Aurora
Action Research Community Of Practice

Annual Report
2016-17

Volume 2

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Table of Contents

Working to Reshape Teacher Professional Learning

Jim Parsons

Jim Parsons is Professor Emeritus from the University of Alberta, where he taught for more than 40 years. He lives in Comox, British Columbia, and continues to teach research and work with in-service teachers.

Teachers either seem to fear research or they have come to believe that research is someone else's job, while their job is teaching. Once upon a time, teachers' professional learning seemed confined to undergraduate education, where they "trained" to become teachers, and to in-service education, where they attended expert-given presentations, where they learned to apply others' ideas to their own practice. Professional development was "other-driven," and at the end of the day teachers remained second in their own practice. Several years ago, I had the pleasure to co-author a social studies textbook on Greece with a long-time grade 6 teacher. He confided to me how much he enjoyed talking to other teachers about his part in that project because "it was the first time in my entire career where I talked to other teachers about what I did."

The Alberta Initiative for School Improvement (AISI), which provided funding for schools to enhance teaching and improve student learning for 14 years from 1999-2013, changed Alberta's teaching and learning landscape. I was among those who changed. Throughout my work with AISI teachers (I was Director for the University of Alberta's AISI work), I came to see teachers grow to become on-site instructional leaders in their schools and school districts. The AISI teachers I worked with became more knowledgeable about research, more confident, more engaged, and more learned. They also became less cynical. In all ways, their students benefitted.

As I watched AISI teachers prove to themselves that they could, in fact, become researchers who improved their own practice and positively impacted student learning, my philosophy, my beliefs, and my practice changed about how teachers should engage their own professional learning. To be truthful, before AISI I really hadn't thought much about teacher professional learning. I did my work as a university professor: I taught my undergraduate courses and worked with teachers who invited me into their schools or to present at their conferences. I trust I was helpful, but my work was from another way of thinking. I am not certain I mattered much.

Over the past two years, the work we have done together in partnership with teachers at Aurora Charter School represents a newer way to engage teacher professional learning. More than two years ago now, Dale Bischoff (Superintendent at Aurora Charter School) asked if I would work with teachers from Aurora Charter School and other Edmonton-area charter schools to help them engage in action research projects of their own

choosing. I agreed, and this book represents the end of our second year of this work. The articles contained here represent the collaborations of a growing community of practice made up of teachers who have partnered with each other and who have shared their research findings.

It is remarkable that these teachers engaged these action research projects at the same time as they taught. Little changed in their loads, with one exception: their Superintendent hired substitute teachers for the days of our meetings – which happened about twice every three months over the 2016-17 school year. Despite their busy teaching schedules, the teachers worked together to design, create, and complete action research projects – the results of which are collected in this compendium.

My job was to work with these teachers to create an organizational structure, to support their research plans, to help them address issues that might arise, and to help them edit their work – both for content and for style. It was a coaching role that, as a graduate student research supervisor at the University of Alberta, I had engaged many times during my 40-year career as a university professor and researcher. However, in this work, I was with full-time teachers in their own classrooms.

I note the nature of this coaching because the change of relationship speaks to the paradigm shift that my coaching role represents for teacher professional learning work I noted earlier in this chapter. I was an "expert" because I had much research experience to draw upon as I dialogued with teachers. But I was not the researcher: they were. I was not in charge. This change of relationship speaks to a new way to work I had written about in a co-authored article with Dennis Shirley (author of *The Global Fourth Way*) titled "Uplifting the Teaching Profession" in *The Canadian Journal for Teacher Research* (Posted: December 12, 2013). In that article, we stated our belief that educational policy and educational research must always be addressed "with teachers in the room."

We listed several things we had come to believe from our work with teachers. Specifically, Dennis and I had come to believe the conditions under which teachers work should not be removed from their abilities to help students learn and that teachers needed more effective ways to focus on their core task of improving teaching and learning. In that short article, we noted that engaged collaborative/creative thinking was needed to forward student learning and to re-shape schools into the kinds of places where we wanted to work. The work at Aurora Charter School with these teachers represented the type of engaged, creative collaboration we spoke to four years earlier.

A second thing we shared was our belief that educational improvement must be practical and collaborative. Obviously teachers, schools, and students differ, but our research had suggested that, when teachers work together, student learning improves. Specifically, my own research on teacher professional learning and teacher efficacy in Alberta found that teachers believed "collaboration with colleagues" – learning to work together through mutual engagement – helped them improve their teaching by opening spaces where they shared their practices and insights with other teachers. The process

we had engaged with Aurora Charter School, even with all its hic-ups, was a collaborative representation of a new philosophy of teacher professional learning.

Our work came with a number of powerful concomitant engagements. When teachers engaged each other, learning was improved. In short, we learned from each other's work because we saw our colleague's action research project reflected in the mirror of our own classroom life. It was always about the collaborative group, and it was always about the individual teacher in the context of that teacher's individual classroom.

In the past, teacher professional learning centered on moving decontextualized "best practice" from one teacher and school to another teacher and school. Traditional professional development practices largely transferred knowledge from an expert to an audience – and teachers were that audience. But research shows that identifying one's self as an audience is rarely an effective path towards professional learning. We know that, when our children are more active and engaged, they will learn more. However, we had not engaged this same philosophy with our teachers. The collaborative work we did at Aurora Charter School represented a new way of professional learning. Obviously, we didn't do it perfectly, but we understood that these teachers, as new as they might be to research, came full of experience and insights – not empty. Although we were different as teachers, we all lived and worked in schools – and this fact was the beginning of our building of communities of shared practice. We learned from one another.

Our learning had three key characteristics. First, it involved sharing our mutual insights about practice with others. Second, it believed teachers should collaborate because they had something to offer the community and, when we shared what we knew, our learning would benefit. Third, our work was empirical. That is, it was inquiry-informed, and teachers were learning to become researchers. These grassroots action research projects were primarily collaborative – as Kurt Lewin envisioned the groundings for Action Research more than seventy years ago. Our small community of practice was a collaborative space where teachers had chosen to interact with each other and to open themselves to influence from others they saw as having something helpful to share.

Dennis and I had come to believe that the non-interactive transmissions of "good" practice offered during isolated professional development events that focused more upon what teachers did and less upon what teachers knew were poor ways to improve teaching and learning. Rather than independent, one-sided transfers of so-called best practice, our teachers' partnership at Aurora Charter School engaged in interdependent, mutual, and transformative conversations of shared practice. These teachers grew to become more competent partners of created and shared professional capital, fuelled by the collective purpose of improving children's learning. These are the marks of teacher professionalism that dare evaluate and challenge what works or doesn't work for our children. We were all teachers learning together.

Finally, our work together was grounded on the belief that working together could make a difference. And, in a small way, although we never spoke it, our work was our way to stand up to be counted as a force for educational transformation. The partnership of

collaboration helped us identify needs and implement educational improvement at the very sites we cared about – our own classrooms. We worked to create higher standards for teaching and learning, clearly improved educational practice, and spaces for learning-centered conversations about teaching and learning as we drew insights from a variety of sources [literature reviews] that furthered our teaching and learning discussions.

The result is this compendium of work. We hope this work helps other teachers choose to build spaces to become more collaborative. Obviously, the individual research projects outlined here represent learning for the teacher-researchers who carried them out. But, they did something more: they represented active incarnations of the belief that teachers should no longer remain isolated, cloistered from colleagues with common interests. They represent the belief that teachers' work will improve as they offer, receive, share, and discuss their own practices. They represent the belief that reflective improvement in teaching and learning can become embedded, ongoing, and sustainable. Finally, this work is an example that teachers can benefit from creating spaces to create, challenge, and support collegial sharing focused upon teaching and learning practices.

The work you see here represents a collaborative inquiry that engaged teachers in action research (defined broadly) about teaching and learning as a means of building agency and informed practice. Our shared goal was to find better ways to teach so as to help our students learn. In our beginning way, we were a collaborative problem-solving group working to build a shared way to talk about teaching. Our discourse community of practice was the beginning of knowledge construction about teaching and learning that emerges from systematically considering practice, based upon the beliefs that teachers should be part of that consideration and that we all will benefit from sharing insights from the pursuits of our common interests.

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Energy Knowledge and Misconceptions in Grade 8 students

By Peter Dang and Vanessa Tran

Peter Dang has been a science teacher for grades 6 to 9 at Aurora Academic Charter School since 2001 and is now also Assistant Principal for the Middle School. He is active and enjoys skiing and snowboarding in Edmonton's winter," movies, solving Rubik's cubes and Sudoku problems, and making things explode.

Vanessa Tran has taught mostly junior high mathematics at Aurora Charter School since 2006. She graduated from the University of Alberta with a Bachelor of Science and Bachelor of Education After Degree and is currently working on her Masters in Secondary Education Mathematics at the same university. She is interested in applying, incorporating and implementing technology into her mathematics classroom for better student learning. In her spare time, she enjoys a good mystery show or travelling with friends.

Key Question: *How can concrete hands-on experience with energy technology improve student understanding and remove misconceptions and myths of real-world applications?*

Abstract

Famed science philosopher Karl Pop once stated, “Science must begin with myths, and with the criticisms of myths”. With the building expansion of Aurora Academic Charter Middle School, solar panels were installed on the roof with access from one classroom in the new junior high wing. Solar energy experts shared the related technological tools available with students, peaking an interest to determine how much students know or believe to be true about energy consumption and solar energy. Graphical representations and programs available with the solar panels and electrical meter reading tools (Figure 3 and Figure 4) were used for the math and science assignments for students to generate data that they then analyzed.

The installation of the solar panels and the work students did with these panels became part of research that studied the results of students' scientific learning. Prior to the study, the test group students were surveyed for their knowledge of energy production and consumption and what they perceived to be true. Then they were taught math and science lessons involving electrical energy and graphical representations of energy production and consumption. The students were surveyed again about what they had learned and if their misconceptions had been nullified. The findings indicated a noticeable increase of correct answers in the post-study survey compared to the pre-study survey. The students involved in this study demonstrated a significant shift in knowledge and preconceived myths related to energy production and consumption, indicating that many of the students had their misconceptions nullified as their knowledge expanded on this topic

Keywords: Electricity Misconceptions, Middle School, Technology, Real-World Applications, Solar Energy, Energy

Context

This action research project aimed to gather what typical grade eight students in a Canadian urban middle school perceived as energy conservation, energy production, and the myths that students believe to surround them. Hands-on experience and group experiments in math and science lessons allowed students to research and test their own theories and questions. Students continued to receive math lessons (Mathematics 8 Alberta Education Statistics and Probability Strand; Specific Outcome 1 and Mathematics 7-9 Alberta Education Statistics and Probability Strand; General Outcome: Collect, display, and analyze data to solve problems) to critique ways in which data is presented in different graphs, explaining how the format such as the axis intervals and bar width might lead to misinterpretation of the data and lessons on the use of solar panels to generate electricity and analysis of electrical energy consumption in small household appliances (Science 5 Electricity; Science 7: Environmental Sustainability; Science 8: Lights and Optics - Energy Consumption; Science 9: Electrical Technologies).

Differences from the pre-test perceptions and post-test knowledge following the concrete experience helped determine the impact of hands-on learning on changing common beliefs about energy. The pre-test and post-test questionnaires reflected student attitudes, energy production via solar and coal-based technologies, environmental impact, and financial impact of energy usage of typical home appliances.

Aims and Objectives

By critically analyzing students' perceptions about the myths of energy usage before and after the lessons, conclusions were drawn about how these myths have changed (if at all) and how science and math teachers can better teach students to relate myths versus real-world knowledge and applications.

The hands-on exploration activities gave students opportunities to constructively create knowledge and draw their own conclusions related to common household appliances' energy consumption and solar energy production and use.

Literature Review

One of the most basic tenants of physical science is that energy is never created nor destroyed, but changed in form or transferred. In essence, energy is conserved in various manners. Tatar and Oktay (2007) concluded that, despite the relative importance of energy in society, "students' mistakes in usage can have detrimental influence on the scientific comprehension of the energy conservation principle" (p. 87). With the importance of facts as foundations for science and math learning, one can see how student's misconceptions could continue to hinder a better understanding of this topic for the rest of their lives.

Brook and Driver (1984), using a group of 15-year old students, found that opinions and beliefs regarding energy conservation were grossly inaccurate. Approximately two thirds

of students stated that energy was used up or lost (which is incorrect). Hermann-Abell and DeBoer's (2011) study on students' misconceptions in science showed that, "in some cases, students were more likely to know a general principle than they were to know how to apply that principle to specific instances. The results also showed that some misconceptions about energy are prevalent at all grade levels" (p. 11).

With ample studies pointing out the dangers of students' misconceptions and their possible long-term effects on learning, work was done to move students in a positive direction and correct these misconceptions. Students can benefit from understanding how their schools use and waste energy and, most importantly, be effective, enthusiastic advocates for increased energy efficiency efforts. The key element is effective education that engages and teaches students (Harrigan, 2014). The cornerstone of reversing the effects of misconception seems to be active exposure to real science with a variety of experts and fact-checked information.

Abdi (2006) suggested several important approaches to foster a climate of inquiry, including giving children opportunities to debate the pros and cons of an event, an activity, or an experiment with each other and the teacher, making sure a new concept is applicable and relevant, relating the new concept to a real-life situation (if possible), letting children engage in self-clarification of their own views and explain the new concept correctly and scientifically. To prevent further propagation of misconceptions in science, teachers must do their best to avoid giving confusing, ambiguous, or incorrect explanations, alerting them to the notion that what may seem so obvious may have no scientific basis.

Methodology

The study location was a medium-sized middle school in Edmonton, Alberta, Canada. Edmonton is one of the most northern capital cities in Canada and this northern latitude plays a significant role in the students' misconceptions of energy production and generation. The school recently constructed a new wing with several environmentally-friendly features built into it. One of those features is an array of solar panels (Figure 1) installed on the roof.

Figure 1. Teacher with students with the rooftop solar panels

In the Foods Lab, a system of meters connects to the circuit panel to measure the current (measured in amps) used by each student chosen household device (microwaves, personal handheld devices, heaters, fans, rechargeable batteries and countertop cooking appliances). Both the solar panel electrical generation and the household devices electrical consumption were monitored through separate web-based

software (Figure 3 and Figure 4).

The test group is one class of three grade eight classes. There were 23 students in this class and the average age of the student was 14-years old. Many students had been at this school since elementary grades. This age group had demonstrated a strong affinity to and competency with technology.

Pre-and Post Test Questionnaire

The test group was given a short pre-test questionnaire (Appendix I) to gauge their knowledge of energy production and consumption. The questionnaire surveyed students' knowledge about facts, common myths, and misconceptions about solar energy and energy consumption of real-world applications. Students also provided opinions and thoughts related to what they currently knew about different sources of energy production and indicated interest areas for future exploration.

In the post-test questionnaire (Appendix II), students answered the same 12 questions from the pre-test. They also provided reflections about their previous opinions and thoughts related to what they know about different sources of energy production and what they learned in their indicated interest areas following the exploration activities. All pre-test and post-test questionnaires were scanned and saved digitally for comparison with students' names removed and replaced with a student ID.

Electrical Energy Consumption Experiment

The test group was broken into small teams and each team brought three brands of a specific device to test energy consumption with the meters in the Foods Lab. Devices included: space heaters, battery rechargers, countertop cooking appliances, microwaves, fans, and personal handheld devices. Students plugged them in, turned them on for 15 minutes to a predetermined setting, and then monitored their energy consumption (Figure 3). Students analyzed their data and discussed their findings with each other.

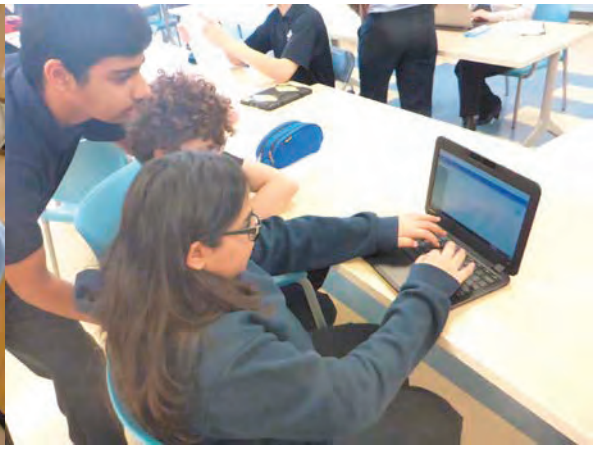

Figure 2. Students monitoring electrical consumption of various devices in the Foods Lab using an online software.

