Teacher Experiences with Flipped Classrooms in Secondary Science

By

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A research project submitted in conformity with the requirements for the degree of Master of Teaching
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FLIPPED CLASSROOMS

Abstract

Flipped classrooms have become increasingly popular in recent years, outpacing scholarly research regarding their effects. As such, I investigated how two secondary-level science teachers perceive their flipped classrooms, uncovering the ways in which they implement their flipped models along with their views on advantages and drawbacks of the approach. A central finding was that both participants did not repurpose class time for higher-level collaborative learning tasks, a frequently reported justification for using the technique. Despite this, the participants reported that they value the increased student-teacher interaction, the self-paced nature of the direct instruction, and the enhanced opportunities to meet individual student needs that flipped classrooms provide. These advantages were tempered with concerns about equity, teacher workload, and curriculum suitability. Overall, flipped classrooms hold considerable potential for improving student learning in science and beyond.

Key Words: flipped classrooms, flipped teaching, technology, teacher experiences
Acknowledgments

I would like to extend my sincerest thanks to Patrick Finnessy, Amir Kalan, and Arlo Kempf for their indispensable guidance and support during various stages of this project.
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CHAPTER ONE: INTRODUCTION

1.0 Background & Significance

“How can I best reach my students?” The answer to this question evolves as our students do. Born during the rise of ubiquitous Internet access, today’s students interact with their world in a manner almost unrecognizable from decades past. For these ‘digital natives’, the vastness of humanity’s knowledge is quite literally at their fingertips. They are accustomed to controlling when, where, and how they communicate and consume information – unbound by time, place, and medium. This constant connectedness has led students to prefer environments that support multi-tasking, to gravitate toward group activity, and to appreciate the social aspects of learning (Roehl, Reddy, & Shannon, 2013). Consequently, there is a push for pedagogy to embrace this reality if it is to continue meeting the learning needs of contemporary students (Beetham & Sharpe, 2013). One pedagogical method in this vein is the ‘flipped classroom’ (Bergmann & Sams, 2012). Generally speaking, it involves using digital technologies to shift direct instruction from the group learning space (inside class) to the individual learning space (outside class), usually via online videos. As a result, class time becomes available for activities that before would have been homework – an inversion or ‘flip’ of the traditional model.

There are many pedagogical advantages of a flipped classroom compared to a standard model (Goodwin & Miller, 2013). First, teachers are freed to spend class time interacting with students on an individual or small group basis, better positioning themselves to respond to their unique needs and to provide real-time feedback on their learning. Second, flipped classrooms leverage students’ digital familiarity through the use of online video as the vehicle for direct instruction – engaging students through ‘speaking their language’. Third, flipped classrooms allow for self-paced learning, as students can pause, rewind, fast-forward, skip, and backtrack.
through videos as needed. Finally, coursework is made more meaningful through the ability to practice and apply learning in the collaborative environment of the classroom rather than the isolated space of the home.

Flipped classrooms, however, are not without their limitations (Milman, 2012). First, quality videos are essential. The skills required for face-to-face instruction do not necessarily translate to video production, and thus some teachers may find the transition professionally challenging. Next, if the class is socioeconomically diverse, it may be difficult to ensure all students have equitable access to online materials. Budgeting for the provision of DVDs, flash drives, or school library computer time could be required. Lastly, class time will only be productive if students have acquired a certain degree of comprehension and understanding from the videos. Needing to excessively re-teach concepts from the videos in class will undermine the advantages of the approach.

Likely due their purported pedagogical advantages, and despite their potential shortcomings, flipped classrooms are becoming increasingly popular. According to an online survey of 2,358 teachers conducted by Sophia Learning and The Flipped Learning Network (2014), the percentage of respondents who recognized the term “flipped learning” increased from 74% to 96% between 2012 and 2014. Also from that survey, the percentage of teachers who indicated they had flipped at least one lesson during the previous school year increased from 48% to 78% during that period. Another indicator of the increasing prevalence of flipped classrooms is the rapid membership growth of the Flipped Learning Network’s online “community of practice” – a site where teachers share best practices related to flipped learning. The community has grown from 2,500 members in January 2012, to 10,000 in June 2013, to more than 20,000 members as of June 2014 (Yarbro, Arfstrom, McKnight, & McKnight, 2014).
In concert with this increase in teacher interest has been a steady growth in flipped classroom literature. Between 2012 and June 2014, the number of books describing flipped classroom pedagogy increased from one to six (Yarbro et al., 2014). Furthermore, 393 of the 486 results from a 03 March 2016 ProQuest search by the author of the terms “flip* AND (classroom OR learning)” in the Title field were articles published since 2012. Evidently, interest in and literature regarding flipped classrooms are proliferating at a rapid rate.

If flipped classrooms are to become a mainstay of modern pedagogy, then it is imperative that we develop a rigorous comprehension of the various implications of the approach. Unfortunately, a significant majority of the flipped classroom literature is not of the scholarly variety – only 107 of the 486 results reported above are from peer-reviewed journals. Consequently, academic research of flipped learning does not appear to be keeping pace with the explosion of interest and discussion. Research of a qualitative nature is particularly lacking, as most scholarly studies to date have approached inquiry into flipped learning from a quantitative angle. However, qualitative investigation of teacher, administrator, and student perceptions of flipped classrooms is essential to building a holistic understanding of this growing pedagogical technique. In doing so, it will help teachers decide if flipped learning is indeed the answer to the question, “How can I best reach my students?”

1.1 Researcher Context

I distinctly remember my twelfth grade chemistry teacher delivering a lecture on quantum mechanics via standing at the front of the classroom and writing on the chalkboard. The students, including myself, were hunched over desks arranged in rows, dutifully taking notes. At the end of class, we copied down the homework assignment consisting of reading pages from a thick textbook and answering some questions at the end of the chapter. The next day, the teacher
briefly reviewed the homework assignment, but had no time to answer additional questions because we had so much material left to cover before the rapidly approaching unit test. Prior to that first lesson, I remember feeling excited to have finally reached the point where understanding quantum mechanics – one of humanity’s most significant and fascinating scientific achievements – was within my grasp. Afterwards, I was disillusioned. The teacher had reduced what I thought would be an exciting topic to a dry and familiar exercise of copying notes, reading the textbook, and answering a few questions at home. In addition, the considerable in-class time consumed by direct instruction meant there was no opportunity for the in-depth discussion, feedback, collaboration, or inquiry that I felt the topic deserved.

Despite the loss of engagement caused by experiences like this, my inherent love of science led me to continue pursuing the subject throughout and beyond secondary school. However, I know from experience that I am the exception rather than the rule. As a secondary science tutor, I frequently encounter students who tell me they are so bored by the subjects that they want to drop them as soon as allowed. I expend considerable energy trying to combat these sentiments, but there is only so much I can accomplish when tutoring hours are far exceeded by negative in-class experiences. “There must be a better way,” I have often thought to myself.

My first exposure to flipped learning as a possible solution to what ails science pedagogy was serendipitous. I was struggling to keep up in a second-year university multivariate calculus course and was desperate to find a way to get extra help. Feeling uncomfortable approaching my peers and without money for a tutor, I half-heartedly typed “calculus” into YouTube. To my surprise, the search yielded an extensive series of instructional videos on the topic produced by a non-profit organization called Khan Academy. Not only did the videos provide me with the assistance I required, they also helped revive my passion for math through their engaging format.
Almost immediately, I could envision how pairing these at-home instructional videos with in-class problem solving, group work, discussion, and teacher feedback might produce an effective learning experience.

Since then, I have wondered if these flipped classrooms might help keep students interested in secondary level science. I have also wondered how teachers feel about the approach, as it entails a significant departure from traditional teaching structures. My hope is that this study will illuminate some of these teacher perceptions regarding flipped secondary science classrooms so that we can begin to understand how they might be most effectively deployed in our schools.

1.2 Research Purpose & Questions

The purpose of this study was to investigate teacher perceptions of flipped science classrooms in secondary schools. A flipped classroom is a pedagogical technique in which direct instruction is transferred from the group learning space to the individual learning space via online video with the intention of transforming the classroom into a dynamic, interactive learning environment where the teacher guides students as they apply concepts and engage creatively in the subject matter (The Flipped Learning Network, 2014).

The central question addressed in this study was: **How do secondary science teachers committed to flipped classrooms view this teaching model?** The following sub-questions were asked in support of the central research question:

1. How do these teachers implement their flipped classrooms?
2. Why did these teachers choose to flip their classrooms?
3. What perceived impact, including benefits and challenges, do these teachers perceive flipped classrooms having on student learning?
The flipped classroom approach is built on pedagogical frameworks that seek to shift learning from a teacher-centred to a student-centred enterprise. Student-centred learning models include active learning, collaborative learning, and cooperative learning (Michael, 2006; Prince, 2004). These student-centred frameworks were used as lens through which teacher perceptions of secondary flipped science classrooms were compared and analyzed, helping inform conclusions from the data.

