AN APPLIED EXAMPLE OF THE FLIPPED CLASSROOM*

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"My students come to class unprepared." How often I'd said these words! And yet I did assign preparatory exercises and suggest readings, accompanied by short questionnaires, to help students identify the most relevant content. Still, all was for naught; I had to start over with every course. In explaining their poor—if not non-existent—preparation, some students said they had trouble understanding the readings because they were so abstract and complex. Others said the readings and exercises were too time-consuming. I felt that needs were most striking in my first-term course on animal biology, which I give as part of the laboratory-technology program for students specializing in biotechnology.

Like many others at the college level, this course involves a combination of highly abstract concepts that, for the novice, can be difficult to conceptualize. As concerns the course in question, the biochemical reactions that take place in a cell are an eloquent example. Presenting the information in a more "user-friendly", accessible form appeared one way to solve the problem. According to students who had tried to prepare for certain classes, the average time spent was three hours. Considering that, in addition to lectures on theory, the course also includes weekly laboratory sessions that often involve the production of reports, the time spent on the course outside of the classroom was too high, especially given the 2-3-3 course weighting. Compliance with that weighting therefore had to be taken into account when promoting better preparation.

The fact that students were inadequately prepared had an immediate effect on the conduct of the theoretical dimension (i.e., that part of the course not associated with lab work). The explanation of abstract concepts took up most of the time available, leaving little left over for exploring the more tangible applications. More than one student had something like this to say: "I like the course, and it's interesting to study cell function, but I'd have liked to spend more time on systems and organs." In other words, some students were unable to establish the relationship between the biochemical reactions that take place in a cell and the influence of those reactions on an organ, a system, or a complete living organism—which represents a major dimension of the competency to be developed. Poor preparation was therefore having an adverse effect on the transfer of knowledge and the competency aimed at by course.

Lastly, the cohort of students enrolled in the course in the fall of 2011 was characterized by a high failure rate (25%), and even many of those who passed ended up with an overall mark of only around 60%. This low success rate translated into a corresponding lack of academic perseverance in the program; only 45% of students enrolled in the course in the fall of 2011 continued with their studies the next year. Could better course preparation have improved the success rate, and thereby subsequent enrolment in the program?

FINDING A SOLUTION

Since poor course preparation seemed to be having a number of negative effects, a search for innovative instructional methods was undertaken in an effort to find a solution to the problem. To qualify for selection, such methods had to:

- empower students to prepare for their courses;
- make the study of abstract phenomena more effective;
- make students more active in the knowledge-construction process;
- allow for the mental organization of declarative knowledge in order to promote its transfer;
- promote the integration of learning by placing more emphasis on tangible situations;
- help increase the success rate as well as the academic perseverance.

While several instructional methods met these criteria, the amalgamation of the following three approaches seemed the most promising solution: the flipped classroom, concept mapping, and the case study.

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The flipped classroom takes its name from the fact that students attend courses at home—most often via video clips—and do their homework in class. This method would seem to enhance learning (Fulton, 2012), motivation, and course participation (Université de Sherbrooke, n.d.) as well as helping students construct knowledge at their own pace (Raymond, 2006). Concept mapping consists in the graphic representation of the relationship between concepts or information components with a view to provide a comprehensive overview of that information (Barbeau, Montini, and Roy, 1997). It is a powerful method for acquiring and organizing declarative knowledge (Tardif, 1992). The more efficiently this type of knowledge is organized, the easier it is to access for problem-solving purposes (knowledge transfer) (*ibid.*).

The case study, which makes it possible to transfer the knowledge developed, uses actual or realistic situations to foster learners' problem-solving abilities (Chamberland, Lavoie, and Marquis, 2011).

The three methods selected were combined as follows. First, video clips, which make certain basic concepts less abstract, were produced and onlined; students had to view these clips before the course and, while doing so, they had to complete or draw a diagram that organized the course concepts. These were called "preparatory activities". Each class associated with a preparatory activity then explored the concepts in question from the viewpoint of animal biology. Over the 15 weeks of the session, six preparatory activities were developed (an average of one such activity every two weeks). All session classes were therefore not associated with preparatory activities; those that were not took a more "traditional" approach (for example, using lectures and exercises). Because it was my first experience with the flipped classroom, I felt it advisable to alternate teaching styles.

The content to be dealt with in the preparatory activities was chosen in keeping with the concepts that students had found the most abstract and difficult to understand. Each class associated with a preparatory activity was also conducted with a view to ensuring an optimal "fit" between the activity and the case studies involved.