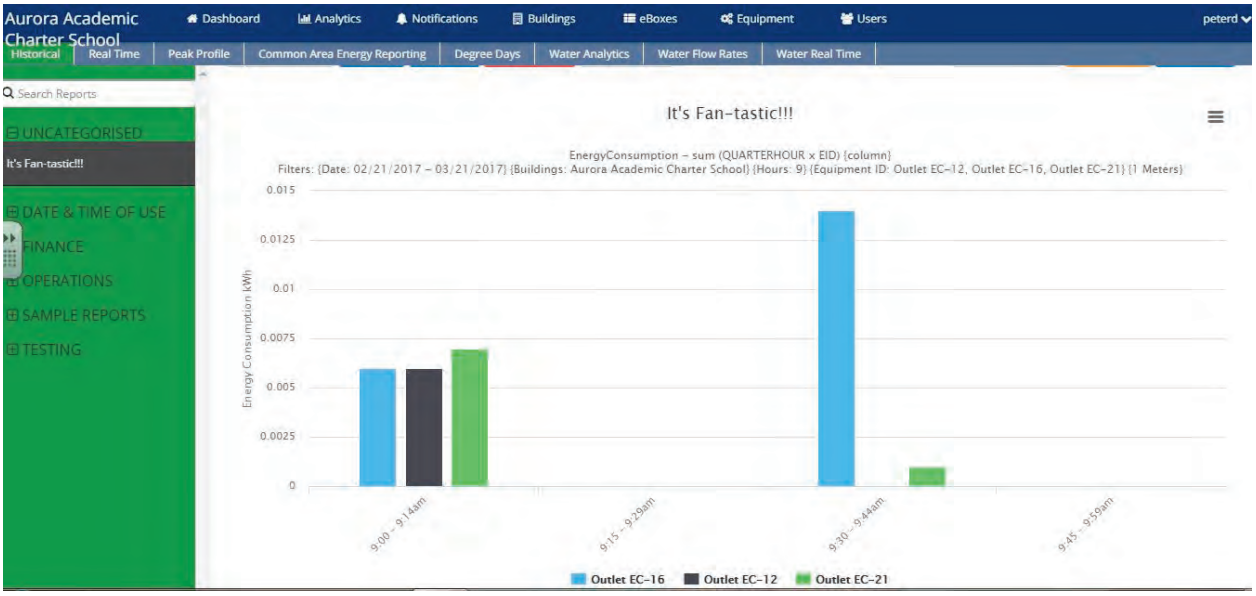

Figure 3. Sample software monitoring and analyzing electrical consumption in the Foods Lab

Solar Energy Generation Analysis

The test group was allowed to inspect the solar panels on the school's rooftop and were taught the science of solar energy electricity generation and the software used to monitor the solar panels in real-time. Students analyzed the electrical generation of the solar panels over a two-month period from mid-January 2017 to mid-March 2017. They compared the day of the highest electrical generation on an intensely sunny day (February 15, 2017) with the day of the lowest electrical generation due to cloud coverage (February 7, 2017). Factors such as time of year with snow cover, the weather, and sun exposure that day were discussed as a class. Students researched the meteorological reports of those days to gain a better understanding of how the local climate, northern latitude, and weather played pivotal roles in the solar energy to electrical energy conversion.

Using the going rate of electricity from EPCOR during those two days, students also compared the cost of electrical energy consumed by their household devices from the previous experiment to how much the school made if it was to sell the excess electricity generated by the solar panels.

Figure 4. Screen shot of solar panel monitoring software

Results

From the 12 questions regarding the facts, myths and misconceptions students were asked in the pre-survey and post-survey, 13 of the 23 students (56.52%) improved on the post-test questionnaire, three decreased (13.04%), and seven received the same score (30.43%). Overall, more students answered each question correctly on the post-test questionnaire. Nine of the 12 questions had an increase of correct responses on the post-test questionnaire with five increasing over 10%.

The three questions with a decrease in correct responses were questions five, six, and 10. The questions related solar energy to commercial graphical representations. Question eight, related to the EnerGuide label (The EnerGuide label on appliances are (**accurate / inaccurate**), had the lowest correct responses: only one student on the pre-test and two on the post-test answered the question correctly.

Student ID	1	2	3	4	5	6	7	8	9	10	11	12	F
1	✓	✓	X ✓	✓	✓	XX	✓	XX	✓ X	✓	✓	✓	
2	✓	✓	X ✓	✓	✓	XX	✓	XX	✓	✓	✓ X	✓	
3	✓	✓	✓	✓ X	✓	X X	XX	XX	✓ X	✓	✓ X	✓	
4	✓	✓ X	✓	X ✓	✓ X	X ✓	✓	XX	X ✓	✓	X ✓	✓	
5	✓	✓	✓	✓	X ✓	✓	✓	XX	✓	XX	✓	✓	
6	X✓	XX	X ✓	✓	XX	✓ X	X✓	XX	✓X	✓	✓	✓	
7	✓	✓	✓	✓	✓	✓	✓	XX	XX	✓	✓	✓	
8	✓ X	✓	X✓	X✓	X✓	XX	✓	XX	X✓	✓	✓ X	✓	
9	✓	✓	✓	✓	✓	XX	X✓	XX	X✓	✓	✓	✓	
10	✓X	✓X	✓	XX	✓X	✓	X✓	X✓	X✓	✓	✓	✓	
11	X✓	X✓	✓	✓	✓X	X✓	✓	XX	✓	✓	✓	✓	
12	✓	X✓	XX	✓	X✓	XX	✓	XX	XX	✓	✓	✓	
13	✓	✓	✓	✓	✓	X✓	✓	XX	✓	✓	✓	✓	
14	✓	X✓	✓	✓	✓	XX	✓	X-	✓X	✓	✓	✓	
15	X✓	✓	XX	✓	XX	✓X	✓	XX	X✓	X✓	✓	✓X	
16	✓	✓	XX	X✓	✓X	✓X	XX	XX	✓	✓	✓	✓	
17	X✓	✓	✓	✓	✓	XX	✓	XX	X✓	X✓	XX	✓	
18	✓	X✓	✓	-X	✓	✓	XX	XX	✓X	XX	✓	✓	
19	X✓	X✓	✓	X✓	✓X	XX	✓	X✓	X✓	✓	✓	✓	
20	✓	✓	X✓	X✓	X✓	XX	✓X	XX	✓	✓	✓	✓X	
21	X✓	X✓	XX	✓	XX	✓	✓	✓X	✓X	✓X	✓	✓	
22	X✓	✓	X✓	✓	✓	✓ X	X✓	XX	XX	X✓	✓	✓	
23	✓	✓	✓	XX	✓	XX	✓	XX	X✓	✓ X	✓	✓	
Changed to ✓	7	6	6	5	4	2	4	2	8	3	1		
Changed to X	2	2		1	5	4	1	1	5	2	3	2	
Still XX		1	4	3	3	11	3	20	3	2	1		
Pre-test correct	16	16	13	15	16	9	16	1	12	18	21	23	F
Post-test correct	21	20	19	19	15	8	19	2	14	19	19	21	L
													S
Pre-Test correct	69.57%	69.57%	56.52%	65.22%	69.57%	39.13%	69.57%	4.35%	52.17%	78.26%	91.30%	100.00%	
Post-test correct	91.30%	86.96%	82.61%	82.61%	65.22%	34.78%	82.61%	8.70%	60.87%	82.61%	82.61%	91.30%	

Legend: ✓= correct for both pre- and post test

X✓= incorrect for pre-test and correct for post test

✓X = correct for pre-test and incorrect for post test

XX = incorrect for both pre- and post test

Table 1: Pre- and Post Test Results

Outcomes and Findings

The data suggested that students significantly increased both their knowledge of energy consumption and generation and shifted misconceptions of these paradigms. Students seemed to understand how electrical energy consumption is affected by choice of device used and how long they used it for. They developed a better understanding of how solar energy generation worked using solar panels (Question 1) and many misconceptions

were debunked.

Students also reflected in the post-test that they learned more about solar energy. They determined that the energy consumption of household appliances varies drastically; and, in some cases, depended on brand/model and age. Reflections also indicated students were able to correct their misconceptions that solar panels only work on sunny and warm days. Many students also stated that they came to realize that energy consumption might not appear to be a lot during a short duration of time, but savings add up over long periods of times. These reflections suggested that the hands-on exploration activities allowed students to connect to the topic of energy production and consumption and transfer their knowledge to real-world applications.

As teachers engaged in this study, we came to believe we must provide our students with such opportunities for conceptual change. These may take the form of discrepant events, inquiry-based activities, or other hands-on experiences; but, in general, they should help students reconstruct and internalize their knowledge. Again, metacognition plays a significant role. If students are thinking about why they hold a particular understanding and reflect on those thoughts, they may recognize a discrepancy and reach a new and better scientific understanding based on the evidence presented. Brown, Gumerman, Sun, Sercy, and Kim (2012) linked dispelling myths of electrical energy with societal attitude shifts. They noted, "by making some stakeholders belief systems more visible, our analysis of prevailing myths can improve social responsibility and foster desirable change" (p. 7).

What's Next?

An electricity challenge for the junior high program is being booked with Inside Education as a final wrap up for this action research. The solar lantern building project hopes to help students grasp the big picture about electricity generation and consumption.

Energy consumption is an important topic that has real-world applications and affects students' lives, both currently as minors living at home and later as consumers with purchasing power. Students will soon grow up to make decisions regarding energy purchases: Which energy company do I choose? Should I choose green energy more often versus coal-based energy? What have I done to reduce my carbon footprint? How can I help with reducing the effects of climate change?

Although hypothetical at this point, a follow-up study 10 years from now of the same group of students would be interesting to see if the lessons learned from this experiment had translated to more conscientious consumption of energy and a better (and more accurate) understanding of electrical energy production. If education is preparing students for the future, then this project certainly has strong and long-term implications for the rest of their lives.

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Supporting Documents

Appendix I

Energy Production and Consumption of Real-World Applications Questionnaire

Answer each question as best as you can. Think about each question carefully and provide answers that truthfully reflect what you believe to be true (not what you think should be true).

Your answers are being collected to determine junior high students' knowledge of energy production and consumption of real-world, everyday technology.

Circle the best answer you feel is correct.

1. Solar panels (**can / can not**) produce more energy than needed to power an average Canadian household for one year.
2. Snow (**increases / does not affect / decreases**) the amount of solar energy produced compared to an average summer day.
3. Solar panels (**do / do not**) work on cold winter days below 45 degrees Celsius.
4. It takes (**more / the same / less**) energy to make a solar panel module than it will produce in its lifetime.
5. Solar panels (**do / do not**) work on cloudy days.
6. Solar energy is (**more / the same / less**) reliable than wind energy.
7. Clean coal-generated electricity is (**better / the same / worse**) than solar energy.
8. The EnerGuide label on appliances is (**accurate / inaccurate**).
9. The energy consumption of typical home appliances will (**increase / stay the same / decrease**) over time.
10. The price difference between two appliances, one more energy efficient than another, (**can / can not**) be earned back in energy savings over one year.
11. Your actions to reduce your carbon footprint, turning off lights when not used, putting appliances into energy saving mode, carpooling, etc., (**do / do not**) make a significant difference in reducing carbon emissions.
12. Graphical representations such as line graphs, pie graphs, bar graphs of data by for-profit organizations and companies (**always / sometimes / never**) are accurate representations of the product.

Short Answer. Provide your opinion and thoughts on the following questions.

1. Tell me something you know about solar energy.
2. Tell me something you know about any type of energy consumption.
3. Tell me something you know about any type of energy production.
4. Tell me something you want to learn or answer about solar energy, energy consumption and/or production.
5. Identify an everyday household technology that you want to learn more about. What do you wish to learn about its energy consumption?

Appendix II

Energy Production and Consumption of Real-World Applications Questionnaire-Post Test

Answer each question as best as you can. Your answers are being collected to determine junior high students' knowledge of energy production and consumption of real-world, everyday technology.

Short Answer. While answering the questions, reflect on the activity completed in math class in the foods lab and the science class on energy calculations and your previous answers (provided on the left)

1. Reflection on Question 1: Do you still believe it to be true? If no, why not?
2. Reflection on Question 2: Do you still believe it to be true? If no, why not?
3. Reflection on Question 3: Do you still believe it to be true? If no, why not?
4. Reflection on Question 4: Describe how your knowledge in this topic has increased or identify new knowledge that you learned.
5. Reflection on Question 5: In terms of the household technology that you identified, what in general did you learn about energy consumption of everyday household appliances?

ACTION RESEARCH: ASSESSMENT IN MATHEMATICS

Kelly Drury Laffin

Kelly Laffin teachers Grade 7 Mathematics at Aurora Academic Charter School

ABSTRACT

The topic being investigated in this project is:

When creating math assessment, how do changes to exam format affect individual students' performance on those math assessments?

In looking at math assessment, most traditionally, exam questions have been organised in difficulty from least to greatest, usually correlating with marks, fewest to most. This format often leads to students running out of time at the end of the exam, thereby leaving the questions worth the most marks as either rushed or incomplete.

This research project investigated the organisation and formatting of math assessment, particularly the order of questions on math exams, as it relates to student understanding and success. To do this, I created different versions of the same test, using the exact same questions but reordering them to see if there would be any differences in understanding and success for the students, depending on which version of the exam they completed. The data was also analysed to see if gender or a student's ELL status, made a difference in the student's performance on these different versions of the math assessments.

Keywords

assessment, mathematics, middle school, junior high, exams, tests, questions, format, analysis, gender, language learner

Context

Aurora Academic Charter Middle School is a public charter school in Edmonton, Alberta, Canada, with a student population of 375 in grades 5 through 9 during the 2016-2017 school year. For this school year, the Middle School had three classes for grades 5, 6, and 8, with 4 classes in grade 7, and two classes in grade 9.

The school population comes from across all of Edmonton, including suburbs around the city, which creates a diverse cultural and socio-economic background of our families. This diversity also means that a significant number of our students are classified as English Language Learners, and that a language other than English is the main language spoken at home. In my two math classes, over 63% of my students first learned a language other than English, and 30/47 students speak a language other than English at home the majority of the time. Our families have sought out Aurora because it is a

publically-funded, self-governed school, and because the school philosophy emphasizes a direct instruction model, where an average student can excel in an academic program.

As a publically funded school, Aurora follows the Alberta Program of Studies, with enhancements in many subjects at each grade level. There is a focus on “properly sequenced teacher-directed learning” and the school provides a rigorous academic program.

Aims and Objectives

Seeing a Problem, Seeking a Solution

This Action Research Project began after I noticed that a handful of students in each of my grade 7 math classes often struggled to finish our unit exams, which are designed to be completed in approximately 60 minutes of an 82 minute class. Because the majority of students work through the exam booklet from front to back in question order, they were often not completing, or were rushing to finish, the final questions.

As is traditional, and supported by much research, these exams have customarily had the easier questions at the start, followed by questions of increased difficulty, culminating in the word problems, which are usually the questions worth the most marks. With this format, and the students working from front to back, it often means that students run out of time to finish the questions that hold the most weight and that would demonstrate the greatest depth of their understanding on the exam.

In researching and designing this project, I wondered what would happen if the exam format were reversed, such that the most difficult questions, worth the most marks, were at the front of the exam, and the easier questions, worth the least amount of marks, were at the end of the exam. I also wondered if there would be differences between the genders, which was indicated as a possibility in the Literature Review I completed. As well, I wondered if students who were English Language Learners, and/or did not speak English primarily at home, might also show a preference for one exam format over the other.

In the creation of the two versions for each exam, I hoped to discover an exam format and assessment method that would allow for the most success for the most students.

LITERATURE REVIEW

Different Research, Different Conclusions

This Action Research Project grew out of my own questions regarding my students and their completion of exams. I had not previously considered this topic, so I was pleasantly surprised to find research on these different issues. As I discovered, research into educational topics seems to have contrary results, and each question must be applied to an individual school, an individual classroom, and individual students.

The first question I began researching regarded the order of questions on exams. Teachers generally assume that most students perform best on exams where the questions are ordered from easiest to most difficult. As Spalding (2011) states: "The examiners' views and the advice drawn from the research literature agree that ordering questions easy-to-hard is good practice." (p. 1).

According to Leary and Dorans (as cited in Spalding, 2011):

> Examiners felt that the first few questions in a paper should be relatively easy so that candidates can relax and not become over anxious. It was their opinion that an easy-to-hard arrangement ensures that candidates are not discouraged early on, thus avoiding the possibility of candidates failing to attempt questions (p. 1).

There is also some indication that exams should be written in the order of the topics studied, combined with ordering from easiest to most difficult, to give students early success on the topics and build their confidence. Spalding (2011) notes: "Examiners also felt that ordering questions by topic was good practice, although more research is required to determine the effectiveness of this strategy." (p. 1).

However, some research indicates that female students perform better on exams that are in reverse-order to the traditional format; that is, in exams where the most difficult questions are placed at the beginning. Kennedy and Butler (2013) state:

> We find that for most of the mathematics students who were examined, the ordering of the questions on a test did not impact performance. However, female majors performed better on classroom exams when the test was arranged with the more difficult questions presented first (p. 20).

Because of our school's cultural diversity, I gathered demographic information from my students and, when reading the related literature, I realised I could organise the exam score data by gender and by English Language Learner status to see if those variables had any impact on exam performance.

A concern of many mathematics teachers has been that there is often a literacy component needed to be able to answer the mathematics question. Fisher-Hoch and Hughes (1996) affirm that: "Assessment of mathematics, it has been argued by practising teachers should assess mathematical, not linguistic skills and abilities. Thus, the presentation of the question is key to the validity of the task" (p. 4).

There is a concern that linguistic skills negatively impact mathematic exam scores, even when a student's knowledge of math is at grade level. Cuevas (1984) states, "The learning of mathematics requires a variety of linguistic skills that second-language learners may not have mastered. Furthermore, special problems of reliability and validity arise in assessing the mathematics achievement of students from a language minority" (p. 134).

I wondered if a student's English Language Learner status impacted mathematics exam performance. Most of our students learned English as a Second Language, and

predominantly speak a language other than English in the home. Cuevas (1984) states, "Students require considerable proficiency in both their first and second languages if they are to cope with the range of linguistic activities required for learning mathematics" (p. 137).

As indicated in the literature, several factors contribute to students' success on exams. Some of these factors are opposites of each other; and, depending on the demographic being focused on, this research becomes even more complex.

Action Research Methods

Planning and Strategies

This project was designed for my two grade 7 math classes, with a total 47 students, 25 females and 22 males. Of the 47 students, 63.8% self-identified as having first learned a language other than English at home; 23 of the 47 students identified a language other than English used in their homes on a regular basis.

The exams used for this research were from the second half of the grade 7 math program, so the "traditional" format was well known to students because they had previously completed 6 exams using that format. The exams used for this research were for the following topics: Percent, Relations/Expressions, Algebra, Area, and Circles.

Each exam was divided into two versions. Version 1 was the Control, with the traditional format of easiest to most difficult. Version 2 was the changed version: this version used the exact same questions as the Control version, but the changes were based partially on the questions I had used from the Control Exam, and my sense of the most logical way to format the Changed Version. The Changed Version sometimes bolded key words that were not highlighted in the Control Version.

The exams each had their own answer keys, with the exact same breakdown of marks for grading and the same format required for the answers on both versions.