1.3 Overview

This paper contains five chapters. Chapter 1 includes study background and significance, researcher relationship to the topic, the research purpose and questions, and study limitations. Chapter 2 contains a review of the literature related to flipped classroom pedagogy. Chapter 3 provides the methodology and procedures used in this study including information about the participants and data collection. Chapter 4 compiles the main themes that arose from the interviews with the participants, and presents the central findings. Chapter 5 describes how these themes inform lessons, insights, and recommendations for practice and further study. References and appendices follow at the end.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

To aid in setting the context for this study, this section will provide a review of the literature related to the flipped classroom approach. First, the conceptual framework of flipped learning, comprising student-centred learning theories and methods, will be discussed. Next, the emergence of flipped classrooms as a popular pedagogy will be detailed. Recent research regarding flipped learning in secondary classrooms will then be summarized. Lastly, existing studies regarding perceptions of flipped learning will be reviewed.
2.1 Student-Centred Learning

Although flipped classrooms are a recent phenomenon, they are indirectly based on concepts derived from decades of thought and research in the domain of student-centred learning theories and methods. Much of this activity was motivated by dissatisfaction with traditional teacher-centred pedagogical models. A particularly apt critique was articulated by Volpe (1984):

The major contributor to society’s stunning ignorance of science has been our educational system. The inability of students to appreciate the scope, meaning, and limitations of science reflects our conventional lecture-oriented curriculum with its emphasis on passive learning. The student’s traditional role is that of a passive note-taker and regurgitator [sic] of factual information. What is urgently needed is an educational program in which students become interested in actively knowing, rather than passively believing (p. 433).

From my experience as a student, these words are as relevant today as they were in 1984. But what should students be doing in order to become ‘active knowers’ rather than ‘passive believers’? Michael and Modell (2003) suggest that students should be building mental models of whatever is being learned, consciously and deliberately testing those models to determine whether they work, and then repairing those models that appear to be faulty. Attention should be on what the students are doing, and it is the students’ behavior that should be the significant determinant of what is learned. What the teacher does also matters, as they are the ones designing and implementing the learning environment, but attention should be firmly on the students.

Providing universally accepted definitions for all of the vocabulary of student-centred learning is problematic, since terms are often used in different ways by different authors. However, Prince (2004) provides some generally accepted definitions of the interrelated strands
within the student-centred learning movement. He defines *active learning* as “any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing” (p. 223). He goes on to mention that although homework could be conducted in this manner, in-class activities are the typical target of active learning strategies. Another student-centred pedagogy defined by Prince is *collaborative learning*. The core element of this strategy is a focus on student interactions rather than on learning as a solitary activity. This is similar to *cooperative learning*, where students pursue common goals but are assessed individually. Finally, Prince defines *problem-based learning* as “an instructional method where relevant problems are introduced at the beginning of the instruction cycle, and are used to provide the context and motivation for the learning that follows” (p. 223). Problem-based learning is usually (but not necessarily) collaborative and cooperative in nature, and involves a significant amount of student direction.

How do we know that these student-centered, active learning approaches are superior to conventional, teacher-centered, usually passive approaches? Over 30 years of research has been directed at proving the efficacy of student-centred learning, and it is beyond the scope of this review to describe this literature here. This research ranges from ‘laboratory’ experiments (in which student learning outcomes are studied outside of the classroom, in a context divorced from a specific course) to classroom experiments (in which learning outcomes in a specific course/classroom are measured) to curricular experiments (in which approaches to learning that span a whole curriculum are compared) (Michael, 2006). Reviews of the student-centred learning literature by Hmelo-Silver (2004), Prince (2004), Smith, Sheppard, Johnson, and Johnson (2005), Michael (2006), and Baeten, Kyndt, Struyven, and Dochy (2010) all reach the same conclusion: the effectiveness of student-centered pedagogy is now well supported by evidence.
Flipped classrooms, with their emphasis on meaningful student-centred activities devoid of in-class direct instruction, implicitly rely upon this research base for their justification.

2.2 Emergence of Flipped Classrooms

The first description in the literature of a flipped classroom is attributed to Eric Mazur (1991), who reported on his experience using computer-based instruction to guide students through a physics unit outside of class time. He remarked on the increased time available in class for one-on-one interaction with his students. About 10 years later, Lage, Platt, and Treglia (2000) described their experience creating a university-level economics “inverted classroom” consisting of multimedia (video tapes and PowerPoint lectures with recorded sound) to be viewed outside of class in a media lab or at home. Importantly, student survey results showed the participating students found the approach to be favorable over traditional teaching due to increased student-teacher interaction, more active engagement, and group collaboration.

Evidently, initial reports of flipped learning emerged slowly and sporadically. It was not until the latter half of the last decade that flipped classrooms began to gain momentum. This was largely the result of the work of two chemistry teachers from Woodland Park High School in Colorado: Jonathon Bergmann and Aaron Sams. In their pioneering book, Bergmann and Sams (2012) described how, in 2007, they began using online, taped lectures to reach students who were frequently absent:

We were spending inordinate amounts of time re-teaching lessons to students who missed class, and the recorded lectures became our first line of defense. … Because our videos were posted online, students and teachers from all over the world began thanking us for them. … He [Aaron Sams] then asked the question: “What if we prerecorded all of our
lectures, students viewed the video as ‘homework’, and then we used the entire class period to help students with the concepts they don’t understand?” (p. 3-5).

Rather than emerging from decades of research on student-centred learning, the flipped classroom paradigm was – at least initially – a product of frustration. However, they quickly realized that their model was coherent with student-centred approaches: “The flipped model has allowed us to empower students to want to learn more content more deeply in an interactive, relationship-rich environment that helps them succeed.” (p. 112). As interest in their flipped learning approach began to grow, Bergmann and Sams founded an online community to provide educators with the knowledge, skills, and resources required for its successful implementation. The Flipped Learning Network, as the community is called, now has over 20,000 members as of June 2014 (Yarbro et al., 2014).

2.3 Efficacy of Flipped Learning in Secondary Schools

There is limited research on the effectiveness of flipped classrooms. Evidence that is published typically takes the form of self-reported data from schools that have adopted flipped learning. In this section, I will describe five case studies highlighting the flipped learning experience in secondary schools, which is the educational environment of interest for the present study. Although not always of a scholarly nature, these cases provide some evidence that flipped classrooms are an effectual means of fostering a student-centred learning environment.

2.3.1 Byron High School (Minnesota)

Kathleen Fulton (2013) has described the effect of flipping mathematics classrooms at Byron High School in Minnesota. In 2006, less than one-third of students (29.6%) passed the state mathematics test, which prompted the school to analyze student performance and take a critical look at its teaching. Faced with a concurrent financial crisis, the school decided to
revamp their program by declining to purchase new textbooks and instead use open-source videos to deliver direct instruction. Led by math teacher Troy Faulkner, the entire math department decided to use these videos as the ‘homework’ portion of a flipped classroom model, which reached full implementation in 2009. By 2011, nearly three-quarters (73.8%) of students passed the state math test, more than double the number from 2006. In recognition of these gains, Byron High School was designated at National Blue Ribbon School in 2010 and won the Intel Schools Distinction award for High School Mathematics in 2011 (Fulton, 2013).

2.3.2 Clintondale High School (Michigan)

According to Greg Green (2012), the lecture-centred teaching and Clintondale High School in Michigan was not connecting with their students, three-quarters of whom were minorities from low-income families. After hearing about flipped learning in 2010, the school implemented the model in all freshman classes. Encouraged by initial positive results, the school converted all grades to a flipped model in 2011. Student scores on the 2011-2012 Michigan Merit Exam (MME) were higher in all subjects compared to scores prior to the adoption of the flipped approach. For example, scores on the math and science portions of the MME increased by four and three percentage points, respectively. Interestingly, the number of student discipline cases fell from 736 in 2009 to 249 in 2010 and to 187 in 2011, a drop in 74% in two years. Parent complaints also dropped, from 200 down to seven after the change in instructional models.

2.3.3 Niagara Falls High School (New York)

Math teachers Ed Ventry and Amy Kilmer at Niagara Falls High School in New York State flipped their classes in 2012 in hopes of using class time for more applied activities and individualized instruction (Ventry & Kilmer, 2013). They recorded video lectures, and supplied students with guided notes to complete while watching the videos outside of class time. In class,
the students worked on interactive problem sets, and received real-time assistance from their teachers. After implementing the flipped approach, 83% of students passed the honours Algebra II/Trigonometry Reagents Examination (a New York State standardized test) compared with 71% the year before. In addition, 35% achieved a “mastery score” compared to 14% previously. For students who took the general (rather than honours) examination, 55% passed compared to 35% pre-flipped learning, and 7% achieved mastery compared to 4% previously.

2.3.4 Bullis School (Maryland)

Stacey Roshan, an Advanced Placement (AP) Calculus teacher at Bullis School in Maryland, decided to flip her course by having students watch videos outside of class, freeing class time for students to work individually and in small groups on calculus problems (Roshan & Roshan, 2012). She (along with her daughter Wendy Roshan, also an AP Calculus teacher) reported that the percentage of students scoring a 4 or 5 on the AP exam increased from 58% to 78% after application of the flipped approach. In addition, no students scored below a 3 after flipping.

