Statement 8 (see Figure 10) whether the flipped classroom approach should be applied to other selected topics in this module, the survey results once again show that students' opinions were divided. Less than half of the 195 respondents indicated that they agreed (62 respondents, or 32%) and strongly agreed (18 respondents, or 9%) to a wider application of flipped classroom teaching, with a similar proportion (80 respondents, or 41%) indicating that they were "Unsure". The remainder indicated they disagreed (27 respondents, or 14%) and strongly disagreed (8 respondents, or 4%) with Statement 8.

10. Overall, I still prefer the traditional lecture over the flipped classroom method of teaching.

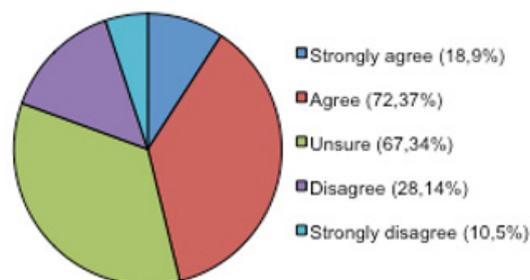


Figure 11. Responses of students to Statement 10 in the survey.

Meanwhile, almost half of the respondents indicated that they agreed (72 respondents, or 37%) and strongly agreed (18 respondents, or 9%) with Statement 10 (see Figure 11). In short, they still preferred the traditional lecture format over the flipped classroom approach. 67 respondents (or 34%) indicated that they were "Unsure", and the remainder indicated that they disagreed (28 respondents, or 14%) and strongly disagreed (10 respondents, or 5%) with Statement 10. It should be highlighted that the students were given 3 months to go through the videos without any formative assessment. The lack of engagement over a relatively long period of time might have contributed to the lukewarm response to this flipped classroom approach.

CONCLUSION

In conclusion, flipped classroom teaching was successfully carried out in a pharmaceutical formulation and technology module in the Department of Pharmacy at NUS. This approach to teaching and learning was advantageous in that it provided students with the opportunity to apply their knowledge of the design of suppositories in the treatment of malaria.

A survey of student perceptions and attitudes towards the flipped classroom approach revealed that although most students had indicated they experienced the benefits of this approach, a large proportion of them still preferred the traditional lecture method format. As the flipped classroom approach requires students to take greater ownership of their learning, step out of their comfort zones and engage as active learners through discussions with their peers, this may unknowingly create feelings of competition and anxiety. These negative feelings are compounded with the uncertainties of how the flipped classroom approach, if implemented on a larger scale, could potentially impact their academic performance in the module. These are possible reasons why many students still prefer the “tried-and-tested” teaching and learning methods, based on the results of this survey. For the flipped classroom approach to work, it is important to allay the anxiety of the students, to continually engage them and give some incentive for active participation.

Furthermore, as it was neither practical nor feasible to teach the same topic using two different approaches, it may have been difficult for students to compare the effectiveness of traditional lectures and the flipped classroom approach on the same basis. The nature of the topic selected for the flipped classroom approach may skew student perceptions and attitudes towards this new teaching approach. Cross-cohort studies that compare the performances of two different cohorts of students, of which one is exposed to traditional teaching methods and the other to the flipped classroom approach, may provide a possible solution.

Another limitation of this study relates to the time available for peer interaction and discussions. As shown in Table 2, a significant amount of time in each face-to-face session was taken up by the instructor presenting the background of the case study, which left little time for peer discussions and presentations. This could be avoided by having the instructor provide students with the case studies beforehand, so that they can acquaint themselves with the background knowledge necessary for a fruitful discussion. These limitations can be addressed in future extensions of this study.

ENDNOTE

1. In the survey, the respondents were asked to indicate the number of videos they had watched.

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