I then collected the exam grades data in a spreadsheet and tabulated results using various filters, including:

- For each version of the exam:
    - Class average, per class
    - Class average, both classes
    - Version averages, by gender, by class
    - Version averages, by gender, both classes
    - Version average differences, by gender, by class
    - Version averages by ELL status, by gender, both classes

Percent Unit Exam

Version B1 was the Control exam, with the traditional format of easiest/least marks at the beginning of the test to the most difficult/most marks questions at the end of the exam. Version B2 was the Changed exam. This version was designed to follow topic

organisation, such that the more difficult questions, instead of being gathered at the end of the exam, were placed so that they followed the easier questions of the same topic. The hope was that the easier questions preceding would help students complete the more complex question on the same topic.

Relations - Algebraic Expressions Exam

Version A1 was the Control exam, with the traditional format of easiest/least marks at the beginning of the test to the most difficult/most marks questions at the end of the exam. Version A2 was the changed version of this exam, with the questions in a completely random order, neither in order of topics studied, nor in order of least to most difficult.

Algebra Unit Exam

Version C1 was the Control exam, with the traditional format with easiest/least marks at the beginning of the test to the most difficult/most marks questions at the end of the exam, following the exact topic order as we had covered in class. Version C2 was the Changed exam, and this version was changed so that topic order was random, focusing solely on the easiest questions, worth the fewest marks at the beginning of the exam, building to the more complex questions worth the most marks at the end of the exam.

Area Exam

Version A1 was the Control exam, with the traditional format of topic order with the easiest/least marks at the beginning of the test to the most difficult/most marks questions at the end of the exam. Version A2 was the changed version of this exam, and was almost an exact reverse of the Control exam, with the most complex questions worth the most marks at the beginning of the exam, and then working “backwards” to the easier questions worth the fewest marks.

Circles Exam

Version B1 was the Control exam, with the traditional format of topic order with the easiest/least marks at the beginning of the test to the most difficult/most marks questions at the end of the exam. Version B2 was the changed version of this exam. It was an exact reverse of the Control exam, with the most complex questions worth the most marks at the beginning of the exam, and then worked “backwards” to the easier questions worth the fewest marks at the end of the exam.

RESEARCH DATA

Answers...

In total, the Research Project analyzed the 5 unit exams for my two classes of grade 7 students, in total 235 exams.

I gathered the following demographical information, which is displayed for all 47 students, with no identifying information included:

- Gender
- Age
- Birth Order
- Years at Aurora
- First Language Learned
- Language Used most often at Home

The data points for the exams that I documented are as follows, per class:

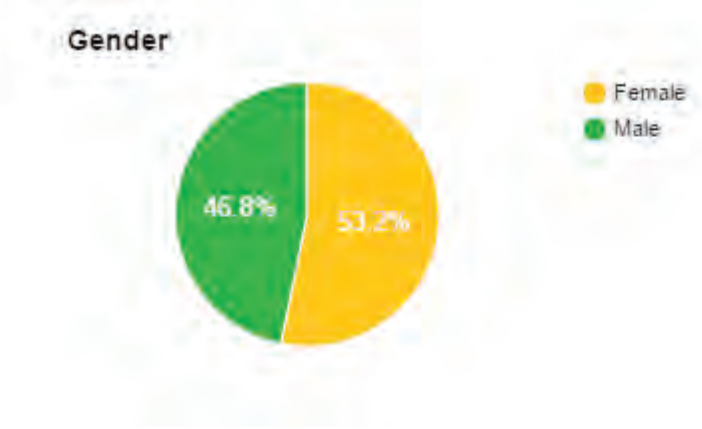
- Overall Class Average (both versions)
- Version 1 Class Average
- Version 1, Female Class Average
- Version 1, Male Class Average
- Version 2 Class Average
- Version 2, Female Class Average
- Version 2, Male Class Average

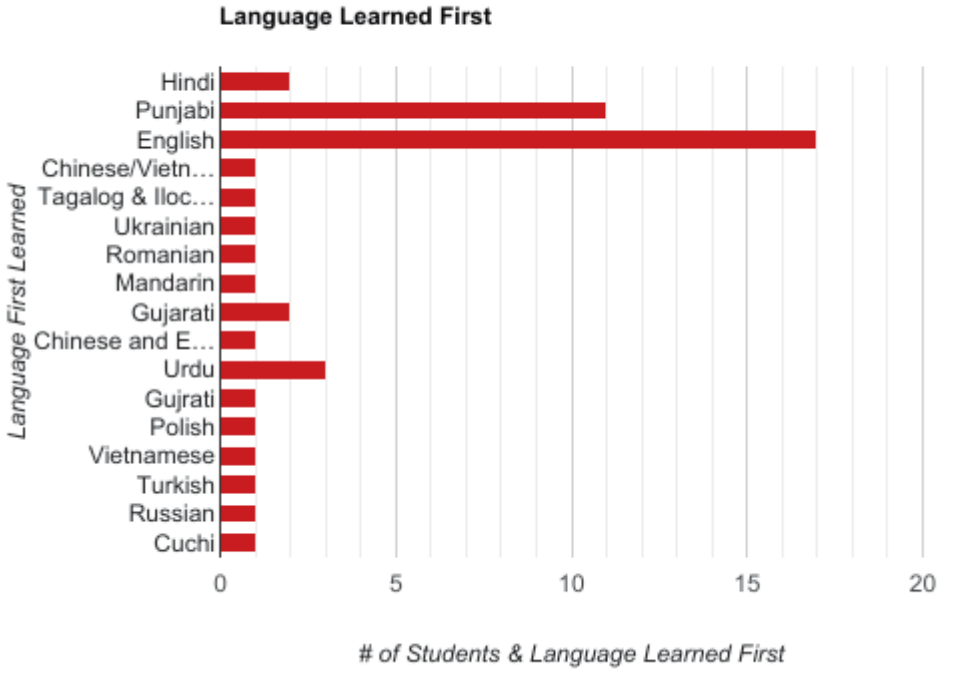
I then also combined the classes to find the same data points:

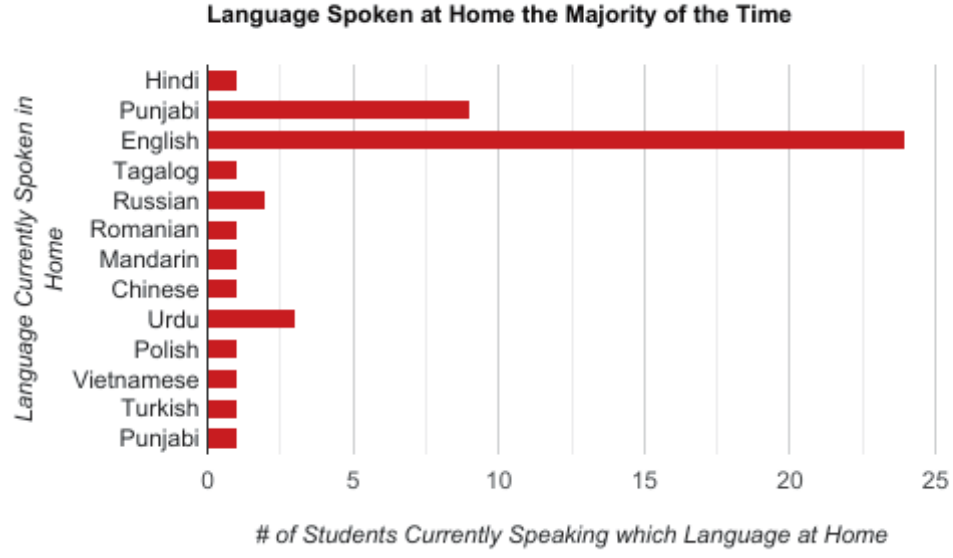
- Overall Class Average (both versions)
- Version 1 Overall Average
- Version 1, Female Overall Average
- Version 1, Male Overall Average
- Version 2 Overall Average
- Version 2, Female Overall Average
- Version 2, Male Overall Average

The above information is shown below in a variety of graphs to highlight the key findings from this Action Research Project.

DEMOGRAPHICS

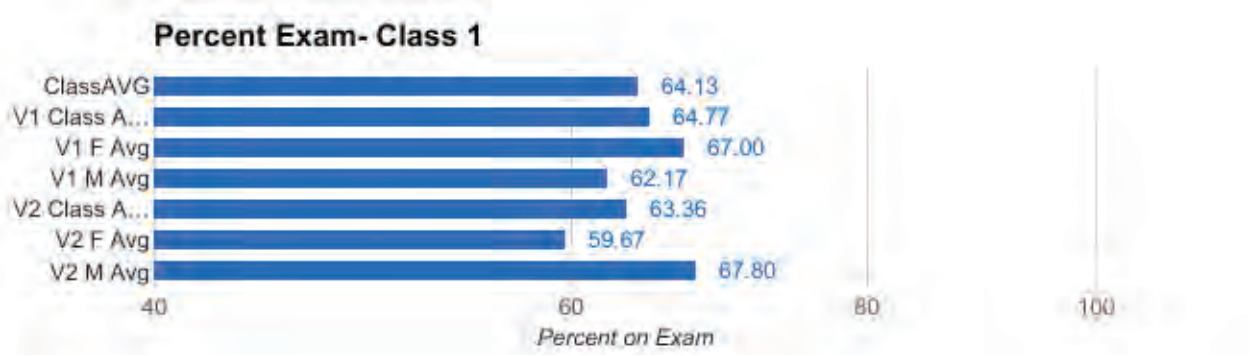


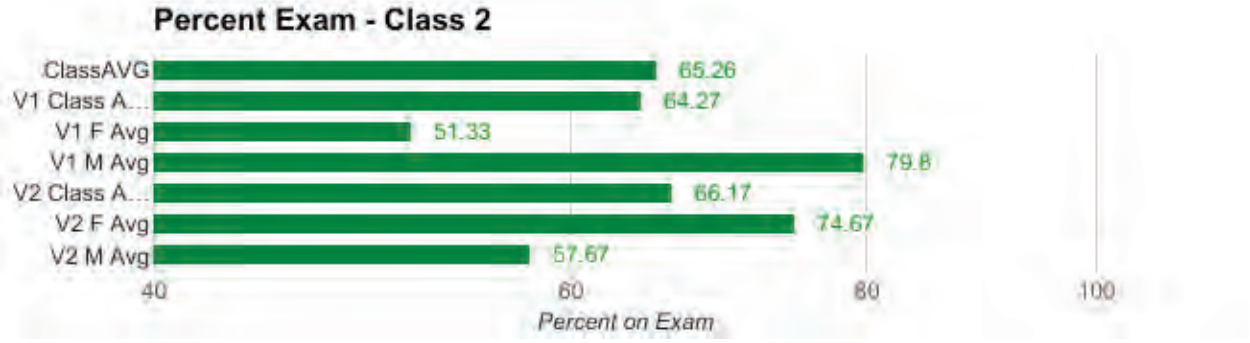

Language Learned First
Language First Learned
Hindi
Punjabi
English
Chinese/Vietn…
Tagalog & Iloc…
Ukrainian
Romanian
Mandarin
Gujarati
Chinese and E…
Urdu
Gujrati
Polish
Vietnamese
Turkish
Russian
Cuchi
0
5
10
15
20
# of Students & Language Learned First

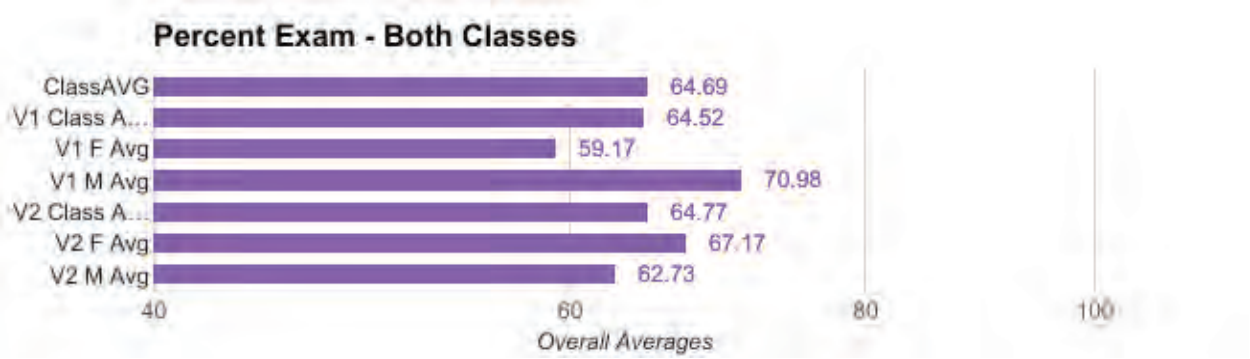

Language Spoken at Home the Majority of the Time
Language Currently Spoken in Home
Hindi
Punjabi
English
Tagalog
Russian
Romanian
Mandarin
Chinese
Urdu
Polish
Vietnamese
Turkish
Punjabi
0
5
10
15
20
25
# of Students Currently Speaking which Language at Home

...More Answers...