2.3.5 Davies High School (North Dakota)

Schultz, Duffield, Rasmussen, and Wageman (2014) investigated the effects of the flipped classroom on academic performance of high school AP Chemistry students at Davies High School in North Dakota. Identical assessments were administered both pre- and post-implementation of the flipped model. Students from the 2011-2012 academic year, in which traditional teaching methods were used, formed the control group, while students from the 2012-2013 academic year, in which the flipped classroom approach was used, formed the treatment group. A statistically significant difference was found on all assessments with the flipped class students performing higher on average.
2.4 Perceptions of Flipped Learning

As is true for research regarding the empirical effectiveness of the flipped approach, qualitative research addressing perceptions of flipped learning is also limited. However, understanding these perceptions is critical to determining how we might best implement flipped classrooms in contemporary schools. Recently, there has been some progress into elucidating these perceptions, which will be described in the sections that follow.

2.4.1 Student Perceptions

Flipped classrooms will only be successful if students embrace them, and so summarizing some of the literature related to their perceptions of flipped learning is relevant to this study. Almost three-quarters of the more than 180,000 middle and high school students who participated in the Speak Up 2013 survey agreed that flipped learning would be a good way for them to learn, with 32% of those students strongly agreeing with the idea (Project Tomorrow & Flipped Learning Network, 2014). The report noted that, similar to other new digital learning trends, student interest in flipped learning was found to precede teacher and administrator interest. The survey also found that the middle and high school students reported an increase in their use of videos as part of their learning process from 40% in 2012 to 60% in 2013, and that this increase included both online and teacher-created videos.

Close to 80% of the 203 students who participated in the 2012 Columbia University Flipped Learning and Democratic Education survey agreed that flipped learning resulted in more constant and positive interactions with teachers and peers during class time; more access to course materials and instruction; greater ability to work at home at their own pace; greater ability to exercise choice in how they demonstrate their learning; and learning as a more active process (Driscoll, 2012). Close to 70% reported that they are more likely to have a choice in what
learning tasks they engage in; they are more likely to engage in collaborative decision making with other students; they are more likely to engage in critical thinking and problem solving; and the teacher was more likely to take into account their interests, strengths, and weaknesses. Driscoll concluded that flipped learning results in a democratized learning environment.

Although not the focus of this paper, the experience of post-secondary students with flipped classrooms has been generally positive as well. In their recent conference paper, Bishop and Verleger (2013) provide a survey of research into the flipped classroom approach at the post-secondary level. They report on eleven studies that have investigated student perceptions of the flipped classroom, with results being relatively consistent in that general student opinion of the flipped classroom tends to be positive, with a minority being opposed.

2.4.2 Administrator Perceptions

Understanding the perceptions of administrators is also important, as they often determine whether or not flipped classrooms will be allowed to operate in their schools. Over 6,000 administrators responded to the Speak Up 2013 survey, and 25% agreed that flipped learning had a significant impact on transforming teaching and learning (Project Tomorrow & Flipped Learning Network, 2014). This was greater than the 21% and 19% who thought the same about mobile technologies and online professional learning communities, respectively. The results also indicated that 40% of administrators were interested in “trying flipped learning” this year in their schools. When asked to identify the technology experiences they think pre-service teachers should have before getting a teaching credential, 41% said that teacher candidates should learn how to set up a flipped learning class model.

2.4.3 Teacher Perceptions

Teachers are of particular interest, as investigating their perceptions of flipped classrooms is the goal of this study. In a survey of 1,401 pre-K to 12 classroom teachers, PBS and Grunwald
Associates (2010) found that 68% of teachers believed that using videos helped stimulate classroom discussion, 66% associated videos with increased student motivation, and 62% said they helped make them their teaching more effective. A majority of teachers (61%) also said students prefer videos to other types of instructional resources, and just under half (47%) said videos stimulated student creativity. Although flipped learning was not the topic of this survey, it is interesting to note the positive feelings teachers’ have towards the use of videos as part of their instruction.

One of the first studies directly targeting teacher perceptions of flipped classrooms was conducted by ClassroomWindow and Flipped Learning Network (2012). This online survey of 450 teachers found that 66% observed an increase in their students’ standardized test scores after flipping their classrooms, and 80% perceived an improvement in their students’ attitudes towards learning. Nearly 9 in 10 of the surveyed teachers reported that their job satisfaction improved, with 46% reporting significant improvement.

Similar perceptions were reported in the 2012 Columbia University Flipped Learning and Democratic Education survey (Driscoll, 2012). Of the 23 educators surveyed who had flipped their classrooms, over 90% said that positive interactions with their students increased; students had greater access to course material and instruction; students could work at their own pace; students were more likely to engage in critical thinking; and instruction became more differentiated and personalized. Close to 80% reported that positive interactions between students increased; that students became more likely to engage in collaborative decision-making; and that students were more likely to have choices in how they demonstrated what they learned. Just over 50% agreed that students were more likely to have a choice of which learning tasks to engage in.
Despite these enthusiastic reviews from teachers who have flipped, only 6% of the more than 56,000 teachers questioned as part of the Speak Up 2013 survey indicated that they were using videos they had found online, and only 3% said they had created videos as part of a flipped classroom (Project Tomorrow & Flipped Learning Network, 2014). Evidently, flipped classrooms are still quite rare. However, the survey also found that 18% of teachers were interested in trying flipped learning, 20% said they wanted to learn more about to create instructional videos for their students, and 15% wanted to learn how to implement a fully flipped classroom model. There thus appears to be a gap between the number of teachers interested in flipped learning and the number actually using the model.

2.5 Conclusions

Interest and adoption of flipped classrooms are growing at a rapid rate, but research has not kept pace. The vast majority of current research targeted at flipped learning is of an anecdotal or non-scholarly nature, particularly so for qualitative inquiry. Furthermore, academic support for the approach from a Canadian context is essentially non-existent. If flipped classrooms are to become a widely adopted instructional technique in secondary schools – both inside and outside of Canada – then this dearth of scholarly justification must be rectified. The goal of this study is to add to this fledgling body of research through qualitatively investigating teacher perceptions of science flipped classrooms in secondary schools.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, I describe the methodology of this study. I begin by reviewing the general approach, procedures, and data collection instruments, before elaborating more specifically on participant sampling and recruitment. I explain data analysis procedures, and review the pertinent
ethical considerations. Relatedly, I identify a range of methodological limitations, but I also speak to the strengths of the methodology. Finally, I conclude the chapter with a brief summary of key methodological decisions, and my rationale for these decisions, given the research purpose and questions.

3.1 Research Approach & Procedures

This research study was conducted using a qualitative research approach, involving a literature review and semi-structured interviews with teachers. Creswell (2013) describes how this approach is valuable when an issue needs to be explored. That is, qualitative research is ideal when a complex, detailed understanding of an issue is desired. As was described in Chapter Two, flipped classrooms have exploded in popularity over the last four years, and scholarly research into this phenomenon has (understandably) failed to keep up. Consequently, the potential effects that the continued proliferation of flipped classrooms will have on the educational landscape are largely unknown, but are predicted to be multi-faceted and non-trivial (Strayer, 2012) – perfect for a qualitative line of inquiry. This is particularly true for understanding how teachers involved with flipped classrooms perceive this growing pedagogical model, as comprehending their human experience is a fundamentally qualitative activity (Roller & Lavrakas, 2015). Through unraveling their experiences in this way, I hope to begin making sense of the intricate effects that flipped classrooms are having on secondary-level science education. Both Creswell (2013) and Roller and Lavrakas (2015) describe this process of untangling the human experience as the fundamental goal of qualitative inquiry.

3.2 Instruments of Data Collection

The primary instrument of data collection used in this study was the semi-structured interview protocol. Semi-structured interviews provide the opportunity to hear about
participants’ lived experiences (Creswell, 2013). The semi-structured format allows for the interviewer to design and plan an interview that attends to the research focus and questions, while leaving room for the participants to elaborate and even redirect attention to areas previously unforeseen by the interviewer. The adaptability of semi-structured interviews was of particular value to the this study, as the rapidly evolving nature of the flipped classroom movement made it difficult to precisely identify all pertinent lines of questioning in advance. Furthermore, semi-structured interviews promote a sense of shared experience between interviewer and interviewee, encouraging back-and-forth dialogue, thus enhancing the depth and richness of the resulting data set (Roller & Lavrakas, 2015).

A full list of interview questions can be found in Appendix B. The protocol is divided into five sections. The first section, composed of ‘background’ questions, not only helped to establish the background of the teacher, but also aimed to put them at ease for the remainder of the interview. The next section targeted gathering data on what the teacher has done to implement flipped learning, as well how they have gone about it, thus providing insight into the first research sub-question. Thirdly, the interview turned to the why-type questions, which looked to answer the second research sub-question: why did these teachers choose to flip their classrooms? In the fourth section, questions were aimed at understanding perceptions of benefits and drawbacks of the flipped approach in terms of its impact on student learning. This directly addressed the third research sub-question. Finally, the interview closed with a pair of questions aimed at probing the teacher’s perceptions regarding the future of flipped classrooms as a teaching strategy.
3.3 Participants

Here I review the sampling criteria I established for participation in the study, and I review the methods I used for teacher recruitment.