TOOLS FOR DEVELOPING PREPARATORY ACTIVITIES

Each preparatory activity was associated with a varying number of clips (three or four). The clips consisted of a screencast in the form of a video recording, made possible by a freeware program called Screenr. The teacher begins by creating a slideshow (using PowerPoint, for example) that may include animations. While recording by screencast, the teacher comments on the figures and animations using a microphone connected to the computer. The final result consists of a slideshow narrated by the teacher; the clips can then be uploaded onto the Web and consulted by students, who need only click on a hyperlink.[1] Clips cannot be more than five minutes long (a limit imposed by the program itself).

To ensure optimal cognitive processing of the clip concepts, students had to draw a concept map using the Cmap Tools freeware program. The map helped consolidate all the relevant concepts contained in the clips. As the students went from one preparatory activity to the next, the maps became increasingly difficult: those associated with the initial preparatory activities involved only a few components and imposed a fairly rigid structure, as most students enrolled in the course were unfamiliar with concept mapping. A detailed template composed of the fields to be completed was supplied; however, as the term progressed, the maps involved more and more components, and the templates became less and less specific—requiring, for example, the insertion of pictorial representations. The last map had to be done without the use of a template; students had to organize concepts on their own.

Each preparatory activity also included knowledge-acquisition exercises that allowed students to determine how well they had understood clip content. These exercises were accompanied by an answer key, which could be consulted while doing the exercises or afterward. For every activity, students could ask questions and obtain further details and instructions by addressing the teacher directly or via internal e-mail.

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THE METHOD AS IMPLEMENTED

All course documents were put on the CÉGEP's intranet platform (LÉA, on the Omnivox site) to ensure that students had direct access to each one. To complete a preparatory activity, students had to download three documents: a sheet including a few instructions and the hyperlinks to the video clips, the template for the map to be produced, and the knowledge-acquisition exercises.

[1] To view an example of a clip, go to [www.screenr.com/kaP8].

Students first had to read the instruction sheet; they then had to click on the hyperlinks to view the clips. As they did so, they filled out the map (while viewing, they could go back or pause).

Each clip could be viewed as often as desired, and students could complete the map at their own pace. They could also measure how well they had mastered the content using the exercises provided, which included an answer key.

In classes associated with a preparatory activity, students had to submit their maps upon arriving. They knew the evaluation could be either summative or formative, and the course outline stipulated that, over the session, ten points could be awarded for maps. To determine comprehension levels, at the beginning of the class the teacher might ask students to write a one-page text on the content explored during the preparatory activity. Such summaries, which could also be evaluated summatively or formatively, limited the possibility of plagiarism, as simply copying a map did not allow for the composition of a coherent text. Moreover, the class was structured around case studies that brought together the knowledge developed by means of preparatory activities. It should also be noted that no explicit instruction on the content involved in those activities was used in the classroom.

FOLLOW-UP OBSERVATIONS

From the outset, all students complied with the requirements involved in preparatory-activity participation. All maps were completed and submitted on time—a victory in itself.

Students arrived prepared for the course. Grades for maps and summaries were excellent. Between November 27 and December 4, 2012, all students in the course were asked to take part in a survey on the preparatory activities. This poll, which was conducted on the SurveyMonkey site, was completed anonymously by 35 out of 40 individuals. Below are a few of the comments they left:

Congratulations on this new method; it's more interesting than traditional homework.

We need more clips to get ready for exams; it's easier to remember, and helps show the relationship with the questions.

I don't have any criticisms. It was perfect and very useful.

Students really appreciated the video clips; they also found the concept maps extremely useful, as shown by the survey findings. Most students indicated that organizing knowledge into such maps had facilitated (60% of respondents) or considerably facilitated (20% of respondents) their learning of the associated concepts, with only 20% of respondents feeling it only moderately facilitated learning.

The favourable impression left by concept mapping suggests that students might use the same method of learning in other courses. One of the survey questions was aimed at assessing their intentions in this regard: 54% of respondents stated they would definitely or probably use concept maps in subsequent sessions; only 6% of respondents said they did not want to use them in the future. According to a teacher who had this student cohort in the winter session of 2013, students actually carried through on these intentions. The high quality of the maps generated without a template at the end of the 2012 fall semester was also very indicative that students had adopted the method. I was extremely impressed by the structure and exhaustive nature of the information contained in these maps. Thanks to the educational strategy used, students converted the teaching method proposed into a personal, effective learning method...an unexpected "plus"!