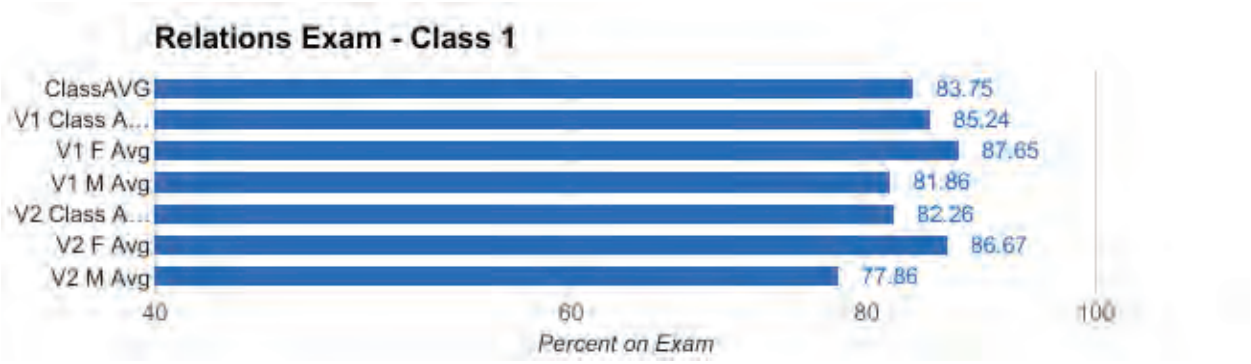
Percent Unit Exam

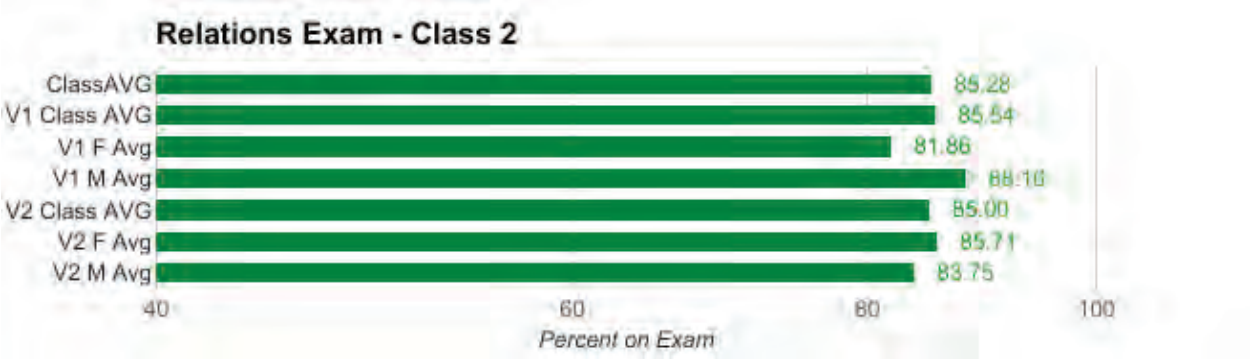




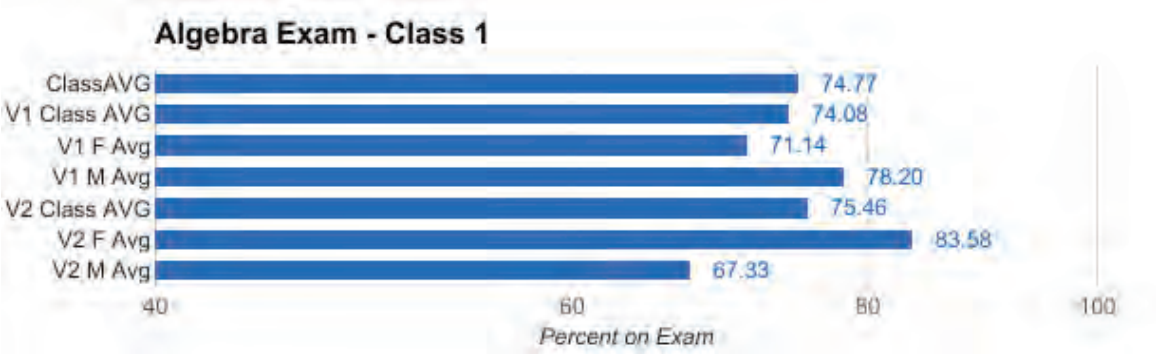


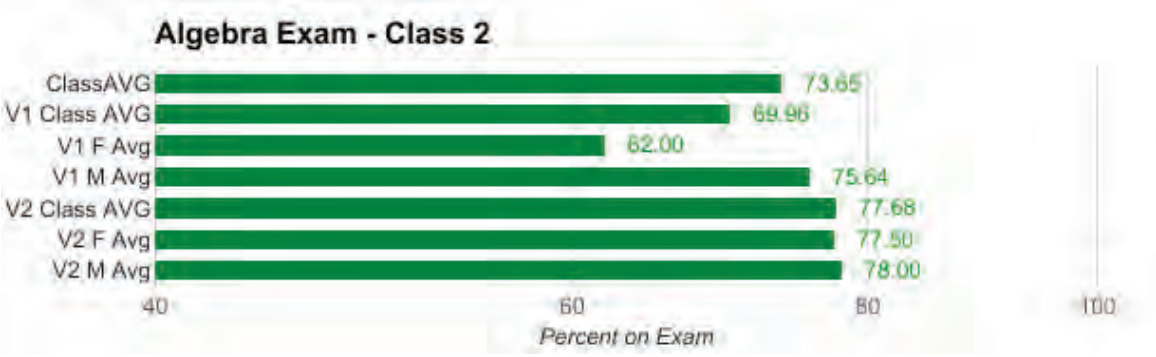
Relations/Expressions Unit Exam

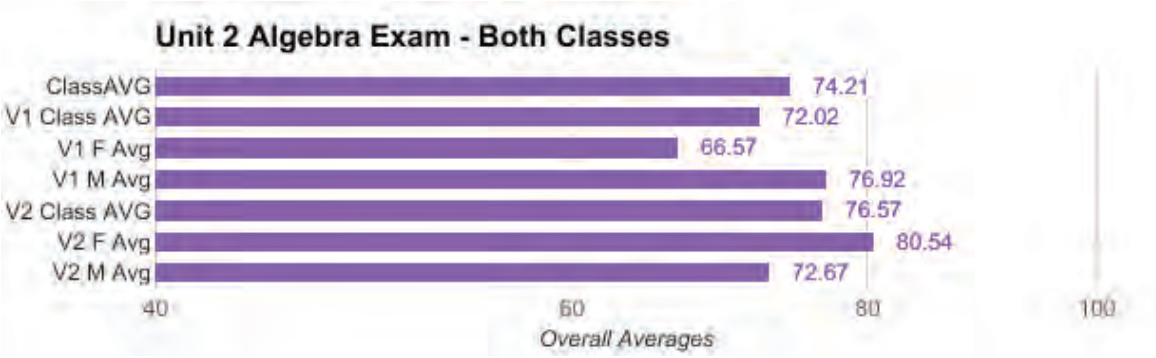




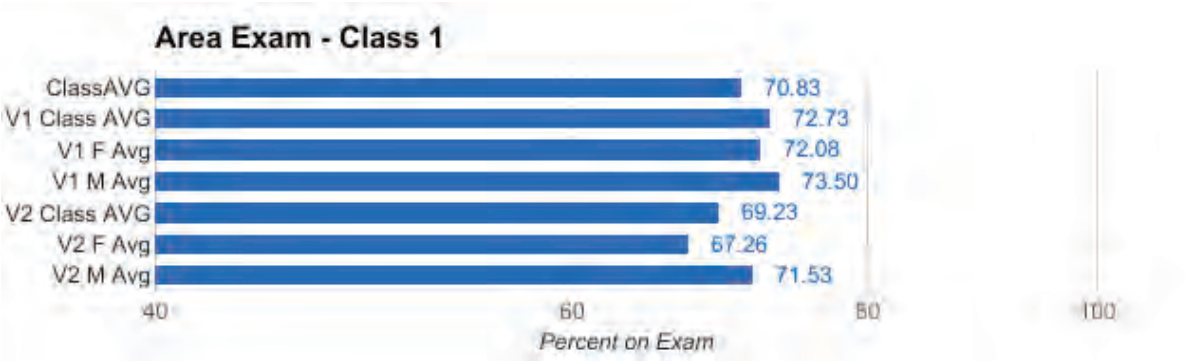
Unit 2 Algebra Exam

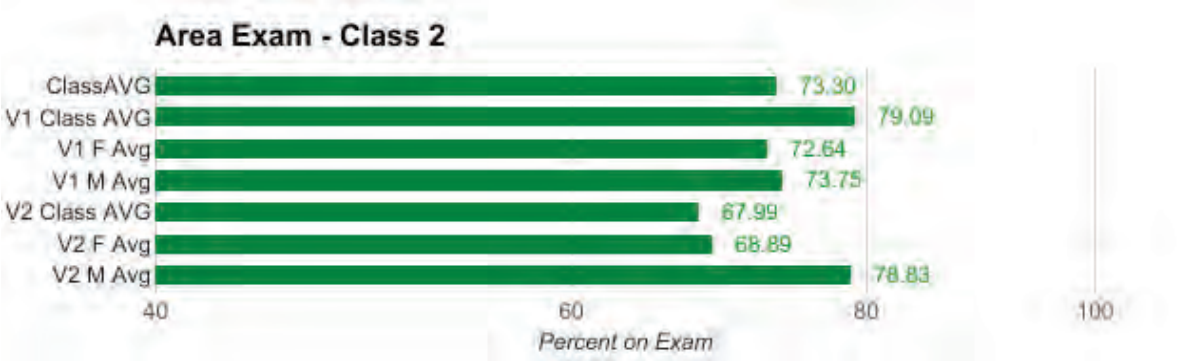


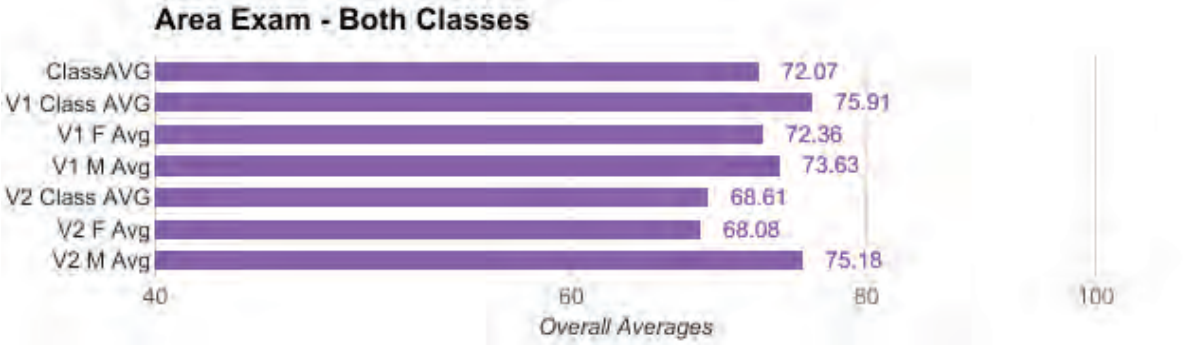




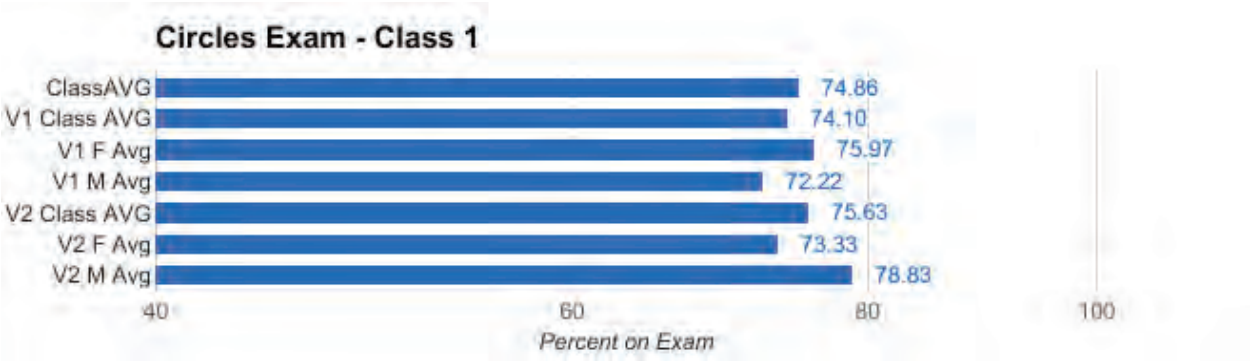
Area Exam

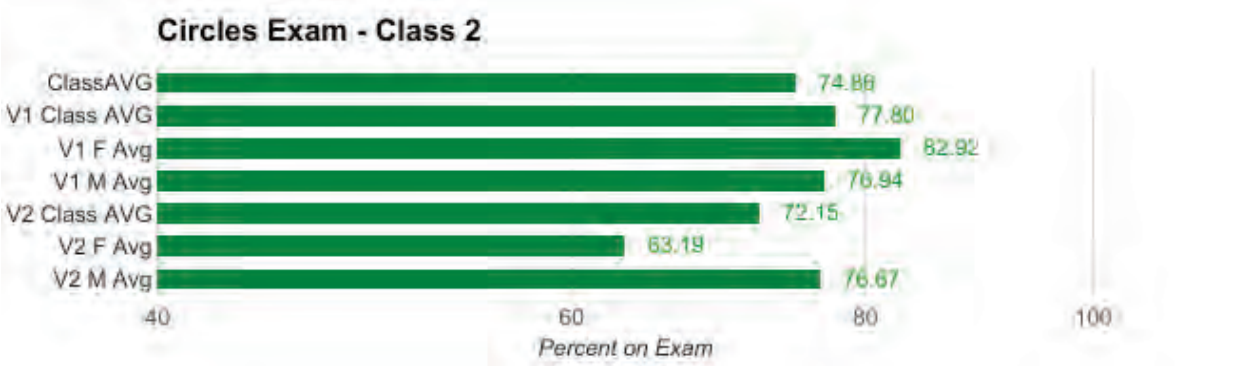

Area Exam - Class 1
ClassAVG
V1 Class AVG
V1 F Avg
V1 M Avg
V2 Class AVG
V2 F Avg
V2 M Avg
70.83
72.73
72.08
73.50
69.23
67.26
71.53
40
60
80
100
Percent on Exam

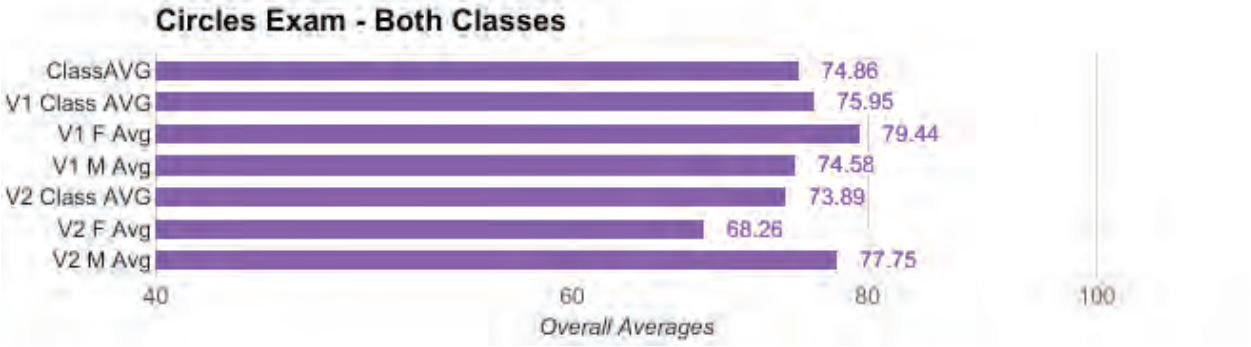

Area Exam - Class 2
ClassAVG
V1 Class AVG
V1 F Avg
V1 M Avg
V2 Class AVG
V2 F Avg
V2 M Avg
73.30
79.09
72.64
73.75
67.99
68.89
78.83
40
60
80
100
Percent on Exam


Area Exam - Both Classes
ClassAVG
V1 Class AVG
V1 F Avg
V1 M Avg
V2 Class AVG
V2 F Avg
V2 M Avg
72.07
75.91
72.36
73.63
68.61
68.08
75.18
40
60
80
100
Overall Averages

Circles Exam







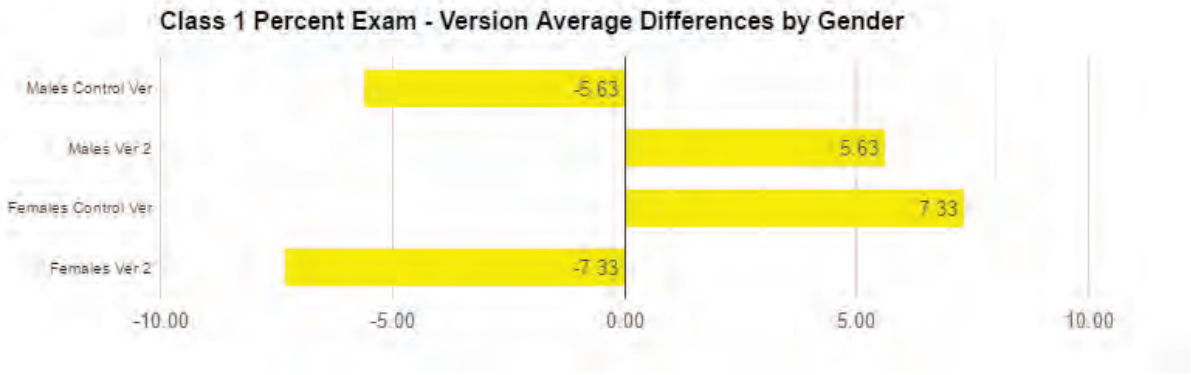
Research Data

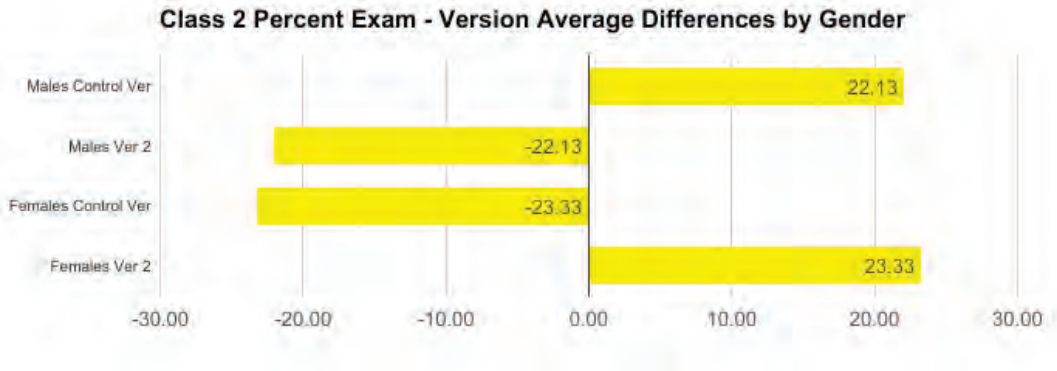
... and More Answers

It was most interesting to gather the data by individual class, also broken down by gender and English Language Learner status. These smaller samples showed some

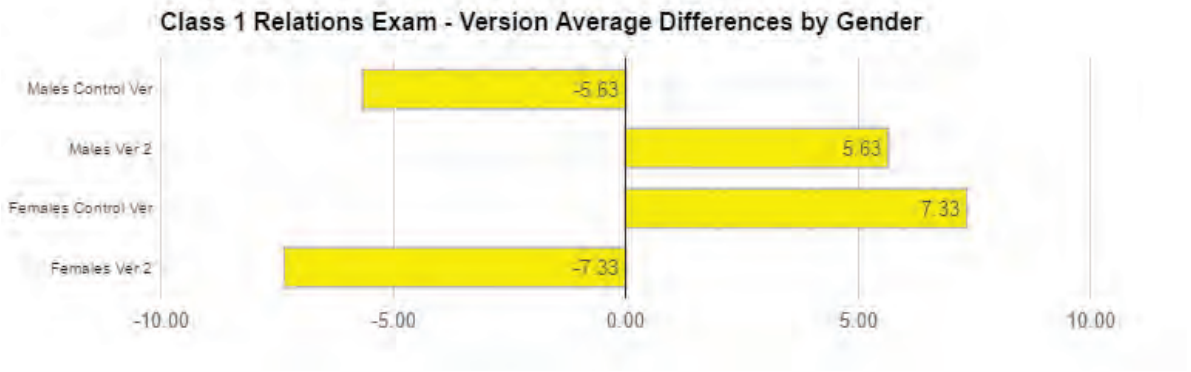
significant gender differences, as well as differences for ELL students on these exams; this data sometimes gets lost when viewing only the combined class averages, even when gender is factored in.

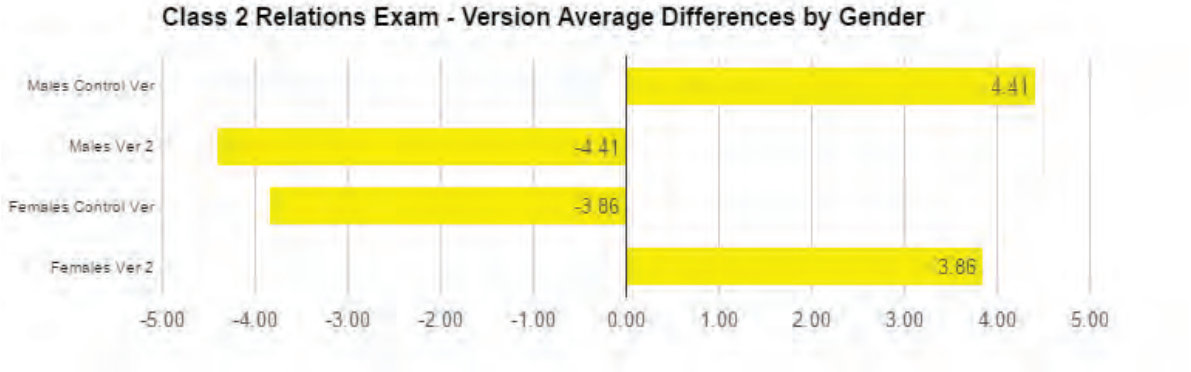
For the Percent Exam, the females in the Class 2 performed over 23% better on Version 2, while the males performed over 22% better on the Control Version. This is a significant difference; whereas, in Class 1, the gender-version difference was smaller, and reversed: the females performed 7% better on the control, while the males performed over 5% better on Version 2.