3.3.1 Sampling Criteria

To qualify as a participant in this study, a teacher was required to satisfy the following sampling criteria.

- Currently teach one or more secondary-level (grades 9-12) science classes
- Currently use at least some aspects of flipped learning in their pedagogy
- Possess experience teaching via a ‘traditional’ (non-flipped) model

The first criterion – currently teaching a secondary science class – was required because this study is focused on that particular educational level and subject space. As described in Chapter One, secondary level science is where the majority of flipped learning has occurred to date, and it is also the area of my personal educational expertise and interest. Secondly, participants must currently be using flipped learning in some form in their teaching. Note that they need not be teaching exclusively through a flipped approach, they simply need to be incorporating some aspect of flipped learning in their teaching. The reasoning for this criterion was that flipped classrooms, despite their rapid growth, are still relatively rare, and so it was anticipated that it would difficult to locate teachers who use this mode exclusively. Also for this reason, there was no requirement for number of years having used a flipped approach. However, it was required that participating teachers possess experience teaching in a ‘traditional’ (non-flipped) setting, so that they were able to draw comparisons between the two pedagogical models.
3.3.2 Sampling Procedures/Recruitment

Qualitative researchers should strive to recruit participants who meet the study criteria and who represent the richest and most complex source of information relevant to the phenomena being studied (Denzin & Lincoln, 2005). Specific strategies include snowball recruitment, where nomination of other potential participants is made by those already enrolled in the study, and media approaches, such as paid advertisements in either traditional print or online sources (Eide, 2008). More specific to this study, I could have contacted teacher organizations, school boards, or principals to provide them with an overview of my research study, including participant criteria, and ask that they distribute my information to teachers that they believe might be a fit. However, I did not rely on any of the aforementioned recruitment strategies, and instead relied on convenience sampling. That is, I used my professional network to locate teachers involved with flipped learning. There were two reasons for using this sampling approach. Firstly, the small-scale nature of this study limited the number of interviewed teachers to two, which was achievable without more formal recruitment techniques. Second, I was already aware of a few potential interview candidates via connections I had made in teaching and education. Using this method, participants were recruited who fulfilled the sampling criteria and represented the best potential source of data regarding teacher perceptions of secondary science flipped classrooms.

3.4 Data Analysis

Before the data was analyzed, I transcribed the interviews. To begin the coding process, I first read through each interview transcript without making any markups in order to get an overall feel for the content of each interview. I then re-read the interviews, this time assigning codes to the transcript using the comment feature in Microsoft Word. I used a mix of descriptive and interpretative codes, with each code aimed at capturing the essence of each statement.
(Saldana, 2008). Furthermore, I constantly considered how the content of the transcript related to the overall research question and sub-questions, and how each code I assigned might help to answer them. That is, my coding was deliberately aligned with the study’s overall aims. For example, the statement, “[The flipped classroom approach] gives me an opportunity to basically see every kid, if not every day, then within every two days” was coded as ‘student-teacher interaction’. The assignment of this code came via viewing the statement through the lens of the third research sub-question: “What perceived impact, including benefits and challenges, do these teachers perceive flipped classrooms having on student learning.” Statements could receive more than one code if they could be viewed in multiple ways. For example, consider the following passage: “And unfortunately with the program that I was using if you started changing like the fifth or sixth slide, everything after that changes. It takes it out of sync. So you really have to record the whole thing again.” This statement was coded as both ‘technology issues’ and ‘teacher workload’, as each of these different but related concepts are contained in the passage.

The result of the coding process was 32 unique codes, each of which had some relation to the overall research question and sub-questions. Some of the codes were relatively similar (e.g. ‘student convenience’ and ‘student time-saving’), but were kept distinct to acknowledge the importance of their slight difference in meaning. After all of the participant interviews were transcribed and coded, similar codes such as these were grouped together into sub-categories and categories with the aim of revealing larger themes related to the research questions.

### 3.5 Ethical Review Procedures

All participants were assigned a pseudonym and were notified of their right to withdraw their participation in the study at any stage of the research. Participants’ identities were kept confidential, and any identifying markers related to their schools or their students were excluded.
There were no known risks to participation in this study. Participants had the opportunity to review the transcripts and to clarify or retract any statements before I conducted data analysis. All data is stored on my password-protected computer and will be destroyed after five years. Participants were asked to sign a consent letter (Appendix A), giving their consent to be interviewed as well as audio recorded. This consent letter provided an overview of the study, addressed ethical implications, and specified expectations of participation.

3.6 Methodological Limitations & Strengths

The research methodology used in this study had some limitations, but also some important strengths. One limitation was that all of the data was of one type: interviews. Creswell (2013) discusses three other data types of value to qualitative studies: observations, documents, and audiovisual materials. Being able to collect data in these other forms is useful because it acts as corroborating evidence for the interview data, as well as providing entirely new information for analysis. For example, being able to observe participant teachers’ flipped classrooms in action would add significant depth to the study. Unfortunately, constraints on the ethical parameters we have approval for prevented this from being possible. Secondly, the interviews themselves were limited in that they were restricted to teachers, again because of ethical parameters. Including the perspectives of other groups, like parents or students, would have added to the value of the study, building a fuller picture of the effects that flipped classrooms are having on student learning. Additionally, available time and resources confine the number of teachers that were interviewed to two – a relatively small number, thus placing a limit on the study’s breadth. Finally, it is important to remember that while the findings can inform our understanding of teacher perceptions of flipped classrooms, they cannot generalize the experience of teachers more broadly speaking.
Despite these limitations, the study had significant strengths. Interviewing, rather than using simple surveys, allowed for each teacher to be heard from in considerable depth and in their own words. This created a space for each teacher to describe what mattered most to them about flipped classrooms. In this way, the interviews acted to validate their voice and history with flipped learning, and provided them an opportunity to make meaning from their lived experience. Additionally, the interviews allowed them to reflect on their teaching practices, and to think about the reasons for why they have made their particular pedagogical decisions. Consequently, the study design offered some direct benefit to the participating teachers, going beyond simply benefiting the research community.

3.7 Conclusion

In summary, this is a qualitative study that uses semi-structured interviews as the data source. Participants must teach secondary science and must use flipped learning as part of their pedagogy. These participants will be recruited through convenience sampling via my professional network. Participation in this study carries no known risks, but the identities of all participants will be protected and their data secured. The data sources (interviews) and participant type and number (2-3 teachers) places some limits on the depth of the study, but it still has a significant strength in that it provides an avenue for teachers to express their voice. Next, in Chapter Four, I report the research findings.

CHAPTER 4: RESEARCH FINDINGS

4.0 Introduction

This chapter describes the study’s findings. I begin by summarizing the background and teaching history of the study participants for the purpose of providing the reader with some context for the findings, which are organizedthematically. Three overall themes emerged from
my analysis of the interview transcripts: 1) flipped classroom structures; 2) flipped classroom advantages; and 3) flipped classroom drawbacks. Each of these themes is described through a series of sub-themes wherein the experiences of the participants are reported and compared to the flipped classroom literature. Finally, I conclude the chapter with a summary of the findings and a preview the next (and final) section of this study.

4.1 Participants

I interviewed two teachers for this study – Mark and Brittany. Both are Ontario Certified Teachers and currently teach at Toronto-area secondary schools.

4.1.1 Mark

Mark teaches at an independent catholic all-boys school, where he has spent his entire 24-year teaching career. He has taught grade 9 science, grade 10 science, and grade 11 biology, but is only teaching the latter two courses during the current (2015-16) school year. All of the courses he has taught have been at the academic/university level, as his school does not offer applied/college-level courses. Mark spoke about how the students at his school are generally “high-achievers” from socioeconomically privileged backgrounds, and so nearly all of his students are aiming to gain entrance into prestigious universities for their post-secondary studies. Furthermore, he spoke about how his students are generally heavily involved in extra-curricular activities, especially athletics and music. Their participation in these programs coupled with their dedication to academics mean that these students are exceptionally busy during school year. This reality contributed to Mark’s rationale for moving toward a flipped approach, which I discuss in section 4.3. Mark has been using some variation on a flipped classroom for four years, but it has been limited to particular units in his grade 9 and grade 10 science classes. The details of his particular flipped classroom style will be discussed in section 4.2.
4.1.2 Brittany

Brittany teaches at a large public school that she described as being “inner city”. She is in her seventh year of teaching, and sixth at her current school. She has taught a wide variety of mathematics and science courses, but the majority have been senior chemistry and junior science. This school year (2015-16) she is teaching exclusively senior chemistry – grade 11 university-level chemistry, grade 12 university-level chemistry, and grade 12 college-level chemistry. In contrast to Mark, her school offers considerably more applied/college-level courses than academic/university-level courses, as it has a large technical studies program. She described her students as being more socioeconomically disadvantaged than those at a “typical” school. Furthermore, her classes are generally composed of students that possess an assortment of unique needs, including those with behavioural, language, and learning challenges. I discuss how these realities contributed to her decision to experiment with flipped teaching in section 4.3. This is the third year that Brittany has been incorporating flipped teaching into her pedagogy, the details of which I describe in section 4.2.