Since compliance with course weighting was one of the criteria established in implementing the strategy, two survey questions dealt with the time spent by students in completing preparatory activities. For activities involving a map template (the first five), the vast majority of respondents (85%) felt that the time required was between 30 and 90 minutes. Given that other work was not assigned if preparatory activities were planned, one can easily say that the workload was in line with the course weighting. For the activity not associated with a map template (the last), 57% of respondents estimated that completion time stood at between one hour and two hours, while 24% said it had taken more than two hours. The fact that the time required to complete the last activity was longer was understandable, given its degree of difficulty; however, most students managed to do so while complying with the weighting.

As regards the course's success, it is difficult to compare two different student cohorts exactly, as the evaluations for each, although equivalent, were different. Moreover, several teachers can testify to the fact that "cohort effects"—i.e., groups or years in which everything simply works better—often exist. With these considerations in mind, we must compare the 2012 fall cohort (which was taught via the flipped-classroom method) to that of 2011 (which was not). In comparing the two cohorts in keeping with their final-exam averages, we see that the 2011 cohort had an average of 69%, while that of



2012 had an average of 74%. These results are representative of the averages obtained by each cohort for the entire term. The 2011 cohort had an average of 71%, while its 2012 counterpart had one of 77%. Overall, 68% of students from the 2011 cohort passed the exam, while the figure for the 2012 cohort was 79%.

Although these results were not analyzed statistically, we can see a trend: students from the 2012 cohort obtained better marks on the exam and passed the course in greater numbers. Even taking into account the aforementioned cohort effect, the findings for the two survey questions would indicate that the flipped classroom is not unrelated to the differences between the two cohorts. Most survey respondents stated the preparatory activities had given them a definite advantage. Students were also ask to assess the effectiveness of these activities; 17% said that the preparation received for the course was excellent, and 46%, that it was very good. Most respondents also felt that the preparatory activities had equipped them well for exams; 34% rated the activities' ability to prepare them as excellent, and 43%, as very good.

Lastly, 83% of respondents said they wished to continue on in the program, as against 8.5% who claimed they did not know, and 8.5% who wished to change direction. These findings were reflected in the program enrolment rate in the next semester (winter 2013).

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OUTLOOK

In addition to the academic results obtained, the instructional strategy implemented greatly helped improve course quality. First, the time freed up by the study of content as part of the preparatory activities makes it possible to explore that content from another angle during class time. The declarative knowledge developed by concept mapping can also be more easily converted into conditional knowledge via case studies; the knowledge acquired can then be applied to more tangible phenomena that pique students' curiosity and hold their interest. These new possibilities are valued by students, and enhance their motivation. Students also arrive much better prepared for the course, and this preparation takes account of the course weighting, as shown by the survey results. When we consult the list of criteria used in implementing the strategy, we see that most were satisfied. Furthermore, students gained a learning tool by appropriating the concept-mapping method—an unforeseen benefit.

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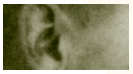
The development and application of the instructional strategy in question did, however, involve some drawbacks. First (even though this does not apply to most students), some types of learners are less comfortable with concept mapping. In a few cases, the maps produced without a template resembled a textual summary more than a true map. The rare students who were responsible for these maps were not penalized, provided the concepts associated with the preparatory activity were present—which was generally the case. Furthermore, although limited by the possibility that a summary might be required, the risk of plagiarism is still something that is hard to eliminate. Lastly, the time required by teachers to conceptualize, record, and online the tools is relatively high. It should be stressed, however, that, once completed, the clips and materials developed can be used in subsequent sessions. To reduce the time needed for tool development, funding could be requested—for example, in the shape of the grants offered by some colleges as part of their success plan. Teachers could also decide to develop preparatory activities over a number of terms, and use them as they become available. After all, in the experiment described in this article, the flipped classroom and attendant instructional strategy were not implemented for every class in the session.

It will be interesting to assess the impact of this strategy on success rates and academic perseverance, by experimenting with several cohorts. Implementing such a strategy could also prove relevant for biology courses in other programs—nursing, for example—and even courses in other disciplines. Although the flipped classroom is not a cure-all, it has already been used by math, chemistry, and physics teachers (AQPC, 2013). Its implementation in areas such as philosophy, history, or geography is certainly possible, and even promising. Whatever the outcome, even if the flipped classroom had no (statistically demonstrable) influence on success rate, it would still be a method that promotes student involvement and improves the classroom atmosphere in general, making courses much more stimulating for both students and teachers.



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