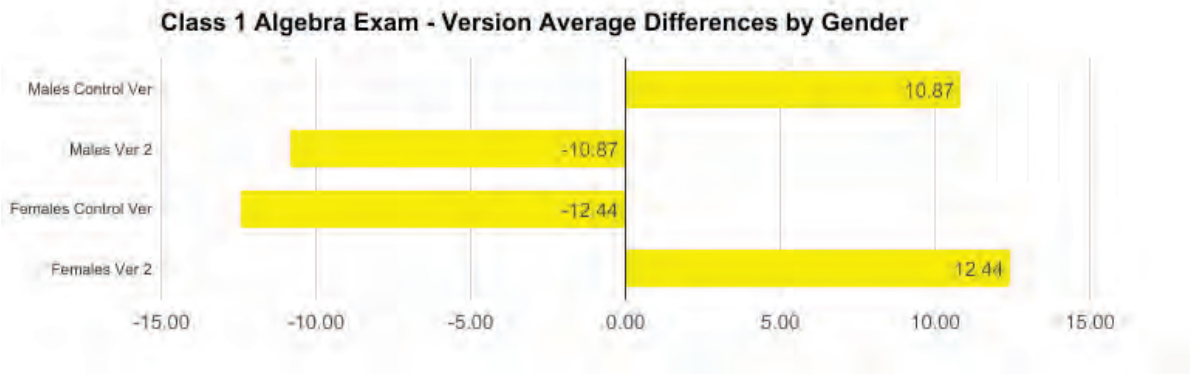


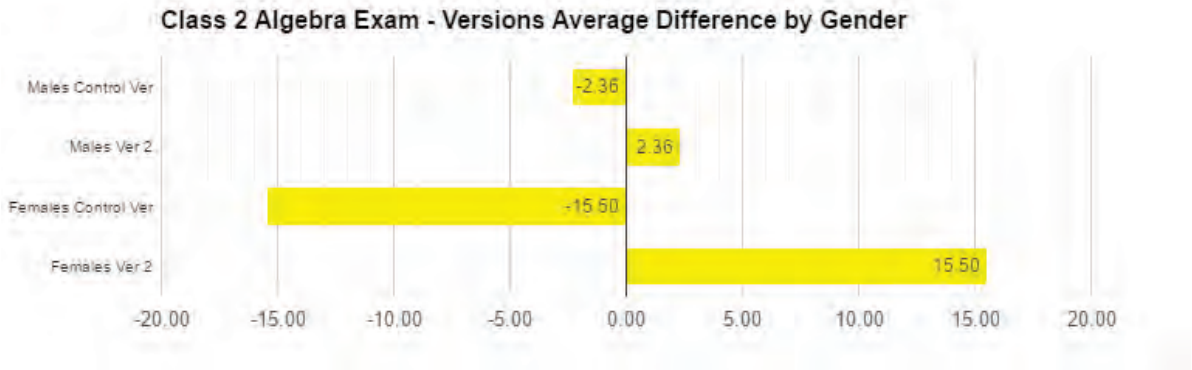
The Relations Exam shows differences that were not as large; however, once again, there were opposite gender differences between the 2 classes in successful exam completion.



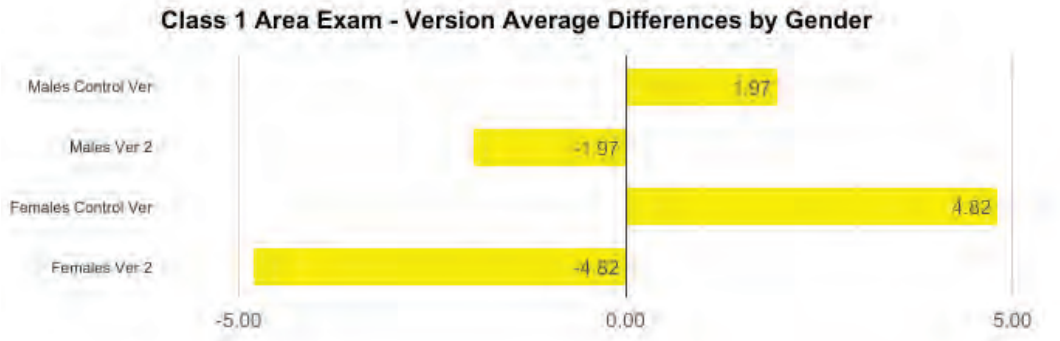


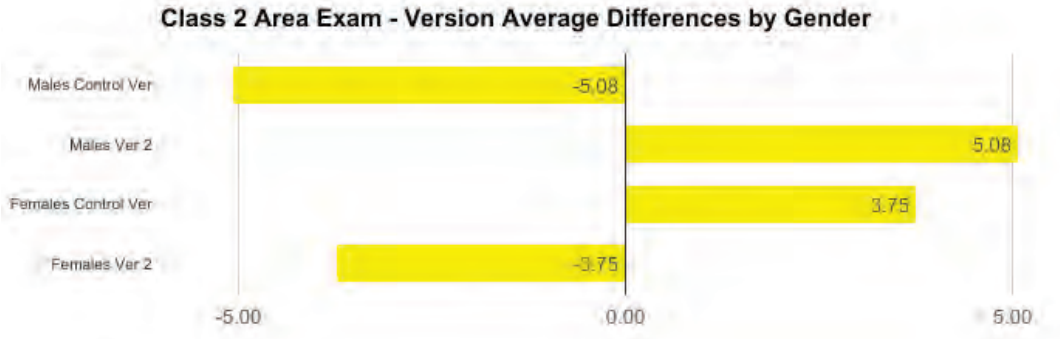
The Algebra Exam showed significant gender differences; but, again, these differences are inconsistent from class to class. For this exam, in both classes, female students clearly performed better on the Version 2 exam; the male students in class 1 performed better on the Control Version, while their counterparts in class 2 did not show significantly different success.



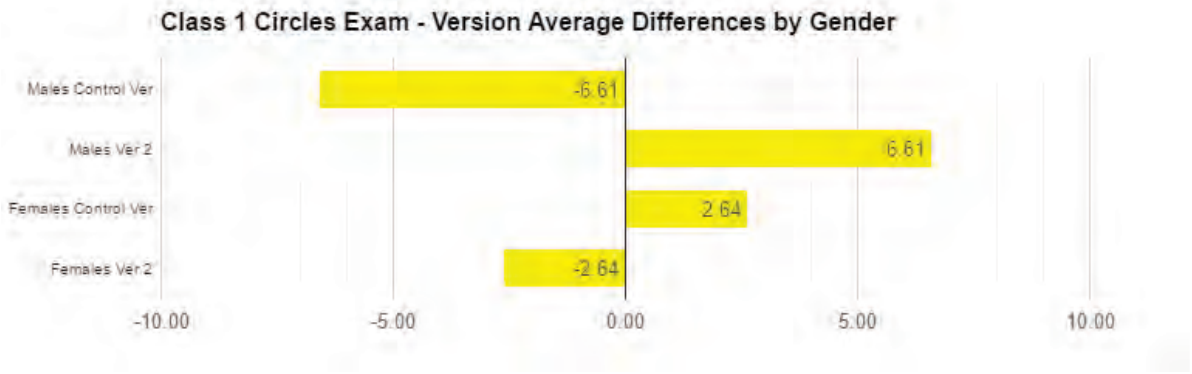


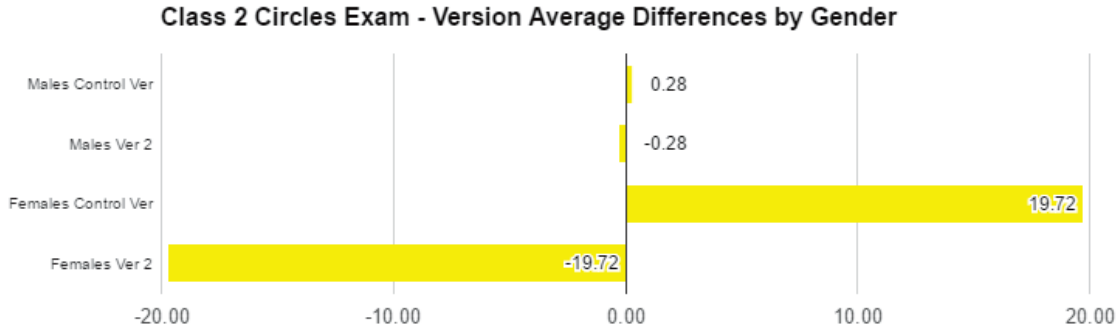
The differences on the Area Exam are smaller, both for gender performance on a version, and between classes, though once again, the gender preference for version is reversed between the two classes.





For the Circles Exam, the differences in Class 1 are smaller, but there is still a gender difference for better performance on one version of the exam than the other. For Class 2, the difference for the female students between the two versions is quite significant.

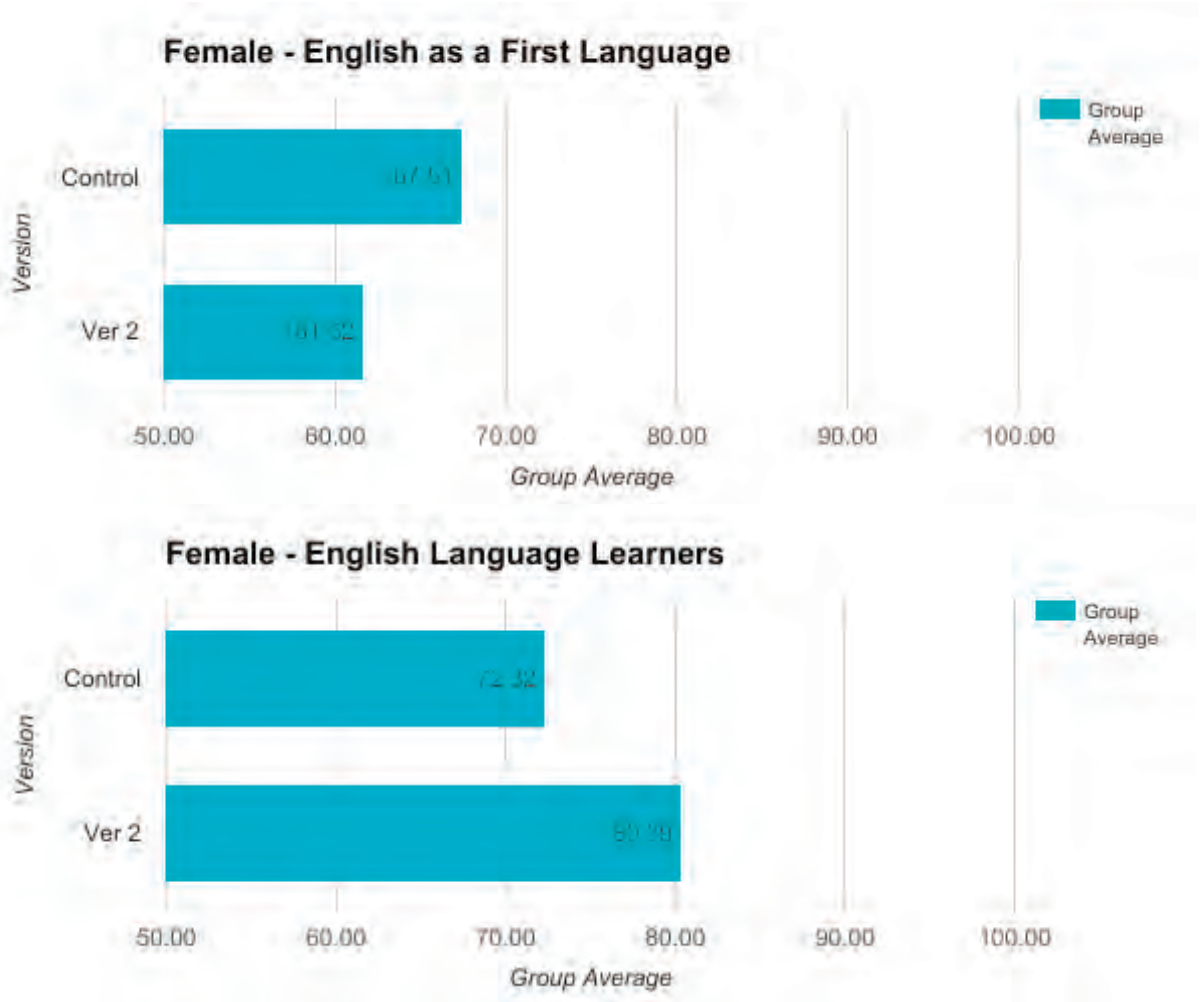




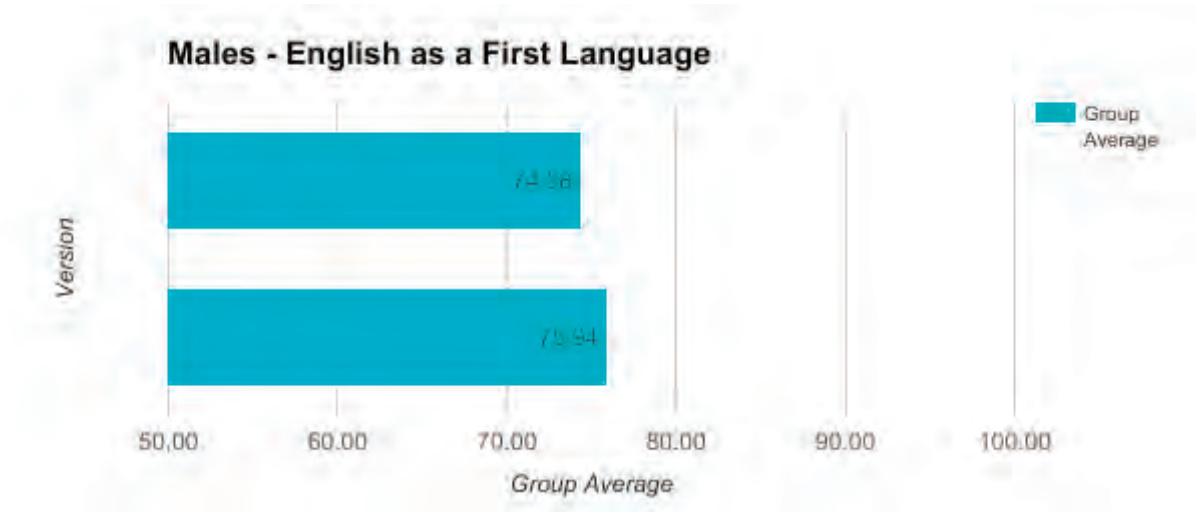
English as a First Language Compared to English Language Learners

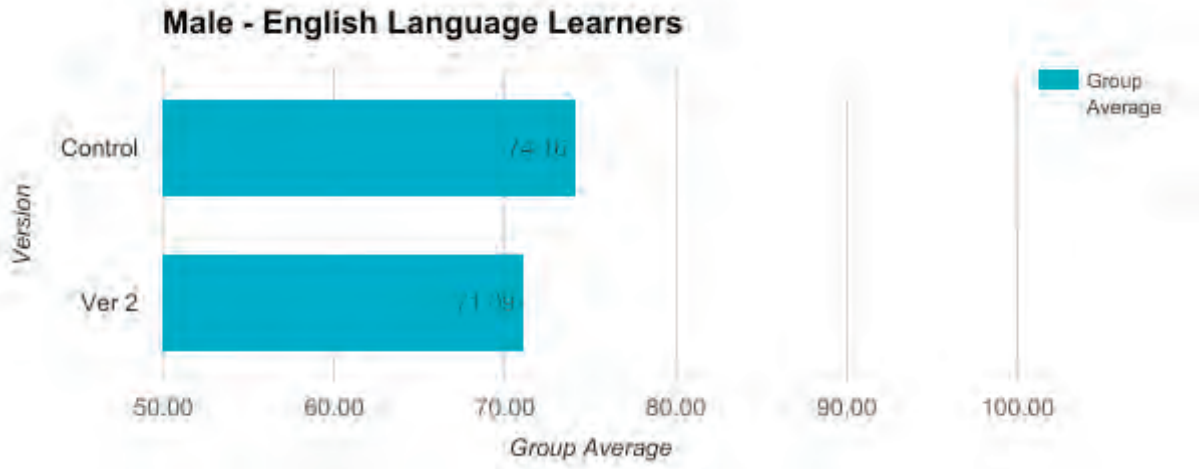
To protect student anonymity, I averaged the Versions of all five exams, based on gender and English Language Learner status. However, several individual students showed a significant percentage difference between the two versions of exams. Unfortunately, these statistics are lost in the process of averaging, which highlights the importance of teachers analysing individual performance on exams.