4.2 Flipped Classroom Structures

According to the The Flipped Learning Network (2014), a flipped classroom is a pedagogical technique in which direct instruction is transferred from the group learning space to the individual learning space via online video with the intention of transforming the classroom into a dynamic, interactive learning environment where the teacher guides students as they apply concepts and engage creatively in the subject matter. However, the participants own definitions were not nearly so ambitious, focusing mostly on the removal of direct instruction from the group learning space. In this section, I describe how the participants structure their particular versions of a flipped classroom. To do this, I first describe how the participants structure the at-home portions of their flipped classes, and then describe their in-class programing.
4.2.1 At-Home Component

Each participant reported a different method for delivering his or her at-home direct instruction. Mark described himself as a “PowerPoint person”, and so he chose to add voice-over narration to the existing PowerPoint slides that he had previously presented during class. He has a maximum of 15 slides per presentation, and each narrated multimedia file takes approximately 15 minutes to listen through (without pausing/rewinding). He described his narrated PowerPoints as being “quick hits” that were aimed at maintaining the students’ interest. He posts the files to a class page on Edsby, an online learning management system that all teachers at his school are able to use for free. At the end of most classes, he instructs his students to login to the site and watch a particular narrated PowerPoint. Some days, he does not have them do this, as the PowerPoint from the previous day was intended to cover two days worth of in-class activities. He tells his students to take notes as they watch, and encourages them to pause and rewind the files as needed. He also tells them to make a list of questions that they have about the material, with the intention of addressing them at the beginning of the next class.

Brittany uses a much different method for creating her at-home instructional videos. Rather than using PowerPoint slides, she uses a document camera that captures the process of her producing notes and going through example problems. She also usually has a webcam capture video of her face as she does this. In her words, “I [use the webcam] so that I can make eye contact with them and so that they know it’s me. When they come into class, they remember that it was me who taught them and not a stranger.” During editing, she inserts the video of her face into the top left corner of the screen, but keeps it small compared to the document camera video. The videos are typically around 20 minutes in length. She posts her completed videos to YouTube, but has them be unlisted so that the URL is required to watch them. Her students access the videos through visiting her class blog, which is publically accessible. She said that
sometimes, for particular topics, she uses an existing instructional video from YouTube instead of a self-made video. However, she does this sparingly. In her words, “There’s a little bit of the guilt factor when you off-load things to Khan Academy or something else. That’s why I like to make my own stuff.” Similar to Mark, she encourages her students to make notes while watching, and to bring up any questions they have at the start of class.

This variability in the particular details of the multimedia used to deliver direct instruction is consistent with the flipped classroom literature. For example, the math department at Byron High School in Minnesota uses screen captures of teachers interacting with SMART Boards (Fulton, 2013), teachers at Clintondale High School in Michigan use software that allows them to narrate over PowerPoints (Green, 2012), and chemistry teachers at Davies High School in North Dakota use existing Khan Academy videos (Schultz et al., 2014). Consequently, I was not surprised to discover that the participants differed in how they were providing the at-home instructional component. There seems to be no single correct way to supply students with virtual direct instruction. Interestingly, neither of the participants reported including a means for the students to interact with the online multimedia. As an example, neither of the participants uploaded their content to EduCanon, a free platform that embeds pop-up box questions over the videos for the students to answer as a method of formative assessment (Meyer, Pierce, & Raths, 2015). The participants were instead content with having all interactivity and assessment occur in class when they are physically present with the students. Overall, the participants differed in how they produced their at-home online instructional media, as was expected from the flipped classroom literature.

4.2.2 In-Class Component

Mark and Brittany use the freed-up class time in similar ways. Mark typically begins his classes with a short formative quiz aimed at assessing understanding of the narrated PowerPoint
from the previous evening. He then addresses any questions the students might have regarding what they learned at home. Students then spend the remainder of the period working on what would have been ‘homework’ in a traditional classroom. In his words, “If they need help they have three resources: their textbooks, their peers, and myself.” He typically allows students to work together, but is quick to intervene if a student becomes disruptive: “You kind of sense who is and who isn’t working.” Mark indicated that his students have responded positively to this arrangement, as normally they wouldn’t have access to their peers or their teacher when doing homework. If time allows, he directs the attention of the class to the front and takes up some of the questions. Importantly, Mark said that he has not changed the tasks that the students are doing – the only difference is that they are now doing them in class rather than at home.

Brittany also begins her classes with a formative quiz targeting basic understanding of the videos. Rather than address student questions in front of the class, she does so on a one-on-one or small group basis. She says this gives students more incentive to watch the videos, since they will be unable to rely on simply learning the material in class via her answers to the questions. The students then work on practice questions based on the videos. In her words, “I might have different groups of students working on different questions based on what I think is best. The idea is that because they’ve learned this stuff, it’s time for them to practice.” She encourages the students to use each other as a resource, because otherwise she can become inundated with students asking her for assistance: “I really want them to help each other as much as possible.” However, Brittany (like Mark) has not been developing new tasks specifically designed for the in-class work environment. In her words, “It really is just a straight flip of what I was doing before.”
The ways in which the participants use in-class time are consistent with what has been termed a “first generation flip” or a “flipped classroom 1.0” (Bergmann & Sams, 2014). That is, they are simply using class time for what would have previously been homework, and not using it for new tasks aimed at leveraging the collaborative potential of the learning environment. There are many reports in the literature of teachers choosing this more ‘basic’ flipped model, including teachers at Byron High School in Minnesota (Fulton, 2013) and Clintondale High School in Michigan (Green, 2012). However, many teachers and schools are moving towards developing deeper and more novel learning tasks for their students to work on during class time (Bishop & Verleger, 2013). When prompted to speak about moving toward such tasks, they both indicated that students were happy with the current approach, and so did not see the need to change it. Overall, the participants structured their in-class time in similar ways, focusing on the completion of tasks that previously would have been homework.

### 4.2.3 Summary

Mark and Brittany utilize similar structures for their flipped classroom pedagogy. Both produce some form of online instruction that their students watch outside of class time, and both have their students work on questions and problems related to the content from that instruction during class. They differ in the specific forms of their instructional media, with Mark producing narrated PowerPoints while Brittany creates videos that capture both her face and hand as she writes notes and speaks. These findings are generally in agreement with reports in literature regarding the structure of flipped classrooms. However, both participants reported that they are not using the newly available class time to experiment with novel learning tasks aimed at maximizing the potential of the learning environment, which is often described in literature as being the ideal outcome of a flipped classroom. All in all, the structures of the participants’ flipped classrooms were generally similar to each other and to those in described in the literature.
4.3 Flipped Classroom Advantages

In their seminal book, flipped classroom pioneers Bergmann and Sams (2012) describe fifteen reasons why teachers might choose to flip their classrooms. Perhaps unsurprisingly, the participants’ rationale for using a flipped approach was not nearly so detailed, and tended to rely on a shorter list of key advantages. The following section reports the advantages to using a flipped classroom as described by the participants. These advantages are increased student-teacher interaction, self-paced learning, and enhanced ability to meet students’ needs.

4.3.1 Increased Student-Teacher Interaction

Both participants agreed that an advantage of flipped teaching is the increased amount of interaction it allows them to have with their students. In Brittany’s words, “I love having time in class to interact with every student. I can circulate and visit all of them because I haven’t spent half an hour giving them a lesson on something.” Mark agreed: “It gives me an opportunity to basically see every kid, if not every day, then within every two days.” Both teachers were eager to provide examples of how they were able to learn things about their students that would have been difficult to know without the increased time spent interacting with them on an individual or small-group basis. For example, Mark discussed how a multiple students were making the same procedural error as he watched them work on a chemistry problem. Since he was in the room, he was able to correct the mistake in real-time, preventing the students from repeating the error on the subsequent questions. Under a traditional model, Mark said he wouldn't discover this issue until they submitted their work for him to mark, and by then the mistake may have become a habit. For both participants, the ability to provide this ‘just-in-time’ instruction – a result of the increased student-teacher interaction – was a key benefit of using a flipped approach.

The consensus amongst the participants that flipped teaching allows for more student-teacher interaction is echoed in the flipped classroom literature. For example, Bergmann and
Sams (2012), Goodwin and Miller (2013), and Fulton (2012) all highlight this notion in their summaries of flipped classroom advantages. However, the quality of the interaction is critical to determining whether or not it actually benefits students. High-quality student-teacher interactions have been shown to support students' adjustment to school, contribute to their social skills, and promote academic performance (Rimm-Kaufman & Sandilos, 2015). Brittany made explicit reference to this notion of interaction quality, saying that her flipped classroom allows her to “have deeper interactions with the kids”. She went on to say, “[having deeper interactions] affects my rapport with the class, and affects how much they feel they can come to see me outside of class and so on.” Mark, in contrast, did not make any mention of the interaction quality, only stating that the approach allowed him to interact more frequently. Overall, the participants viewed the increased student-teacher interactions as being one of the major advantages of implementing a flipped approach to teaching.

