ABSTRACT

The “flipped” classroom has been hailed as a new pedagogical method (Bishop & Verlegen, 2013), but as a professor who has been using a Socratic/case-based approach to teaching for years, I was not impressed. When assigned to teach in a problem-based learning (PBL) classroom, though a natural fit for my class, I did not anticipate any substantial changes to how my class ran. After only one semester in the new classroom environment, however, I am seeing some positive effects. This paper outlines a statistical study to determine the impact of the PBL environment on my students.

KEYWORDS: Flipped Classes, Gap Analysis, Problem Based Learning

INTRODUCTION

Socratic Inquiry

Socratic Inquiry (also called the Method of Elenchus, or refutation) is defined as a pedagogical technique in which a teacher does not give information directly but instead asks a series of questions, with the result that the student comes either to the desired knowledge by answering the questions or to a deeper awareness of the limits of knowledge (The American Heritage Dictionary, 2009). The belief is that by leading students to discover information for themselves, through the process of struggling to come up with answers to questions that are posed, students learn more effectively. Rhode (2001, p. B15) stated that Socratic Inquiry can help students develop "useful professional skills, such as careful preparation, reasoned analysis, and fluent oral presentations." Moreover, the Socratic Method is effective at developing higher level cognitive skills (King 1990). Truffant (2003) provided a list of positive results that come from using the Socratic Method.

These positive results are not automatic, however. Rhode (2001) noted problems that can occur when using the Socratic Method, including:

- Classes can become a forum for students vying for attention from the professor.
- In larger classes, discussions often discourage participation from some students.
- Discussions do not offer adequate feedback on performance.

Additionally, instructors resort to lecturing due to the need to cover required material, because lecturing is easier than controlling a discussion.

Case-based Teaching

The essential principle behind case-based teaching is that the students learn more from application of tools and techniques than as mostly passive recipients of lectures. "Using a case-
based approach engages students in discussion of specific scenarios that resemble or typically are real-world examples.” (CTL, Queen’s University, 4/27/14). In essence, case-based teaching is an outgrowth of the Socratic method of teaching and can help solve some of the problems identified with case-based teaching.

In the course of a semester, it is common to have individuals or groups of students “responsible” for a given case. From case to case, that means different students will be automatically encouraged to participate, encouraging smaller groups of students to step up and lead the discussions. With each case, the students (whether directly responsible for case or simply participating) receive feedback on the work they have done (or failed to do). Finally, multiple cases means multiple deadlines, lending a certain focus to the discussions as students frantically try to complete the case work before the next case begins. Thus, case-based teaching can combine with Socratic Inquiry teaching to create an intense learning environment.

Problem Based Learning (PBL) Classrooms

My college created several PBL classrooms, also called hybrid classrooms or collaborative learning environments, to encourage innovative teaching/learning approaches. Figure 1, below, shows a standard lecture room layout, while Figure 2, on the following page, shows the same room reconfigured for a PBL environment. For the Spring, 2014 semester, I was assigned to teach in one of these new classrooms. I had been working for the past semester to prepare for the move to the new classroom, but hadn’t really found much I needed to change. The class was already case-based, rather than lecture based, so I thought I was ready to go.

Figure 1: Traditional Lecture Classroom
Case-based teaching, in the traditional classroom, centers on questions from the students. The student groups tended to sit together, but either strung out in a row or in two rows, some behind the others. Various group members would ask questions, but the groups had a hard time interacting or even all seeing a single student’s laptop. The whole class would hear my responses to each question, so they would benefit, but targeted work, with a single group, was difficult (unless the group had the time to come to my office to discuss the case). All group work, with or without me, had to take place out of the classroom. The benefits of case-based learning were being realized, but the classroom time was little better than mini-lectures.

Figure 2: Problem Based Learning Classroom

In Figure 2, each TV/Table grouping is a collaboration station where the group members sit and work together. Each station can copy the display of the main screen, or can be connected to a student’s laptop computer. All chairs and tables are on rollers, allowing the space to be easily reconfigured should two (or more) groups want to work together. In this environment, each
class opens with me answering general questions from the students, just as I had done before. If needed, however, a group’s screen could be sent to all the screens, so everyone could see the point that was being addressed. I kept this portion as short as possible, freeing time to move around the room to deal with whatever specific issues each group might have run into. Working with these smaller groups is very rewarding, because I can see them begin to master the material as they apply it to the problem, and I can help them progress faster by dealing with their specific problems.

Flipping the Classroom

Bishop & Verlegen (2013) define the flipped classroom as a new pedagogical method, employing asynchronous video lectures and practice problems as homework, and active, group-based problem solving activities in the classroom. It represents a unique combination of learning theories once thought to be incompatible: active, problem-based learning activities founded upon a constructivist ideology and instructional lectures derived from direct instruction methods founded upon behaviorist principles. Successfully implementing the flipped classroom concept goes well beyond simply recording a video and having students do homework in class (Findlay & Mombourquette, 2014).