Female English as a First Language Compared to English Language Learners

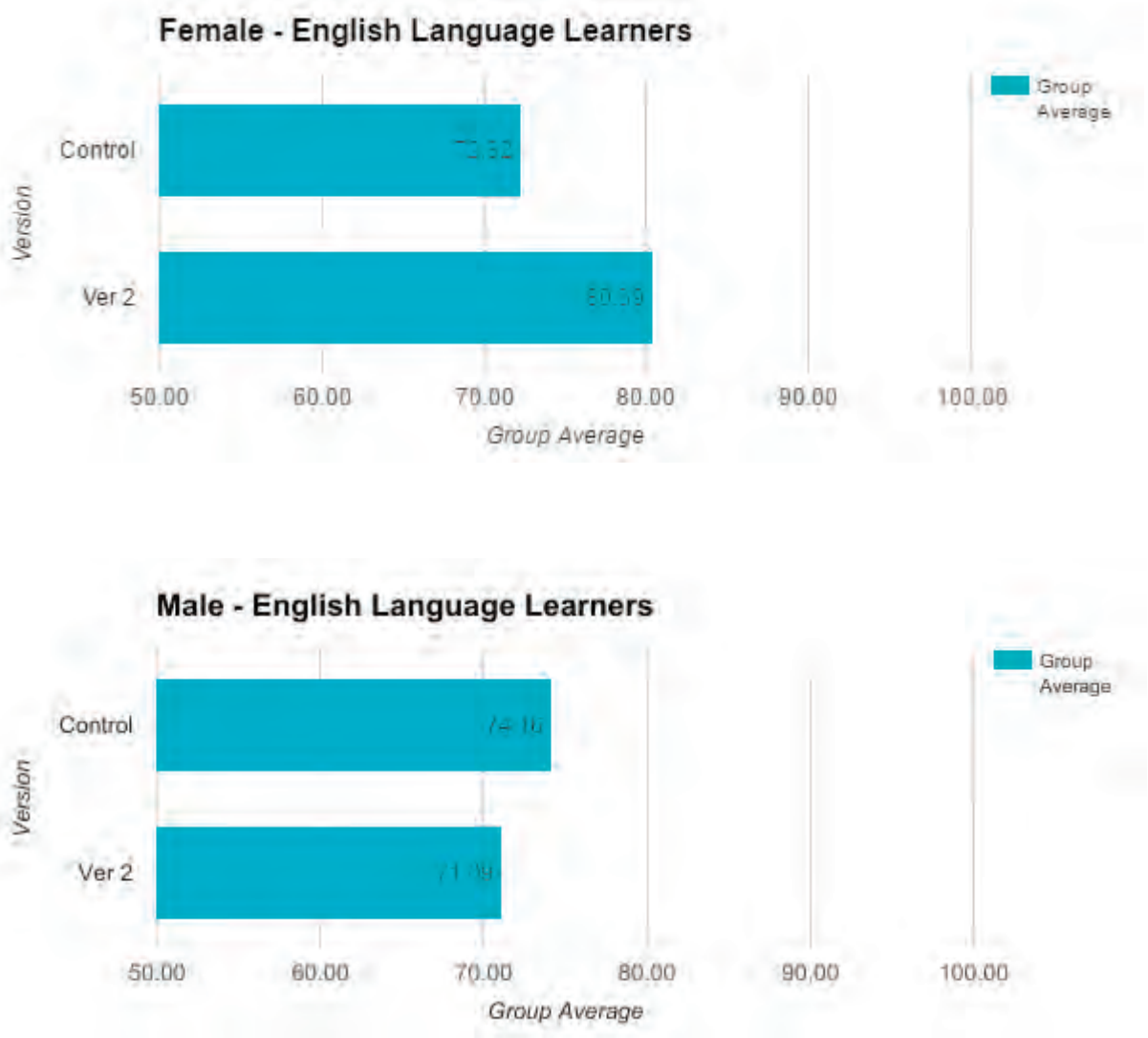


Male English as a First Language Compared to English Language Learners





Female Compared to Male, English Language Learners



Research Outcomes

... But More Questions

To be honest, I was surprised by the findings after this data was collected and analysed. I had not expected much difference, except perhaps a slight increase in overall class average because some students previously unable to finish the entire exam were now able to finish the exam. I started to see significant data success differences after the first exam; however, the data did not always “do” what I thought it would do.

As some of the literature I read had suggested, there appears to be a difference in how different genders perform on the different types of exams. I would like to extend this research into next year, with exams from the first term as well, focusing even more on the "reverse" versions, specifically to see if there is a consistent gender difference; and, if one exists, to create a plan regarding how to accommodate the version preferences of the different students in my classes.

There were some considerable performance differences between the genders on the two versions of exams; unfortunately, this data was inconsistent; that is, I could not definitively determine that female students would be more successful if they were given a particular version of exam.

It was also interesting to look at the self-identified English Language Learner (ELL) status of my students, which can be seen in the graphs above. These graphs show that female ELL students performed considerably better on the Version 2 exams, as well as markedly better than their first language English counterparts. Meanwhile, male ELL students performed slightly better on the Control exams, but had similar averages compared to their English as a first language counterparts.

Mathematically, I can recognise that the combined data shows only small statistical differences, and that the scores cluster when looking at all 47 students, even accounting for gender. But as a classroom teacher, I cannot ignore the rather large differences between the genders, the ELL students, and between the two classes, even when those differences were inconsistent throughout both classes. There were obvious preferences for certain styles of exams, for males and females, for ELL students, and for the two classes. Thus, this research has led to more questions about how to use this data to ensure individual students are able to perform their best on these tests.

Key Learnings

Questions Seeking Answers

This Action Research Project has created more questions for me than answers, but it has reinforced the importance of teacher analysis of exam results, and the value of reflecting on exam content and format to ensure we are striving for the most authentic and accurate assessment of our students' learning.

The discrepancy this research showed between the classes, and even between the genders, for overall averages earned on the two versions of the exams, highlights the importance of exam analysis and reflection both on the questions and on the format of the exam itself, including the order of the questions – even if they are the same questions.

With regard to English Language Learners, there appeared to be a preference among female students for the Version 2 exams, while male English Language Learners preferred the Control versions.

Our English Language Learner students at Aurora, despite a majority speaking a language other than English at home, are very proficient in English, which correlates with their strong results on these exams, sometimes even stronger than our English First Language students.

The inconsistency of the results, particularly among the gender groupings, creates questions regarding what to do with this information, as it would be challenging for a teacher to implement any changes to exam format for individual students, without prior knowledge of these preferences, which the students themselves probably do not even know.

The variability of these results emphasizes the need to analyse the strengths and weaknesses of individual classes, as well as individual students, and to be prepared to make changes to exams and to lessons, as dictated by these strengths and weaknesses.

At the least, the data collected and analysed here shows the importance of creating different versions and types of exams throughout the year to help ensure that all students' strengths can be highlighted over the course of the year. With planning and experimentation, it may even be possible to allow the students to choose the format that they would prefer, so that they can "play to their strengths" when showcasing their knowledge.

What's Next?

Moving Forward

As a teacher, I am both perplexed and excited by the variability of results from this Action Research Project. It is easy to become stagnant, especially with our exams, and this project has re-emphasized to me that exam reflection and analysis should occur in every class and every unit, every year.

I would like to continue this project next year. There are several exams during the first half of the year that I did not create two versions of for this project, and I would like to see if my findings continue to occur with new classes; if those differences remain variable, or if they become more consistent, at least along gender lines.

I would also like to add a component of metacognition, in the format of student self-reflection regarding the exam format they prefer to write, including strategies to help them perform better on exams that are not in their preferred format.

I believe teachers also need the time, ideally with teaching partners, to perform an analysis of their exams, as well as time to implement changes, so we can keep the exams fresh and ensure that our exams remain accurate and authentic assessment tools for all students, regardless of gender or English Language Learner status.

It was extremely worthwhile for me to compile these exam versions and the data related to this project. My research found interesting data points and correlations I had not

previously focused on, and I know this project has expanded my learning and skills as a classroom teacher.

Supporting Documents

Demographics Questionnaire

The following questions were asked of each student in my two classes via an online questionnaire. The questions and answers that informed this research project are listed below. The answers were gathered in a spreadsheet to correlate with their exam results, but all data was used was anonymously. This data collection and analysis will be deleted upon completion of this research project.

Full Name (used only for correlation of data)

Gender

English is the first language I learned at home (yes/no, if no, more questions followed)

If English was NOT the first language you learned, please indicate which language was the first one you learned.

If English was NOT the first language you learned, please indicate the age at which you learned English. (When you could read and write in English.)

Please indicate which language is CURRENTLY spoken in your home most of the time.

If your parents help you with Math homework and studying, please indicate if the conversation is in English or another language.

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Fostering Effective Vertical and Horizontal Collaboration within Single School and Multi-School Settings Simultaneously and Independently

Janet Rockwood and Jacqueline Harman

Aurora Charter School

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Jacqueline Harman is principal of the elementary school at Aurora Academic Charter School. She received a Bachelors degree from the University of British Columbia in History, a Bachelors degree from the University of Alberta in Secondary Education, and in 2017 will be receiving a Masters of Business Administration from the University of Alberta. She has been a school administrator for more than a decade, with a focus on high-achieving, traditional educational settings.

Keywords: Teacher Collaboration, Teacher Growth, Relationships, Effective Professional Development, Teacher Efficacy, Common Assessments, Student Achievement

Summary/Abstract

In the past five years, Aurora Academic Charter School has almost doubled its student and staff population. To facilitate this growth, the school was split into two mutually dependent but separate entities, an elementary K-4 school and a grade 5-9 middle school. The need to maintain a cohesive program in the face of such growth and change led to a series of two research questions:

How can we build effective collaboration between and among teachers, schools, and stakeholders? How can we ensure vertical and horizontal integration between and within subjects, grades, and schools?

In this first iteration of the project, we decided to research how collaboration is currently happening among teachers and to use our findings to take some initial steps in modelling collaborative leadership.

Context

Aurora Academic Charter School is comprised of an elementary school (Kindergarten - Grade 4), and a middle school (Grade 5-9) with 409 and 342 students enrolled

respectively for the 2016-2017 school year. Aurora is continuing to grow, as the 2017-2018 school year will see the middle school expand to 418 students. Approximately 14% of Aurora's students are coded as English Language Learners. Aurora School is publicly funded, and all teachers are certified to teach in Alberta. Aurora currently employs both teachers and support staff. Alberta curriculum is followed, and embellishments are in place at all grade levels.

The vision that grounds Aurora School is that Aurora School is the best choice for *traditional* public education in Alberta, and the mission is to provide an orderly and structured environment, with properly-sequenced, teacher-directed instruction and strong home/school partnerships, where average children can excel in an academically-oriented program. Aurora has two main charter goals: (a) that children will read above grade level, and (b) that students will be above grade level in mathematics. These goals are achieved through additional instructional minutes above the provincial recommendations in English Language Arts and Mathematics.

Aims and Objectives of Our Study

The purpose of this project was to examine how to effectively foster collaboration between and among teachers and schools both vertically and horizontally between subjects and grades.

The last several years have seen a substantial growth in the student population at Aurora School, and therefore a growth in staffing. No longer were single teachers responsible for any given curriculum. Additionally, with expansion we also divided into two distinct campuses with separate administration and teaching staff. One measure taken to address these changes and ensure a continuous, seamless, strong program was to increase the number of professional development days. A portion of time on these days was dedicated to collaboration, but what exactly that collaboration might look like is still evolving.

Our aim for this action research study was to provide opportunities for collaboration and relationship building and to gather feedback as to what teachers believed was effective and added value to their teaching and student learning. Ultimately, we would like to build a culture of collaboration.

Related Literature

In their research summary of collaborative leadership, Anfara, Pate, Caskey, Andrews, Daniel, Mertens, and Muir (2008) defined this form of leadership as one where all stakeholders participate in decision-making as it relates to organizational goals. Furthermore, Knackendoffel (2007) cites Friend and Cook (1992) as listing the following key features of collaboration:

- Collaboration is voluntary and requires parity amongst participants

- Collaboration is based on specific and important mutual goals
- Collaboration depends on shared responsibility for participation and decision making
- Collaboration involves individuals freely sharing both their resources and accountability for outcomes

In a study of more than 575 teachers and 6000 students, Sehgal, Nambudiri, and Mishra (2016) found that teacher self-efficacy, or a teacher's belief in his/her own ability to teach well, improved the delivery of information, teacher-student interaction, and regulation of student learning. Furthermore, they found that collaboration and principal leadership both improve teacher self-efficacy, thus leading to improvements in student learning. Collaboration improves self-efficacy by decreasing uncertainty and providing support when encountering the inevitable challenges in teaching practice, which has also been shown to improve teaching quality directly (Sehgal, et al.). Collaboration improves teachers' perceptions of themselves and their work as well as improving the academic performance of their students (Lieberman, 2000).

The principal's role in collaboration is to provide support by utilizing physical resources, motivation, goal-setting, professional learning (Sehgal, et al., 2016). Principals should dedicate specific time slots in regular schedules to encourage collaboration, which must then be rewarded; however, collaboration cannot be commanded from above because individuals must have their own commitment to a shared goal for true collaboration to occur (Sehgal, et al. 2016). Thus, the most important role of a principal is to convince teachers of the importance of collaboration to their own practice and to the increased achievement of their students.

In a study of an alliance of publicly funded Academy schools in England, Keddie (2014) found that school-to-school collaboration was also paramount to increased student achievement and school improvement. In the Academy system, public schools are given more autonomy and flexibility in delivery of curriculum and staffing decisions in exchange for increased oversight and reporting. Underperforming schools are linked to outstanding schools in alliances meant to share resources and knowledge to improve the performance of all schools. While collaboration in the alliance was voluntary and all Head Teachers (Principals) in the study reported gains from collaboration both in their own practice and in their schools as a whole, Keddie found that collaboration could be undermined when schools were competing for students in the same geographic area or when the need to avoid draining resources from the strongest schools led to increased demands on already struggling schools.

Kiddie (2014) found that the main gains from school-to-school collaboration included:

- Schools made better use of existing expertise with the alliance, especially in

regard to the professional development of principals.

- Schools were able to create a common language of practice to more clearly articulate their goals, values, and strategies

- Head Teachers were able to draw on quality teaching practices used in more successful schools, thus using evidence-based decisions to drive change in their own schools

- Successful networking among Head Teachers was seen as the greatest gain from the alliance, but successful networking needed to be strategic, well-planned, and reciprocal instead of based on an expert model with the outstanding school teaching all others

- The alliance needed to foster inter-dependence with the strongest schools using their resources to advocate for the weaker schools in the alliance

In a study of collaboration as the basis for implementing inclusive special education, Renee and Med (2010) found that although collaboration was recognized as important, effective leadership is one of the most significant challenges in implementing successful collaboration. They also found that professionals interested in collaborating needed to have a willingness to be flexible in many areas of their teaching practice. Thus, although leaders interested in encouraging collaboration needed to apply best practices to foster it, individuals ultimately decide if true collaboration occurs within an organization.

Strategies

One key area of focus for our action research was to ask staff for feedback. We structured one of our initial professional development days to gather ideas from our teachers. We asked teachers four key questions:

1. What are the benefits of collaboration?

2. What collaborative strategies are working for you now?

3. What might you try in the future?

4. How can administration help with collaboration?

In addition to the activity conducted with staff, administration from both schools believed that one of the most effective ways to foster collaboration was to build positive relationships. In an attempt to create opportunities for this, several initiatives were undertaken. First, on all Professional Development Days (there were a total of 10), breakfast for both staffs was provided by administration in a common space so that all members would have the chance to get to know each other better in a less structured, low-risk environment. Additional opportunities were also provided throughout the year

both within individual staffs and collectively through luncheons. Some of these were provided for staff, and some were potluck, thus further developing teamwork.

Throughout the year, staff from both schools gathered collectively for common professional development day sessions (First Aid; Mental Health; First Nations, Metis, and Inuit information).

In an attempt to further support collaboration, time was allocated on each professional development day for teachers to work together in subject and grade teams. Following this time, a collaboration form was given to teachers to assist with focusing collaboration as well as giving necessary supports. The forms contained the following guiding questions:

- Today we worked on...
- Something we are thinking about for future collaboration...
- I need assistance in the following ways...

Data

We realized quite early in the process that much of our data would be qualitative in nature. This research study focuses on the depth and experience of collaboration for teachers and will chart the gradual evolution of an organization. The qualitative process of the project is as much a part of the research as the quantitative data that ensues.

To gather quantitative data, we decided to use a collaborative process. During a professional development day at the beginning of the year, teachers from both schools came to the gym to work in mixed groups. Each group began with one of our initial questions as we worked to find out what teachers valued in collaboration. This process was based on best practices we found from other research: giving teachers time to work together on questions that have meaning to them. After each group had worked on its question, groups rotated to the next table. There, they read what the previous group had written about that question and then added to the answers. In this way, all teachers were able to answer all questions and teachers were able to engage with others in their own groups. At the end of the exercise, teachers were invited individually to put a checkmark beside the answers which most resonated with him/her.

This process yielded interesting qualitative results. Unsurprisingly, teachers initially were hesitant to break out of their traditional groups and had to be coached to do so. Teachers were also coached on following a positive brainstorming practice, where crossing out others' ideas was not allowed. Reading other groups' answers was valuable, as the new team was able to engage positively with other groups. One of the most commonly heard phrases was "Yes! Exactly!" as teachers read the work of previous groups. This process set the stage for future collaboration to have a positive tone as teachers across all grades, subjects, and schools saw that they have similar interests,

needs, and experiences.

The data showed that, overall, teachers at Aurora had similar thoughts surrounding the four questions posed. The following charts explicate the specific quantitative results gathered through this process.

Chart One

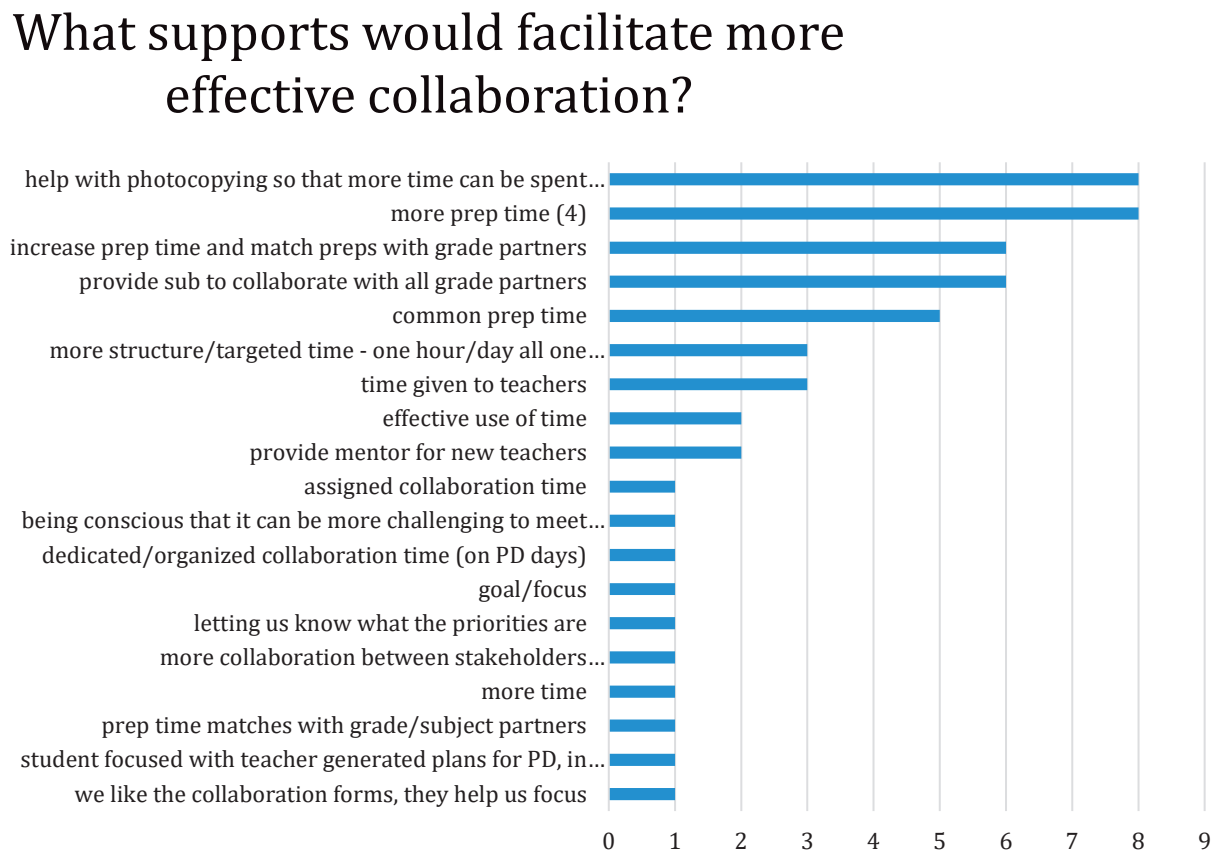

Chart One answers the question, "What supports would facilitate more effective collaboration?" The goal of this question was to ensure that this research project truly models the goals of collaboration by coming from a place of true curiosity. Rather than make assumptions about what teachers require from their administration, or parroting research that had been done in other contexts, we ensured that teachers had the opportunity to participate in the decision-making process. The overwhelming answer was solution-focused, but mirrors other research: teachers need support with administrative tasks so that they have more time to collaborate with each other. At our school, that translates into help with photocopying, more prep time, and scheduling prep time so that teachers who need to collaborate can take it together. In all, the top seven answers dealt with administrative support to release teachers' time. Four of the other supports dealt with ensuring that scheduled collaboration time and activities were organized, focused, targeted, and effective.