4.3.2 Self-Paced Learning

As described in section 4.2, both participants use some form of online multimedia to deliver the at-home direct instruction portion of their flipped classrooms. In both cases, students are able to pause, rewind, and replay the multimedia, allowing them to learn at their own pace. In Brittany’s words, “They can take the time to go through the lessons at their own speed. So, if they get it, they can watch the 20-minute video and it’s done. If they are having trouble, they can pause it and rewind it. They can slow down the pace.” Mark concurred, mentioning how students can watch his narrated PowerPoints “numerous times” if necessary. Both pointed out that this is not possible with in-class direct instruction. When direct instruction is delivered in class, they said, some students need the teacher to slow down, but doing so would leave others restless and potentially disruptive. Brittany, who frequently teaches students with a history of behavioural issues, emphasized the improvement in classroom management experienced when flipping her
classroom. Consequently, according to the participants, the self-paced nature of flipped classrooms benefits both individual students and the learning environment as a whole.

The self-pacing afforded by flipped classrooms is one of their most frequently cited advantages (Bergmann & Sams, 2012; Berrett, 2012; Bishop & Verleger, 2013), and so the participants’ agreement with this view was not at all unexpected. Interestingly, research regarding self-paced learning has shown that it only results in improved academic performance when the students involved have sufficient metacognitive monitoring and control (Tullis & Benjamin, 2011). That is, students need some level of self-awareness about their personal learning processes, or else they will not know when they need to pause or rewind the multimedia. Mark spoke to this point: “Sometimes I’m not sure if they are taking advantage of my [narrated] PowerPoints. I think some of them blow through it and consider themselves done. Mind you, I think those are also the students who aren’t going to stop me in class and ask questions.”

Evidently, providing students with the opportunity to self-pace their learning doesn’t necessarily mean they are capable – or willing – to take advantage of it. Despite this, both participants were firm in their belief that the self-paced nature of the direct instruction was a distinct advantage of flipped learning.

4.3.3 Meeting Students’ Needs

Both participants agreed that flipped learning allowed them to meet the needs of their students in ways not previously possible. Mark focused on how it allowed for more efficient use of his students’ time. In his words:

A lot of the kids that come to this school are very athletically inclined – they’re involved with hockey and other sports. I was having parents call me, saying they’ll pull them off the sports teams. I thought that was crazy. They need to stay involved; they need to be well rounded. With the narrated PowerPoints, they can watch on their phones or iPads
when they're on their way to and from school – subway, bus or car. You can’t really work on questions or problems on the bus, but you can watch something. So it makes use of all this time we didn't have access to before.

Mark goes on to describe how his students have appreciated the flexibility provided by the flipped classroom format, as they can choose how and when they receive direct instruction.

Brittany also stressed how using a flipped approach helped her meet the needs of her students. As has been discussed, Brittany routinely has students with varied learning challenges, many of whom require significant accommodations. Students with processing issues can watch the videos as many times as they need to learn the material. In her words, “They no longer frantically copy down notes and hope that they understand them later.” Additionally, students are more easily able to ask for help when working on ‘homework’, as they work on ‘homework’ in class with the teacher present. Both Mark and Brittany talked about how students can even work ahead if they want, and that there is no requirement that everyone be working on the same thing during class time. Overall, this flexibility makes it more likely individual needs are being met, with Brittany stating that certain students “finally felt like they were enjoying learning science” as a result.

4.3.4 Summary

Both participants described a similar set of advantages to using a flipped approach in their science classes. They emphasized how they are able to interact with their students more frequently in one-on-one and small group settings, and how this level of interaction would not have been possible previously. They also described how students benefit from self-pacing, specifically the ability to pause, rewind, and replay the at-home instructional media. Finally, they stressed how the method allows them to better meet the unique needs of their particular sets of students. Each of these advantages is consistent with previous reports in the literature regarding flipped classrooms. Interestingly, an oft-cited advantage to flipped learning in the literature is the
potential to use class time for deeper and more collaborative learning tasks (Bishop & Verleger, 2013), yet both participants did not speak to this. As was described in section 4.2, the participants use class time for students to work on what would have previously been homework, and so this is probably why they refrained from mentioning this. Having said that, they are observing considerable benefits even without transforming the in-class learning tasks. All in all, the findings suggest that teachers using flipped learning view the approach as having a distinct set of advantages that set it apart from traditional teaching methods.

4.4 Flipped Classroom Drawbacks

Much of the prominent literature regarding flipped classrooms neglects to mention any potential disadvantages of the approach, tending to portray flipped classrooms as being something akin to an educational panacea. However, the participants weren’t nearly so enamored with the technique, and were eager to point out its drawbacks. I report these drawbacks in this section, which are inequitable access to online multimedia, excessive teacher workload, and unsuitability for particular topics.

4.4.1 Access to Online Multimedia

As mentioned, Mark teaches at a school in which the students are predominantly from privileged socioeconomic backgrounds. In his words, “We’re pretty lucky here being a private school, since most of our kids have access to technology.” However, he went on to describe how not all of his kids have that access, as there are a small number of students who are able to attend the school via bursary for financial need. Those students, he said, are at a disadvantage because they don’t have the latest “gadgets”, and so “it takes a little more planning for them to watch the videos.” Since the ability to easily watch the videos outside of class is so crucial to keeping up with the content, he found the inequitable access troubling. Mark also acknowledged that this access issue must be a “bigger deal” at public schools. He went on, “Telling the kids to go to the
library everyday if they don’t have access at home seems like a recipe for disaster.” Brittany, too, reported inequitable access as a major disadvantage of flipped classrooms. However, she was less worried about students being forced to use the library, saying that she has students who do that everyday and still tell her that they like her teaching method. In addition, she provides students with USB drives containing her videos if they have access to a computer but not the Internet. Access was still a drawback for her though, “I’m not sure if everyone is telling me the truth sometimes about his or her tech access. So I worry about that.”

There do exist some mentions in the literature of inadequate access to technology as being a drawback of flipped classrooms. For example, it is discussed by Nielsen (2012) and Milman (2012) in their editorial analyses of the approach. However, most of the scholarly research examining the efficacy and perceptions of flipped classrooms avoids this issue via ensuring that the schools under study are populated by socioeconomically privileged students (Bishop & Verleger, 2013). That is, much of the research seems to intentionally avoid the reality that students do not share the same level of access to technology outside of class. For me, this makes the flipped classroom literature feel out of touch at best, and discriminatory at worst. Consequently, it was encouraging to see the participants acknowledge the access issue as being a significant drawback of flipped classrooms.

4.4.2 Teacher Workload

Both participants expressed concern that the workload required to set up and maintain their flipped classrooms might be unsustainable. They described how creating instructional multimedia is a labor-intensive process that adds a significant amount of work to their already busy schedules. Brittany, in particular, has found the workload especially burdensome. In her words, “I do like the methodology of it, but I find with a little one at home it’s tough to put the videos together and get everything prepared.” Mark agreed, “I think it’s a lot easier if you don’t
have a lot of outside commitments. It’s not easy putting together good online materials.” He also spoke at length about the challenge of making good multimedia:

It sounds easy – talk about that slide, talk about this slide. But then you go back over it and think to yourself, what have I missed? Do I want to include this or that? So, after you make them, you have to go over them. Maybe record them three, four, five times. You’ll use them once, and all of a sudden next year you think, ok, that worked or didn't work and then you have to change it around. So it can take up a lot of time.

Brittany, too, lamented the amount of work required to make good videos. Both seemed to agree that this might deter teachers from experimenting with flipped classrooms. Mark suggested that teachers should use pre-existing instructional media as a first step before they commit the time and effort toward making their own. This way, they can find out whether or not they like having their classrooms flipped. In his words, “They won’t get fooled by the ‘sunk cost’ fallacy, since it’s not too hard to find stuff online.” However, he stressed that the workload will become an issue as soon as they start making their own media. Both participants stated that the burden of producing content has prevented them from further expanding their use of a flipped approach.

The concern shared by the participants regarding teacher workload has been reported previously in the literature (Milman, 2012; Nielsen, 2012). Interestingly, Meyer et al. (2015) suggested that the recent explosion of online platforms aimed at ‘helping’ teachers create better flipped classroom content has actually made the problem worse. Now, they argued, there is so much new software for teachers to experiment with that they can become overwhelmed. That is, teachers might experience the workload burden before they even begin creating online instructional materials. The participants, luckily, both had some previous experience creating online media, and so decided to continue with what they knew rather than learn a new platform–
avoiding an even more burdensome workload. Overall, the participants both expressed concern regarding the workload demands of their flipped classrooms, agreeing that it was a major disadvantage of the teaching method.