Further, as I managed to prove this semester, merely teaching in a PBL classroom does not create a “flipped” class. Class time was spent on group-based problem solving, but I did not see a significant change in the level of understanding the students brought to the class (although I do feel there was improved understanding that they took away from the class time). An essential ingredient in the “flipped” approach is having the students prepare for the classroom time by studying the basic material (the previous lecture material, now available in asynchronous form) before coming to class. I provided the material, as I did long before teaching in a PBL classroom, but I still spent too much time in class answering general questions at the start of each class. The PBL environment was helping, but I do not believe I got the best use out of it. Apparently, I needed to do more to complete the flip.

That’s not to say there were no improvements. For each case covered in the class, a group of students is assigned to present the case to the rest of the class. The presenting group was required to meet with me, often for more than hour, to review their analysis and clean up their presentation slides. In recent semesters, I have begun strongly recommending the non-presenting groups meet with me as well, but few groups took advantage of the chance. The PBL setting made it easier, and more likely, for all groups to talk with me, resulting in better understanding by the students as shown in the improved quality of the post-presentation discussions (not quantified, but noticeable to me). It would be useful, however, to go beyond my anecdotal observations to try to quantify whether the PBL classroom had a positive impact on student learning.

**EXPERIMENTAL DESIGN**

With one or two minor exceptions, the way the class was taught did not change between Fall 2013 and Spring 2014, except that it was taught in the PBL classroom. This creates an opportunity to evaluate whether the environment itself had an impact on student satisfaction. Looking ahead, a different comparison might be possible should I implement more “flipped” aspects to the class.
For the past two years, a survey of student satisfaction based on Moore’s Theory of Transactional Distance (TD), has been given to my classes. A brief discussion of this theory, and the adaptations we have made to it, is provided next.

Transactional Distance

Moore (1991) took the concept of transaction (Dewey & Bentley, 1949) and applied it to distance education, defining it as “a psychological and communications gap, a space of potential misunderstanding between the inputs of instructor and those of the learner.” Transactional distance exists in any teaching situation, whether face-to-face or distance. Moore proposed two sets of variables, dialogue and structure, to measure transactional distance. He defined (1991) “dialogue” as “the interaction between the teacher and learner when one gives instruction and the other responds” and “structure” as “course design,” hypothesizing that high structure and low dialogue create remote transactional distance and low structure and high dialogue create close transactional distance. He also identified three kinds of interaction: student-student, student-teacher, and student-content (Moore, 1989), but he limited his construct of “dialogue” to student-teacher interaction. Perhaps because of his emphasis on the importance of interaction between instructor and students in reducing transactional distance, most of the related research in distance education has investigated student-teacher interaction.

Measuring Transactional Distance

While Moore’s original theory was developed when distance learning referred to correspondence courses, Zhang (2003) extended the theory to include today’s web-based learning environments. She redefined transactional distance as “cognitive, psychological, social, cultural, behavioral and/or physical distance between learners and the other elements of their learning environments that prohibit students’ active engagement with learning in the online course.” Based on this definition, transactional distance in a web-based learning environment is a multi-dimensional construct, and Zhang’s model has four dimensions of transactional distance: between student and student (TDSS), between student and teacher (TDST), between student and content (TDSC), and between student and interface (TDSI). TDSI refers to the instructional technologies used as part of the course delivery system.

Zhang developed a list of 200 questions to measure the four constructs. Using SEM (Structural Equation Modeling), she showed her model to be valid as the measurement models provided a good fit for the data and her modified scales possessed factorial validity. The statistically significant questions are grouped by construct and each item is measured by a five point Likert scale from “untrue” to “true.”

Zhang went on to define three student outcomes: sense of learning (SL), achievement of learning goals (LG) and overall satisfaction (SS), and hypothesized that transactional distances must produce some type of “bottom line” difference in these outcomes between two individuals experiencing different transactional distances in a given environment. To validate her constructs, Zhang added specific questions to her instrument for these outcomes and showed that the outcomes were statistically correlated to each other and that the TD constructs were significantly correlated to her outputs.
Relative Proximity Theory (RPT)

The concept of relative proximity combines Zhang’s model with the business planning tool of gap analysis. BusinessDictionary.com defines gap analysis as “A technique that businesses use to determine what steps need to be taken in order to move from its current state to its desired, future state. Also called need-gap analysis needs analysis and needs assessment.” Needs assessment has been used in higher educational settings to identify administrative priorities in an academic setting (Swart & Kaufman, 2009; Swart, 2010). It has also been suggested as an ingredient for strategic planning in academia which may lead to decisions such as whether to expand distance education (Watkins, Kaufman, & Odunlami, 2013).

RPT requires that a student respond to each of Zhang’s questions twice – once to evaluate how the professor actually did, and once to indicate what an ideal result would have been. The further the actual from the ideal, the greater the relative proximity, or gap (Swart, et. al, 2014), and, it would be expected, the lower the student’s satisfaction. Both the actual and ideal responses use the same five-point Likert scale, as shown in Figure 3, which has an example of one question from the TDST construct. The full questionnaire has the same format for all of the TD constructs (TDSS, TDST, TDSC, and TDSI).