Chart Two

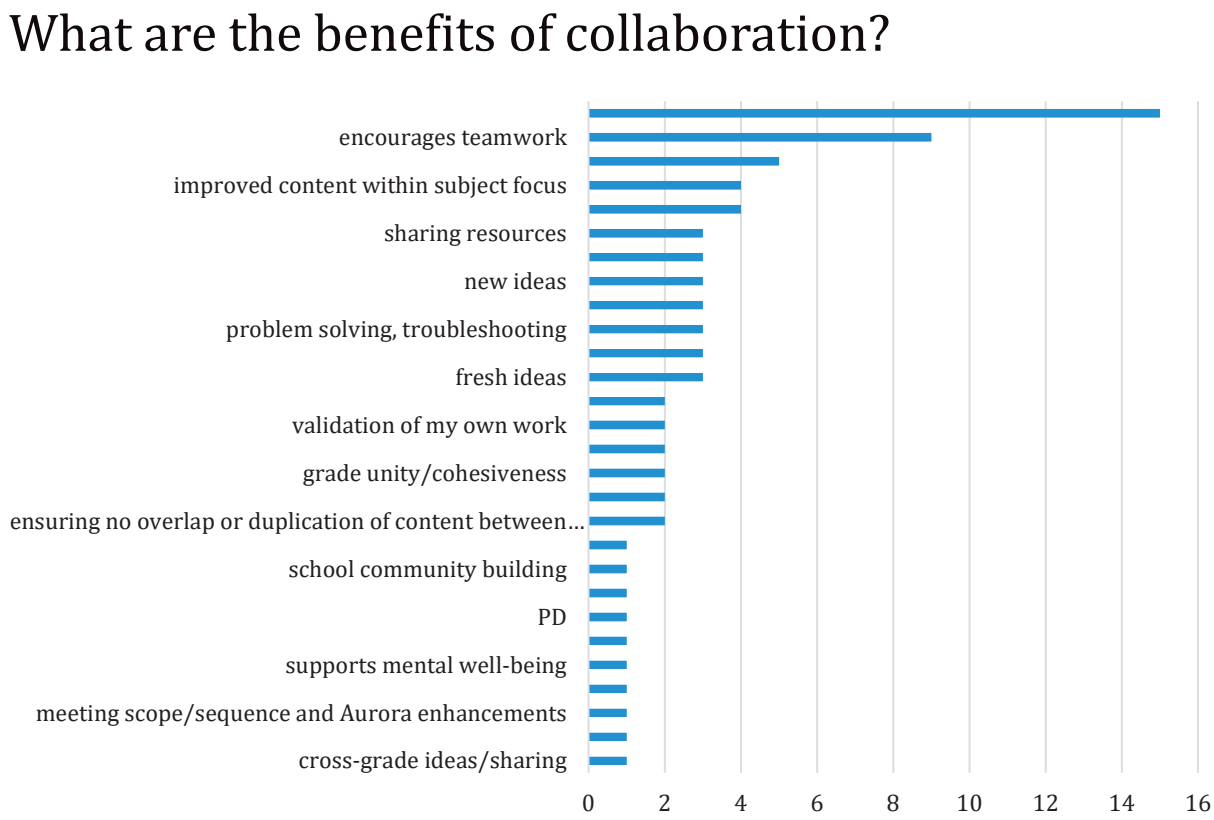

Chart Two answers the question, "What are the benefits of collaboration?" The purpose of this question was, again, to involve teachers in the collaborative process. Although administrators are responsible for setting organizational goals, as Knackendoffel (2007) shows, true collaboration must be voluntary and based on important, mutual goals. Without teachers seeing the benefit of collaboration, this research project was doomed to fail. Again, however, it was the teachers leading the process because they are the ones generating the reasons to collaborate, rather than being told the reasons why this research project is necessary.

Again, answers were grouped into obvious themes. Ten of the top 13 answers revolved around the idea of gaining support from other teachers, whether socially, through positive relationships; or pedagogically, through access to shared resources and ideas; or professionally, through feedback and validation. The second most popular theme focused on ensuring a cohesive program for students through common outcomes, timelines, and tests while avoiding duplication and overlap. When taken with the data from Chart One, it becomes obvious that teachers at Aurora are looking to collaboration as a method of improving outcomes for themselves and their students, but are looking for increased time to do so. This collaboration should focus not only on strengthening curricular goals but also on social cohesion, because the number one answer was overwhelmingly about the social aspect of positive work relationships.

Chart Three

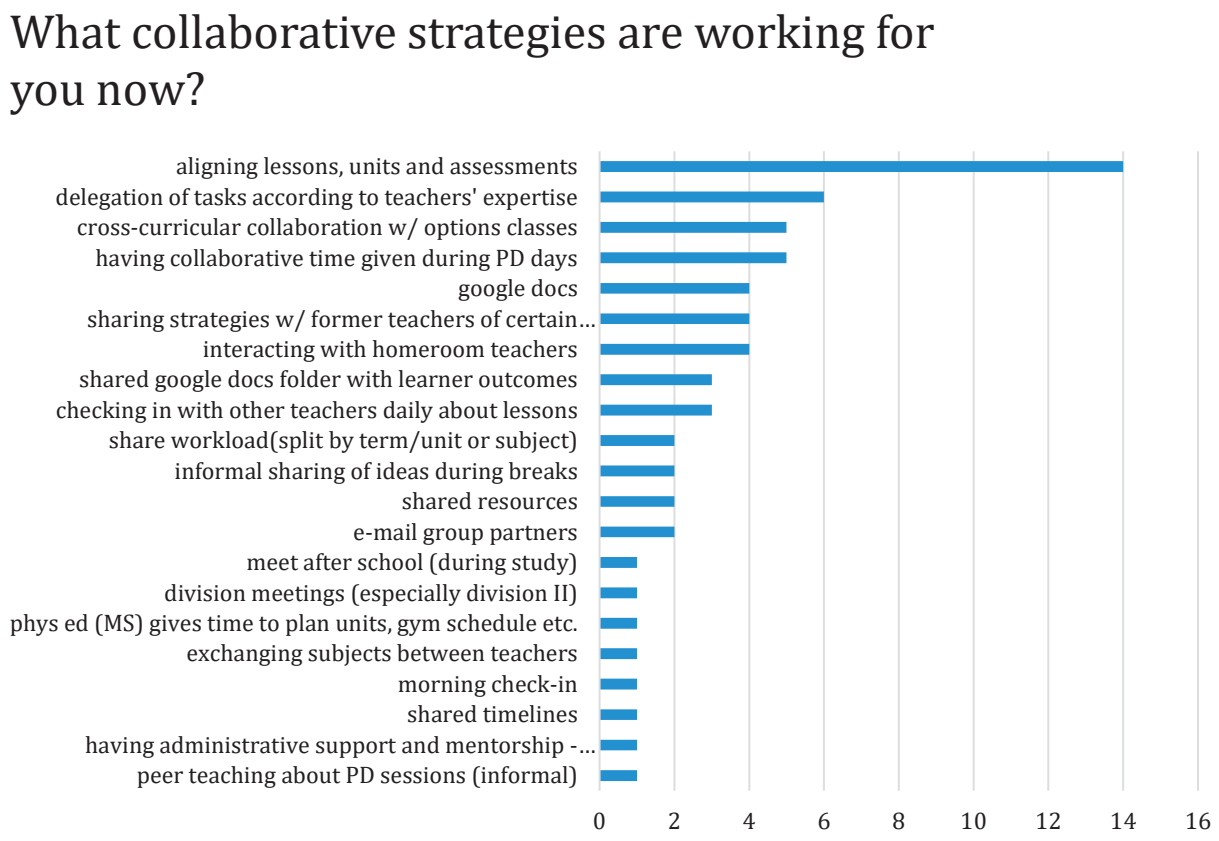

Chart Three answers the question, "What collaborative strategies are working for you now?" Rather than focus on a top-down approach by instituting strategies from an administrative perspective, we wanted teachers to reflect on the best practices they were currently using themselves. Following the collaborative process we used to collect this data, teachers were able to take responsibility for freely sharing what had worked well for them in the past. Collaboration is a part of any workplace and will take place whether encouraged by administration or not. Our focus with this research project was to understand the processes and foci of current collaborative practice and then expand it, while also following best practices as found in current organizational research. We were not attempting to re-invent the wheel; rather, we were thinking as ourselves as "putting gasoline in the car."

Interestingly, while the main benefit teachers listed was social, the main strategy was curricular, which included "aligning lessons, units, and assessments". This strategy relates to the pedagogical support teachers found to be a benefit of collaboration. The second and third most popular strategies, delegation and cross-curricular collaboration, relate to the validation and support that teachers listed as a benefit of collaboration. The most popular methods of collaboration were PD days, the use of Google docs, and face-to-face time to discuss individual classes or students. Each of these strategies relates to a

different purpose: PD days for strategizing; Google docs for creating; and discussions for implementing. These findings will be most important to our implementation of a new collaborative project in phase two of our action research.

Chart Four

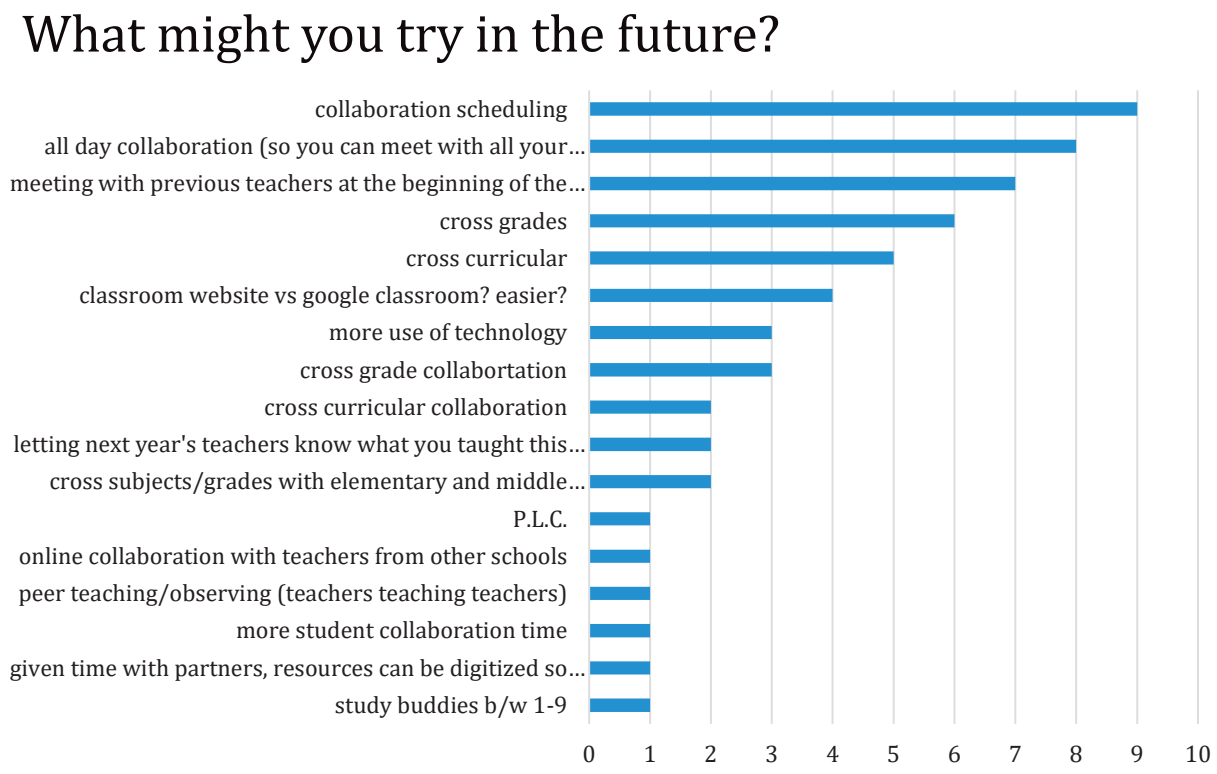

Chart Four focuses on stage two of our action research project: "What might you try in the future?" By asking this question, we were interested in finding out if there were certain things that teachers were curious about or open to. Rather than starting from assumptions, we tried to follow best research practice in having teachers take responsibility for their own collaborative goals. Considering that we learned that time is one of the biggest barriers, it is no surprise that the top three ideas for future practice focused on carving out time specifically scheduled for collaboration. The fact that so many teachers were interested in cross-grade and cross-curricular collaboration bodes well for the future of this action research project, because research has shown that true collaboration requires teachers to take responsibility for the process and products. Collaboration cannot be a top-down mandate.

Key Learnings

1. Scheduling and time were found to be the most important factors enabling collaboration.

2. Teachers see social, pedagogical, and professional benefits to collaboration, and are most interested in the way that collaboration enables a positive working environment.

3. Teachers see collaboration as a way to access support from other teachers.

4. Teachers currently are focused on collaboration as a strategy to achieve curricular goals.

5. Teachers find face-to-face professional development days to be the most beneficial approach to collaboration, in part because of the social benefit of collaboration.

6. Teachers use face-to-face approaches to collaboration for strategizing and implementation and online platforms for creating materials to meet the collaborative goals.

If we are going to proceed with the next phase of this action research project, we will need to ensure that collaboration time is focused, efficient, and scheduled; however, we will also need to ensure that the social benefits of collaboration are not neglected by focusing too narrowly on pedagogical objectives.

We will also need to ensure that face-to-face collaboration time in built into the schedule, as technology provides a tool to create materials, but teachers find that working together in the same space meets multiple goals of collaboration.

Teachers need the freedom to choose an authentic collaboration project that will affect student achievement if we are to ensure that they take responsibility for the success of the collaboration and have rich, meaningful projects that provide personal benefits.

What's Next?

The second phase of the project will use our findings to facilitate improving student achievement through collaboration. We will work to create measurement tools to measure the efficacy of collaboration, because collaboration is a tool, not an end in itself.

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Considering First Nations' Perspectives in Successful Music Pedagogy

By Ron Ceilin

On top of Ron's education degree, Ron has a degree in mechanical engineering, a diploma in recording arts, and vast experience in music composition and performance. After 12 years as a production and manufacturing engineer while co-owning a commercial printing and manufacturing company and freelancing as a musician, Ron decided to devote his time and effort, and offer his life experience, to the service of educating children. Although Ron's varied education and experience offers support in science and mathematics, Ron's passion has become providing music education. Presently, Ron teaches at Aurora Academic Charter School in the subjects of middle school math, science, and music.

My Research Concern

In beginning to work through an action research project, my interest is in adding First Nations' perspectives to music. Specifically, utilizing successful music pedagogy, is it possible to "draw out" rather than "push in" First Nations' perspectives?

Background Information

Recently, the province of Alberta has worked to incorporate a First Nations, Metis, and Inuit (FNMI) Education Policy Framework into its educational work. This policy has been explicated in a number of provincial documents. Main among them is the document titled GUIDING VOICES: A Curriculum Development Tool for Inclusion of First Nation, Métis and Inuit Perspectives Throughout Curriculum. As well, the "Circle of Courage" philosophy and model (described first in the book *Reclaiming Youth at Risk* (2012), authored by Larry Brendtro, Martin Brokenleg, and Steve Van Bockern) encourages positive youth development by integrating Native American philosophies of children's development and contemporary resilience research. This Circle of Courage work is based in four universal growth needs of all children: belonging, mastery, independence, and generosity. *Reclaiming Youth At Risk* offers strategies for helping troubled youth by outlining the roots of discouragement in youth (destructive relationships, learned irresponsibility, and a loss of purpose) and offering ways to mend that broken circle and to reclaim lost youth. Finally, *Walking Together: First Nations, Metis and Inuit Perspectives in Curriculum* is a curriculum digital resource built for Alberta's school children (K-12) that provides authentic information about, among other things, FNMI worldviews, symbolism, and traditions; FNMI oral traditions, culture, and language; FNMI Indigenous pedagogy; Aboriginal and treaty rights; and help in healing historical trauma.

Hypothesis

I began this action research project from a belief that successful pedagogy, particularly in the field of music instruction, has inherent First Nation's perspectives. To have a successful music program, there must be a willingness to dedicate time and effort into

music goals both independently and interdependently. First Nation's perspectives are helpful because they provide a platform for the importance of music as a human imperative. [More will be discussed about these integrations later in this article.]