### 4.4.3 Unsuitability for Particular Topics

Another drawback of flipped classrooms that emerged from the analysis was its unsuitability for particular topics. Mark only uses a flipped style for the chemistry and physics units of his science classes, opting for a ‘traditional’ arrangement for biology and earth sciences. He said that he tried doing flipped learning for everything, but he discovered that it didn't work well for topics that lacked “problem solving-type questions.” Furthermore, for biology and earth sciences, he said he prefers there to be student-teacher interaction during the lecture portion. In his words, “You want to get the class discussion going – build a solid group dynamic into the lecture.” When asked why he doesn’t value that type of interaction for the other topics, he said that he does value it, but that there was so much “procedural learning” in chemistry and physics that the students can learn just as well from the videos. Brittany agreed that flipped learning is better for topics that are heavy on calculations. In her words, “If it’s one of those topics where I’m using three boards to solve one problem, then it’s just so much easier to do it in video form. It’s better for them if they can control the pace.” She, too, when teaching the grade 9 and 10 biology and earth science units tends to not use flipped learning. However, both participants stated that if they knew of some way to make their online media more interactive, then they would be open to trying a flipped approach with these topics.

According to a large survey conducted by Sophia Learning and The Flipped Learning Network (2014), 71% of educators who teach via a flipped classroom are teachers of math or science (p. 1). However, there are no reports in the literature that I could find suggesting that these math and science teachers are only using a flipped approach for certain topics within their
classes. Consequently, the participants’ disclosure that they do not find flipped learning appropriate for all topics within a given course is a particularly interesting finding. Overall, they agreed that this was a major challenge teachers face when designing and maintaining their flipped classrooms.

4.4.4 Summary

The participants described a common set of flipped classroom drawbacks. Potentially inequitable access to online multimedia outside of class was one key disadvantage, while another was concern regarding the workload teachers face when creating their flipped classroom instructional multimedia. The participants’ focus on these drawbacks did not surprise me, as other researchers and writers have described similar issues with the approach. It was surprising, though, that the participants viewed the flipped classroom structure as being poorly suited for particular science topics, as this is not something that has been mentioned in the literature. In one sense, the lack of discussion on this issue is not unexpected considering how much of the writing on flipped classrooms carries a strongly promotional tone. All in all, the findings suggest that teachers using flipped learning view the approach as having a distinct set of drawbacks that subtract from their overall satisfaction with the teaching method.

4.5 Conclusion

In this chapter, I presented the findings of the study. I began with a description of the participants, detailing how they each teach considerably different student populations despite both using a flipped approach in their secondary science classrooms. Next, I detailed the findings, which I organized thematically. These themes were: 1) flipped classroom structures; 2) flipped classroom advantages; and 3) flipped classroom drawbacks. The findings related to each theme were reported via a series of subthemes, and were compared with the flipped classroom literature.
The first finding was that the participants described using flipped classroom structures that are both similar to each other and to those from the literature. They both invest time and effort to create unique instructional media, which they post online for their students to view outside of class. Although differing in their preferred formats – Mark creates narrated PowerPoints while Brittany produces multi-camera videos – both participants use their online media as a replacement for in-class direct instruction. They do not, however, utilize any of the more recent online platforms that enable instructional media to be more interactive and assessment-rich. For their in-class component, the participants both have students work on tasks that would have previously been ‘homework’. That is, they do not take advantage of the extra time in the group learning space to design tasks that are potentially more meaningful and collaborative. This is significant, as proponents of flipped classrooms often describe the ability to assign such tasks as a major benefit of the approach. Overall, the participants reported structuring their flipped classrooms in ways that are generally consistent with the literature, but are not as ambitious as they could be in terms of their use of class time.

Another finding from the study was the advantages of the approach as experienced by the participants. Both participants indicated that they value the increased student-teacher interaction made possible through flipping. Since they spend minimal time speaking in front of the class, they have ample opportunity to circulate amongst the students and work with them on a one-on-one or small group basis. They felt this ability greatly improved the learning environment of their classes. Another advantage that they reported was the potential for students to control the pace at which they experience direct instruction. Students are able to pause, rewind, and replay the online instructional media, which is of course impossible during ‘live’ direct instruction. Both participants agreed that this self-pacing ability is beneficial to student learning. Finally, the
participants described how a flipped classroom allows them to better meet the unique needs of their students. For Mark, this means he can make more efficient use of his students’ limited available time outside of class, while for Brittany this means she can better accommodate her students’ diverse learning needs. In general, these three advantages are echoed in the flipped classroom literature. Again, since the participants were not using their class time for novel learning tasks, they neglected to mention this oft-reported flipped classroom benefit.

The final finding from the study was that the participants experience significant drawbacks to flipped classrooms. Firstly, the participants described how the approach has the potential to be inequitable when used in classes with students from diverse socioeconomic backgrounds. That is, some students may have better access to the online instructional materials compared to others. Second, the participants expressed concern regarding the workload required to setup and maintain their flipped classrooms. Specifically, a considerable amount of the time and effort is necessary to produce quality instructional multimedia. The participants indicated that this gives them pause about continuing with the approach. Lastly, according to the participants, flipped classrooms do not work well for certain science topics. They reported using a flipped approach for topics more reliant upon calculations and problem solving, like chemistry and physics, while avoiding its use for topics like biology and earth sciences. Interestingly, inequitable access to online materials and excessive teacher workload are drawbacks that have precedent in the literature, while the finding regarding topic unsuitability does not. Overall, the participants described a series of drawbacks that cause them to frequently reconsider whether they want to continue using the teaching method.

In Chapter Five, I will describe the implications of this study for the educational community, as well as for myself as a researcher and teacher. I will also present some
recommendations for future research based on questions that arose as a result of this work. Finally, I will make some concluding comments regarding the findings and their general significance.

CHAPTER FIVE: IMPLICATIONS

5.0 Introduction

This chapter describes the study’s implications. I begin by presenting an overview and summary of the study’s key findings for the purpose of providing the reader with some context for the subsequent discussion. Next, I describe the implications of the study for the broader educational community as well as for myself as an educator. I then outline a set of recommendations that emerged from the study regarding flipped classrooms, which are aimed at teachers interested in using this pedagogical approach. Finally, I identity some priorities for future flipped classroom research, and conclude with some final thoughts on the study and its significance.

5.1 Overview of Key Findings

In this study, I interviewed two secondary-level science teachers with experience using a flipped classroom approach for the purpose of investigating their perceptions of this teaching technique. Three central themes resulted from my analysis of these interviews: flipped classroom structures; 2) flipped classroom advantages; and 3) flipped classroom drawbacks. Each of these themes contained findings that were of significance.

Firstly, both participants reported structuring their flipped classrooms in ways that are generally consistent with the literature, but are not as ambitious as they could be in terms of their use of class time. That is, they both create online instructional media for their students to watch outside of class time, but do not use the resulting extra time in the group learning space to deploy
tasks that are potentially more meaningful and collaborative. Instead, they use class time for
students to complete what would have previously been homework, which is a departure from the
flipped classroom best practices described in the literature. Both participants indicated that
students are happy with their current approach, and so do not see the need to develop the higher
order learning tasks suggested by most flipped classroom proponents.

A second finding from the study was the advantages of the approach as experienced by
the participants. As opposed to the myriad purported advantages reported in the literature, the
participants described a more modest set of three flipped classroom benefits. Firstly, both
participants value the increased student-teacher interaction made possible through flipping,
which they feel greatly improves the learning environments of their classes. Secondly, the
participants appreciate how flipping allows students to control the pace at which they experience
direct instruction as students can pause, rewind, and replay the online instructional media. Both
indicated that they view this as being beneficial to student learning. Finally, the participants
described how using a flipped classroom allows them to better meet the unique needs of their
students. This advantage manifests for one participant as the ability to make more efficient use of
students’ limited available time outside of class, while for the other, this means they can better
accommodate students’ diverse learning needs.

The third major finding from the study was that the participants experience significant
drawbacks to flipped classrooms. They reported concern for the potential inequity of the
approach, as some students may have better access to the online instructional media compared to
others. Furthermore, the participants expressed reservation regarding the workload required to
set up and maintain their flipped classrooms, with the time and effort necessary to produce
quality online instructional media being of particular concern. Finally, according to the
participants, flipped classrooms do not work well for certain science topics. They reported using a flipped approach for topics more reliant upon calculations and problem solving, such as chemistry and physics, while avoiding its use for topics such as biology and earth sciences. These findings regarding flipped classroom disadvantages are significant, as much of the literature is skewed towards the promotion of the approach and tends to overlook or downplay its drawbacks.

5.2 Implications

In this section, I describe the implications of the study. I first discuss the implications for the educational community at large, and then comment on the implications for myself as an educator.