![Figure 3: Example of RPT questionnaire](image)

Data Analysis

The questionnaires were (will be) given to students in OMGT 6613 – Management Science, both on-line and face-to-face sections. The raw data from the surveys will be combined, first to identify the relative proximity between actual and ideal for each of Zhang’s four constructs, labeled $\Delta$TDSS, $\Delta$TDST, $\Delta$TDSC, and $\Delta$TDSI, respectively, and then to determine average relative proximity for each construct. Finally, we will determine the average relative proximity at the item and construct levels for all respondents. The individual response values will range from a value of 1 to a value of 5, where 5 corresponds to the “best” answer from a TD point of view, so that the higher the score, the closer the transactional distance (except for the inverted question for which the opposite is true). Furthermore, the relative proximities are calculated as (Actual – Ideal), creating a range of 1 to 4 for relative proximity. See (Swart et al, 2014) for computational details.
Relating transactional distances to outputs was a key feature of Zhang’s original research as it was for this study. Zhang found that all three of her output measures: sense of learning (SL); achievement of learning goals (LG); and overall satisfaction with the course (SS) were statistically correlated to each other. To verify whether the same will be true for the OMGT 6613 data, a correlation matrix will be obtained. In other analyses, a high degree of correlation among the outputs was identified, and it was possible to use the overall satisfaction (SS) as the only output variable. We will see whether that occurs for this data.

The four measures of relative proximity can be shown as the axes of a radar diagram, as shown in Figure 4, below. The relative proximity measure for student satisfaction, ΔSS, has been added as a fifth axis. The data points represented by the red and blue lines are simply an example of how two sets of relative proximity results can be compared visually. This allows all five measures to be seen at once, providing an overview of the strengths and weaknesses (in terms of relative proximity) of two classes, instructors, or for our data, once it is available, two teaching environments.

The analysis and understanding gained about how the perception of transactional distances has changed can shed much light on what might be done to further improve transactional distance. The goal is to improve student satisfaction (and hence learning) and the means to do so are derived from an analysis of the relative proximity data analysis – e.g. will we improve student satisfaction if we improve the transactional distance between students and students or between students and content, and if so, by how much? A good educational theory must not only deal with student learning, but also contribute to guiding what teachers can do in their teaching to facilitate learning (Moore, 1980). Relative proximity does exactly that by measuring the gap in transactional distance for each construct and each item defining that construct. Although each construct has a stand-alone meaning, they all work together to create student learning.
To determine the impact that the relative proximities of each TD construct had on predicting the outcome of relative proximity of student satisfaction, other variables which might affect that outcome must also be accounted for. The complete set of variables that were identified as causal or independent variables for the dependent variable ΔSS is:

\[
\begin{align*}
\Delta TDSS & \quad \text{Relative proximity of each of the four TD constructs} \\
\Delta TDST & \\
\Delta TDSC & \\
\Delta TDSI & \\
\text{GENDER} & \quad \text{Dummy variable for gender (F=1)} \\
\text{ROOM} & \quad \text{Dummy variable to differentiate the teaching environment}
\end{align*}
\]

Based on these variables, the following multiple linear regression model can be hypothesized:

\[
\Delta SS = \beta_0 + \beta_1 \Delta TDSS + \beta_2 \Delta TDST + \beta_3 \Delta TDSC + \beta_4 \Delta TDSI + \beta_5 \text{GENDER} + \beta_6 \text{ROOM} \tag{1}
\]

A stepwise linear regression using the data will be performed and the statistical significance of the terms will be determined to begin to create a model that will guide future improvements. An example of this process (for different data) can be found in Swart, et. al. (2014).

**CONCLUSIONS**

At this point, obviously, there are no conclusions. The model described herein has been successful at finding high correlation between TD constructs and student satisfaction for other data sets. The research about using the data to devise strategies to improve student satisfaction is only beginning. Determining whether a PBL classroom has a positive or negative effect on student satisfaction will be one more step in that process. A perhaps more interesting question will be considered using the data for Fall, 2014. With the examples of my colleagues and the information they have prepared for their “flipped” classes as a guide, I know what material I might prepare to help the students with the “out-of-class” portion of the experience, which will, in turn, let me make better use of the in-class time to help the groups with the cases. RPT scores for Fall, 2014 may give a much clearer picture of the effects of a flipping a class.

Even without quantifiable results, I have learned there is a distinction between case-based teaching and “flipping” a class. In case-based teaching, basic material is provided for the students to review outside of class, and it is assumed that the students will study it. Class time is allocated to clearing up any misunderstandings about the out-of-class material and analyzing the current case. The concept behind flipping the class, as I now perceive it, is to not only provide the material outside of class, but to provide it in such a way as to break it down into manageable modules and to tightly connect the out-of-class work to the in-class work, including evaluating the student’s comprehension of that material (beyond simply grading the case work). This process of encouraging the students to prepare the out-of-class work is the next step I need to complete to and RPT will be the guide to taking full advantage of the PBL environment, giving my students the best learning experience I can give them.
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