5.2.1 For the Educational Community

There is no doubt that flipped classrooms are becoming increasingly popular. According to an online survey of 2,358 teachers conducted by Sophia Learning and The Flipped Learning Network (2014), the percentage of respondents who recognized the term “flipped learning” increased from 74% to 96% between 2012 and 2014. Additionally, the body of flipped classroom literature has been overwhelmingly promotional in its tone, tending to give significantly more credence to advantages than to drawbacks. Taken together, this rapidly increasing popularity and substantially positive literature make flipped classrooms appear more like an educational fad than a serious new pedagogy. This is unfortunate, as flipped classrooms undoubtedly have potential to improve student learning, but may be discarded in a wave of backlash if the promised overabundance of benefits fail to materialize. For flipped classrooms to grow sustainably, they need to be investigated in a manner that is both more thorough and more balanced than has been occurring to date. This will allow educators to be more deeply informed about the totality of the approach, and thus more capable of weathering potential setbacks.
Toward this end, the findings of this study provide some intriguing insights for the educational community.

The finding that the participants were not using the newly available time in the group learning space to have their students complete deeper and more collaborative learning tasks should give educators some pause about flipping. As an example, school administrators who are promoting flipping to their teachers based on the notion that it will provide students with enhanced in-class learning opportunities, might be setting themselves up for disappointment. Simply put, designing and implementing these new and presumably improved in-class activities is difficult and time-consuming. Many teachers, like the participants in this study, might not see the value in taking on this work. Furthermore, teachers must do this while also undertaking the formidable task of creating quality online instructional media. As reported by the participants, the time and effort required to do this is problematic even without the added burden of creating enhanced in-class learning tasks. This reality points to teachers needing more resources and support than they currently receive if the full benefits of a flipped approach are sought. Those in the educational community interested in flipping should keep this in mind when considering moving toward this teaching style.

5.2.2 For Myself as an Educator

I was drawn to investigating flipped classrooms as a result of my own disappointing experiences as a science student, and I wondered if using a flipped approach might be the answer. Due to the overwhelmingly positive nature of the literature, I initially thought that flipped classrooms represented an unequivocal improvement over more traditional teaching styles. However, through conducting this study, I have developed a more nuanced understanding of the teaching method. The findings regarding flipped classroom advantages – especially those related to student-teacher interaction – are certainly encouraging, but they are somewhat offset
by the findings concerning the drawbacks of the method. In particular, the finding that the participants have concerns about the equity of their flipped classrooms is significantly troubling on a personal level. My philosophy of education is based upon the notion that equity is paramount, and my goal is for all students to be successful and reach their full potential. Consequently, based on the study’s findings, I will only consider using a flipped approach in my future practice if I can guarantee that all students have sufficient access to the online instructional media. Unfortunately, I only foresee this being achievable if students are issued web-enabled mobile devices (for example, iPads with a data plan), which is hardly realistic. Under any other circumstance there will surely be some students who have better access than others, either in terms of Internet connection reliability or mobile device quality. As such, it is unlikely that I will use a flipped approach in my future teaching practice.

5.3 Recommendations

Based on the findings of this study, educators should consider the following when contemplating flipping their classrooms:

- A substantial initial time investment related to learning *how* to create effective online instructional media will be required, as will a further time investment regarding actually creating that media.
- For the benefits of a flipped classroom to be maximized, newly available in-class time must be used for fostering a dynamic, interactive learning environment where the teacher guides students as they apply concepts and engage creatively in the subject matter.
- A further substantial time investment will be required for creating appropriate activities for this new learning environment.
• Ensuring equitable access to online instructional materials will be challenging, and potentially impossible in schools with insufficient resources

If taken into account, these considerations will better prepare teachers for the realities of designing and implementing a flipped classroom.

5.4 Areas for Further Research

There is a dearth of rigorous literature regarding nearly every aspect of flipped classrooms, and so there are a multitude of potential avenues for future research. For me, there are two critical unanswered questions that rise above the rest:

1. Do flipped classrooms improve student learning?
2. How can teachers learn how to implement a truly flipped classroom?

It is by no mistake that these two questions appear rather foundational – flipped classrooms really are that unstudied. Despite their rapid proliferation, there is a lack of basic evidence supporting the effectiveness of flipped classrooms. We simply do not know if they enhance or perhaps degrade student learning. Consequently, large-scale research of both a quantitative and qualitative nature comparing a broad spectrum of student success criteria in flipped and non-flipped classrooms is badly needed. Furthermore, as indicated by question two, it is unclear whether teachers can reasonably be expected to implement true flipped classrooms at all.

Producing effective online instructional media requires a skillset that does not necessarily overlap with those of traditionally trained teachers. In addition, leveraging the newly created expanse of class time for the deployment of deeper and more collaborative learning tasks is a daunting proposition for most teachers. As a result, considerable further research investigating possible solutions to these issues is required if flipped classrooms are to thrive. Overall, there are
fundamental unanswered questions about flipped classrooms that must be addressed for the approach to be considered a serious pedagogy.

5.5 Concluding Comments

In this study, I investigated how secondary-level science teachers perceive their flipped classrooms, uncovering the ways in which they implement their flipped models along with their views on advantages and drawbacks of the approach. The participants reported structuring their flipped classrooms in ways that were generally similar to those in the literature, but without the key inclusion of higher-level in-class learning tasks. As such, these implementations lacked one of the most significant purported benefits of the approach. This finding is significant for administrators keen to promote the approach amongst their staff, as moving direct instruction outside of class does not necessarily equate to better use of class time. Even without this crucial aspect of flipped classroom best practice, the participants nonetheless reported experiencing noteworthy advantages to the approach. Namely, they lauded the increased student-teacher interaction, the self-paced nature of the direct instruction, and the enhanced opportunities to meet individual student needs. These advantages were tempered with concerns about equity, teacher workload, and curriculum suitability. For me, the equity issue is particularly problematic, and gives me considerable pause about using a flipped approach in my future teaching practice. To conclude, although flipped classrooms are far from being the educational panacea that the literature would suggest, they still hold considerable potential for improving student learning in science and beyond.
Date: October 2015

Dear ________________,

I am a graduate student at OISE, University of Toronto, and am currently enrolled as a Master of Teaching candidate. I am studying the effects of flipped classrooms on student learning for the purposes of investigating an educational topic as a major assignment for our program. I think that your knowledge and experience will provide insights into this topic.

I am writing a report on this study as a requirement of the Master of Teaching Program. My course instructor who is providing support for the process this year is Arlo Kempf. The purpose of this requirement is to allow us to become familiar with a variety of ways to do research. My data collection consists of a 40-minute interview that will be tape-recorded. I would be grateful if you would allow me to interview you at a place and time convenient to you. I can conduct the interview at your office or workplace, in a public place, or anywhere else that you might prefer.

The contents of this interview will be used for my assignment, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a conference or publication. I will not use your name or anything else that might identify you in my written work, oral presentations, or publications. This information remains confidential. The only people who will have access to my assignment work will be my research supervisor and my course instructor. You are free to change your mind at any time, and to withdraw even after you have consented to participate. You may decline to answer any specific questions. I will destroy the tape recording after the paper has been presented and/or published which may take up to five years after the data has been collected. There are no known risks or benefits to you for assisting in the project, and I will share with you a copy of my notes to ensure accuracy.

Please sign the attached form, if you agree to be interviewed. The second copy is for your records. Thank you very much for your help.

Yours sincerely,

Matt Caicco

416-356-7685, matt.caicco@mail.utoronto.ca

Instructor’s Name: Arlo Kempf, arlo.kempf@utoronto.ca
Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw at any time without penalty.

I have read the letter provided to me by Matt Caicco and agree to participate in an interview for the purposes described.

Signature: ______________________________________

Name (printed): __________________________________

Date: _____________________
APPENDIX B: INTERVIEW PROTOCOL

Section A: Background:

1. A) For how long have you been teaching?
   
   B) What grades/subjects do you teach?
   
   C) Can you please describe a typical day in your classroom, in terms of what the students are doing and what you are doing?

Section B: What/How?

2. What is a flipped approach to teaching?

3. What have you done to flip your classroom?

4. A) How do you use video in your class(es)?
   
   B) For how long have you been doing this?

5. A) What specific tools and resources do you use in your flipped classroom?
   
   B) Where do you get these tools and resources and how were you made aware of them?

Section C: Why?

6. A) Why did you get involved in flipped learning? How did this process happen?
   
   B) Did you learn about flipped classrooms during your teacher preparation program?

7. Would you recommend the use of a flipped model for other teachers? Why or why not?

Section D: Benefits/Drawbacks

8. What indicators do you look for to measure your students’ learning?

9. To what extent do you think the flipped classroom model helps or hinders:
   
   A) Student Motivation/Engagement
   
   B) Student Self-Regulation/Self-Reflection
   
   C) Student content regulation/understanding of the curriculum
10. Do you find the flipped model tends to work particularly well with a specific type of student? Contrastingly, do you think it hinders learning for a specific type of student?

11. What are the most significant challenges of implementing a flipped classroom?

12. What are the most significant advantages of implementing a flipped classroom?

Section E: Next Steps

13. A) Where do you see the future of flipped teaching going? Why?

   B) Where would you like to see it go? Why?

14. To what extent should learning about flipped classrooms be a part of teacher preparation programs in the future?

15. What advice would you offer to a teacher who is new to flipping their classroom?
REFERENCES


Bergmann, J., & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. Eugene, OR: ISTE.