Action Research Design

My action research project design is based upon an interview with Francis Whiskeyjack of amiskwaciy academy. My intent was to discuss with Francis First Nations' perspectives and how music plays an important role. Then, based on Francis' interview, I hope to construct a list of characteristics that outline First Nation's perspectives. From this list, my hope is to develop one or two leading questions I can use to generate a discussion with various music teachers about their insights as to how they define a successful music program and what pedagogy has been effective in order to nurture their own music program. Hopefully, these discussions can help extract and examine characteristics that connect with First Nation's perspectives so that I can represent them on a graph.

Initially, I have chosen a number of possible leading questions to ask other music teachers:

1. Tell me about the shape of your music program.

2. What do you consider to be a successful music program? And, why?

3. Consider a time when you considered your music program to be very successful. Outline the reasons you consider to be integral to that success. [Why did it work? What did you have to do to support its success?]

My hope is to establish a data sample based on input from other music teachers and/or school administrators. This data sample should be across grades 7 through 12. In total, my hope is to engage in up to 12 interviews, two at each grade. In total, although I have not received confirmation from all of these music teachers, I have outlined the teachers I hope who might be part of my community of practice for music pedagogy.

Again, although I am still in the planning stages for my work, my general plan will be to interview the teachers in the data sample who are willing to talk with me. I am currently uncertain whether these interviews will be focus group (a number of teachers discussing together) or individually interviews. From these interviews, I hope to draw successful pedagogical ideas that relate First Nations' perspectives, to chart the data, and to draw a number of conclusions from my findings.

Of these interview questions, one or two will be based on perspectives provided by Francis Whiskeyjack from amiskwaciy academy. Other interview questions will be drawn from a list of characteristics based on First Nations' perspectives. Finally, a successful music program as defined by the interviewee (Is it participation? Awards? Dedication? Interaction with other aspects of the school community? Students carrying

on with their music after high school? Students' ability to define their musical voice? Out of school interactions among students? Success of extracurricular programs? Parent participation? Student enrolment?)

I will interview a number of music teachers, most of who teach music as an option but one who teaches mandatory music. Teachers' responses to interview questions and how those responses reflect First Nations' perspectives will be charted by results. My belief is that a chart would help visually represent the data. Teachers might also add new perspectives, and these can be discussed with Francis and tallied as well. Hopefully, my observations and any insights from the data I collect from interview discussions can be included on either graphs, charts, diagrams, or calculations.

Initial Timeline

The following chart outlines my initial timeline as I see it now.

Task	Timing
Talk with Francis	Mid February - DONE
Extract characteristics of First Nation's perspectives	Beginning of March - DONE
Prepare data group list	Mid March - DONE
Prepare leading questions	End of March - DONE
Set appointments with data group participants and record their interviews	Month of May
Extract community building characteristics from interviews	Summer 2017
Rough draft of findings	Summer 2017
Prepare initial in-progress paper	Summer 2017
Present findings	To be decided

Work Thus Far: Action Research Journey

It all began when I went on a Professional Development day to Boyle Street Education Centre and amiskwaciy academy. Both experiences were very fulfilling, but I really resonated with amiskwaciy, particularly Francis, the elder, and Fred, the principal. I came to believe I would like to collaborate on a music project with Francis.

When I suggested this to my principal, she liked the idea and supported my collaboration. Word got out and our superintendent suggested I do an action research project pertaining to this collaboration as it was timely and would lend itself well to First Nations curriculum augmentation.

My first formal meeting with Francis was to establish a learning opportunity for students to build some authentic frame drums. As I toured the school and then sat down and talked with Francis and Fred, my perspective began to change. It wasn't just about drums anymore but about the "Truth" portion of "Truth and Reconciliation." At first, we discussed how the "Circle of Courage" was being implemented at amiskwaciy. I saw parallels between the "Circle of Courage" and Steven and Sean Covey's "Leader in Me" philosophy, to which I was a lighthouse member at a previous school. I also knew of several other protocols that schools implemented to provide students with scaffolding towards stronger values and better citizenship.

I had studied *Reclaiming Youth at Risk - Our Hope for the Future* by Brendtro, Brokenleg, and Van Bockern as well as *Secret Path* by Gord Downie and Jeff Lemire. I eventually saw that there might be a link between First Nation's values and perspectives and how we can apply cross-curricular competencies to our pedagogy by utilizing these values and perspectives. Essentially, I was attempting to determine a unified perspective based on First Nations' values and perspectives.

Upon discussing my initial thoughts at our Action Research meeting in January, I realized two things:

1. I would prefer to "draw out" these perspectives from various teaching practices rather than try to "push in" the values and perspectives. I wanted to find the present philosophies that underpinned a quality school culture rather than dictate the qualities that my research might find. My experience suggests that implementing new "habits" is always more challenging than first expected. I have come to believe that you must first determine and abolish an old habit before implementing a new one. For this reason, the "pushing in" principle isn't always effective. In my experience, the method of "pushing in" was what was being implemented through these various protocols at different schools and it was having limited success.

2. The perspective of music teachers alone would provide enough data to flush out these values and perspectives. It would be important to consider music programs considered "successful" because only those programs and teachers would possibly

> have values that could be "drawn out" of the teacher's philosophies. I would allow these teachers to define what they considered a "successful" music program and then allow them to describe how and what they implement in order to achieve this success. Then I would link parallel principles by comparing Francis' teachings and other teachers' perspectives. From this I could quantify my data to produce visuals and because I can quantify my data, I decided to structure my research based on a method that is familiar - the scientific method.

My second formal meeting with Francis offered me the opportunity to narrow my field of research to the value of community building. It wasn't so much what Francis said but a reflection of the environment at amiskwaciy - particularly their "morning song." It was my belief that without a strong sense of community, all other values would break down. I was also reflecting on my experience teaching in various band rooms as well as my personal experience as a band student.

Again, I didn't want to blatantly ask music teachers how they build community, I wanted to "draw out" the values in their present pedagogy and allow them to talk about what they believed. I came to believe I could create a number of leading questions that might provide music teachers a platform from which they could present their beliefs without influencing their thoughts. I decided I would interview Francis formally to accumulate the aspects of community building that could be reflected in what the music teachers presented. In this way, I could quantify my findings and prepare visuals.

My third formal meeting with Francis was a formal interview where I audio recorded his responses. As an addition to my findings, I wanted to present my findings in a way that respected First Nations traditions - that being the aural passing of information and experience from elders. I decided that my final paper wouldn't be paper at all but a YouTube video or podcast with verbal responses from each of my interviewees.

During this interview, Francis, once again, changed my perspective. His responses were not focused on community building but on the value of music. As I listened to the interview, I was moved towards a more enlightened perspective on music itself: not that music provides outlets to more tangible endeavours like language, math, science, or even cross-curricular competencies, but that music, in and of itself, is a human imperative. From this interview, I was able to extract ideas about these perspectives. Currently, my intention is to interview several music teachers who are in, or have established, successful music programs and see if their values and perspectives, as engaged in the context of their programs, emulate the First Nations' values and perspectives Francis provided.

After our cohort's action research meeting in May (2017) and the information provided then, which seemed to outline the purpose of Action Research better for me, I feel that this final approach to my project is best suited to this type of research. The focus of my career, although not intended, has been music pedagogy and my values and perspectives have been heavily influenced by my musical pursuits. This action research will only

enrich my perspective and better my understanding, which, in turn, will better my practice and my relevant networks by collaborating with other music teachers.

Problems remain to be solved before I move forward in my data collection. As my action research goes forward, I soon realized finding interviewees and potential interviewees might be difficult. I have had to work around schedules and contact and re-contact people. It's my hope that, in utilizing the summer to interview music teachers, I will have better success and will be able to conclude my research and present my findings by the beginning of the next school year.

I suspect that my action research process will be iterative: that is, I will come back to my interviews and extract more information and re-listen to interviews to refine my data. As it stands, I have a summary of seemingly pertinent parallels I extracted from my formal recorded interview with Francis. They are as follows:

Key Points of Francis' Interview

#1) Our teachings come with an aural pass down rather than a writing down. To learn from our elders, a lot of times we have to listen. A lot of times it's about "showing and telling."

Connection: Evidence in a successful music class might be best based upon skill studies through performance rather than written "method" books or study material.

#2) Elders were given the purpose of teaching.

Connection: Evidence in a successful music class centers upon whether the teacher is knowledgeable and proficient in music. Possibly the teacher plays one or more instruments well or at least is knowledgeable about what is good sound on an instrument and how to get good sound on an instrument.

#3) Everything connects to all living things such as plants and animals. The history of [First Nations] music has to do with our relationship and connection to the universe, to the Earth, and to all the plant and animal life.

Connection: Evidence in a successful music class can center upon the historical significance of music as a human imperative in the same way as (1) Eating, (2) Breathing, (3) Bonding with others, and (4) Connecting with nature.

#4) Music is beyond entertainment. Why did men start singing? Listen to the birds. Birds sing when they're happy. That transfers itself to the good energy of what the song does for an individual. If a bird is sick, it will not sing. Song has to do with communication - whales sing, wolves howl. When it is time to hunt, it is time to build community together. Song is about telling stories, about community gathering, about ceremony, console people that have lost loved ones, communication to the spirit world.

Connection: Evidence in a successful music class centers upon the purpose of music and from where it evolved. There is a human element of music. It's a connection to our prehistoric past. Music's historical importance can be found when a person sings or hums, they're like that bird, they are happy or they're consoling themselves.

#5) Tempo is part of music's communication as well. Songs can have a healing effect. They can put the soul in a meditative state, into a healing place – music is a place of harmony and peace.

Connection: Evidence in a successful music class is that music has a role in the therapy and emotional state of humans.

#6) You have to give in order to receive. Tobacco, known as the first medicine, is used to give back to the spirit world after taking from it (killing an animal or tree). They are giving their life so you can heal. This is the story about the connection that we have and how song, dance ... everything like that leads to community. It's done as a ritual - the ceremonial aspects of music are important at first, and then you bring that energy to other people.

Connection: Evidence in a successful music class centers upon (1) Sharing and (2) Community building. Performance links with collaboration.

#7) Never carry bad energy to the ceremony because that energy will carry itself to the people that are with you.

Connection: Evidence in a successful music class is that it practices to provide best performance - audience empathy. Good music pedagogy must find a way to have music reach as many students as possible - not forced but accommodated.

#8) From a native perspective, there's a very close connection to music, food, ceremony and community building. Communicating with drums served the purpose of bringing community together. Every culture has a natural rhythm, drum or instrument of some kind.

Connection: Evidence in a successful music class is exposure to provide varying perspectives.

#9) Identity and music go together, which means that music is universally important - in and of itself. The most important aspect of music is how it soothes the spirit and how it lifts people up. It helps to forget for a while so it supports healing.

Connection: Evidence in a successful music class is the recognition that music as a human need or imperative and not just entertainment.

#10) If you're ever wondering if music truly does sooth the spirit or move the spirit, just look at children when there's music around and watch their movement. A child is truth. If that child is sad, they will not dance. If they're happy, they'll be jumping around.

Connection: Evidence in a successful music class is how the program “knows” that music has touched students and audience.

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Individual Pursuits as Project-based Learning

Janice Dinel and Lori Vigfusson-New Horizons School

Janice Dinel has been a teacher at New Horizons School since 2001. In that time, she has taught a variety of grade levels and different courses. Her love for technology drives her to seek learning opportunities for her students that enhance their skill sets. Throughout her 16 years of experience with gifted learners, she has come to understand their unique needs. She strives to incorporate a more project-based learning approach in her teaching as a way to engage and push gifted learners to be creative problem solvers in a collaborative environment. This action research project was borne out of this need to provide this approach, but yet preserve the unique learning needs of each student.

Lori Vigfusson has been a teacher since 2006 at New Horizons Charter School in Strathcona County. She received her Masters in Education in 2015 and moved into the role of Vice Principal. She is also the school counsellor, providing social and emotional support to students in individual, small group, and whole class settings. Her 11 years of experience working with gifted students has allowed her to learn much about working with this unique population. She loves helping students find the joy in learning and has always strived to provide engaging, hands-on learning opportunities where students can collaborate and share their discoveries with others.

Keywords - PBL, Project-based Learning, Individual Pursuits/Independent Study, Inquiry, Collaboration

Summary/Abstract

This research focused on how to move individualized student research projects (Independent Studies) to a more project-based approach, yet still allow students to explore a research area that would be of their own choosing. Our first strategy moved from topic-based inquiry to a problem/question based inquiry, which is more in line with Project-Based Learning (PBL). Our second strategy moved toward a more collaborative approach in the inquiry process. This approach incorporated the collaboration aspect of PBL to solve inquiry problems. Finally, we incorporated a number of PBL components into our lesson plans including: PBL Elements from the Buck Institute for Education, PBL protocols, surveys, student self-reflections, and interview questions. Essentially, our research focuses on how, as teachers, we might change individualized student learning to more collaborative student learning.

Context

Our research took place with three Alberta elementary classes from a Charter school within central Alberta. Charter schools are unique in that they are publicly funded and therefore accountable for the Program of Studies as set out by Alberta Education; yet, each school has a specific mandate or charter for which it is also accountable. The school in this research includes kindergarten to grade 9 with about 250 students and has a charter of meeting the academic, social, and emotional needs of gifted learners.

The classes involved in the research were grades 4, 5, and 6 with a total of 68 students. The school's charter mandates that the school will "Promote specific projects geared to individual student interests and abilities while focusing on in-depth research and the development of strong presentation skills." To meet this mandate, every student in the school completes an Independent Study (I.S.) research project each year based on a unique area of interest to that student.

The school also has a focus within its Education Plan to incorporate Project-Based Learning activities throughout the school year. Because the format of the I.S. was intended to be inquiry-based and allowed students to research and share information on a passion area, some aspects of the I.S. fit within the Project-based Learning model and so became a strong foundation upon which to base our research project.

Aims and objectives

How can we move our independent studies (individual pursuits) towards using a project-based learning approach?

At the onset of our research project, we were hoping to address three main problems over the course of our study. These were:

1. As previously mentioned, our school is moving towards implementing a more project-based learning approach to deliver learning outcomes.

2. We have also had an ongoing desire to improve our Independent Study projects to make them more meaningful to students and allow greater engagement within these individual pursuits.

3. Students at our school have access to a lot of technology (a 1-1 ratio from grades 4-9) on a Google platform and we were looking for ways to better incorporate this technology into student learning.

In the beginning, our interest was primarily how we could use technology to assess and manage project-based learning. We soon discovered the vastness and complexity of such a task. We narrowed our investigation to how we could use Google applications to manage and assess project-based learning. With this in mind, we began to explore areas in our current program that could be improved through a Project-based Learning approach using technology.

We had previously decided that our Independent Study (I.S) projects from grades 4-6 would be a good context for collecting our research data. We have linked our Independent Study projects in the Alberta Language Arts Program of Studies General Outcome 3; "Students will listen, speak, read, write, view and represent to manage ideas and information" (Alberta Education, 2000). Through this outcome we assess the skills associated with research rather than the content so students are free to choose a topic that is of interest to them. Many key components of Project-based Learning were already embedded in the I.S. projects and technology use was also a key component to

the research and presentation components. Through further discussion and understanding of Project-based Learning, we concluded that, although technology was a valuable tool in implementing project-based learning activities, it was not where the focus should be to move our educational program forward. Rather, we realized that we had an opportunity to improve the depth and complexity of these I.S. projects by including a more PBL approach.

This opportunity felt like a more meaningful approach to our research because it solved a problem we had been having about how to improve upon our current I.S. projects while at the same time incorporating more PBL into the learning environment. After studying the issue, we had that Project-based learning would provide deeper learning opportunities for our students; thus, our new question became:

"***How can we move our Independent Studies program to a more project-based learning approach?"***

Related Literature

As part of our research, we conducted a literature review. The literature review found here explores research in project-based learning and best practices within gifted education. Although our research took place in a congregated setting with gifted learners, we believe this review is applicable to a variety of learners across many grades and learning environments.

Project-based Learning

There are many definitions of project-based learning (PBL). For our research, we focused on the idea that "project-based learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge" (Buck Institute, 2017). *Gold Standard PBL* (Larmer, Mergendoller, & Boss, 2015) notes seven essential elements to successful project-based learning activities: Student voice and choice, Authenticity, Sustained Inquiry, a Challenging Problem or Question, a Public Product, Critique and Revision, and Reflection.

PBL Benefits

Project-based learning has a variety of benefits: these include student engagement and acquisition of 21st Century skills. Soporat, Arnold, and Klaysom (2015) found that students participating in PBL learned the following 21st Century skills: Communication Capacity; Thinking Capacity, which includes students "show[ing] that doing projects helped them pay more attention" (p. 17); Problem-Solving Capacity; Capacity for Applying Life Skills through collaboration and supporting one another; and Capacity for Technological Application. This article also found that low-ability learners reflected on improvement in collaboration and high ability learners reflected on improvement in their ability to solve problems (2015).

In *PBL for 21st Century Success,* Larmer, Mergendoller, and Boss (2013) found that using PBL in the classroom improved achievement, helped students master 21st Century skills, provided equity amongst diverse learners, improved motivation in learning, and increased job satisfaction in teachers who had shifted their instructional pedagogy to PBL.

Gifted Education

Gifted Learners should be provided with regular opportunities "to be unique and work independently in their areas of interest" (Rogers, 2007, p. 385). Independent study projects provide opportunities for students to engage in meaningful research on individual areas of interest. Rogers also believed schools should "provide opportunities for gifted learners to socialize and to learn with like-ability peers" (2007, p. 388). Collaboration is a key component of Project-based Learning, and this collaboration provides students regular opportunities for socialization and peer feedback.

Kanevsky and Keighly (2003) explored factors contributing to boredom in gifted students who disengaged from classroom learning. They report that 5 Cs were necessary to keep students engaged in learning and to avoid underachievement: "control, choice, challenge, complexity, and caring" (p. 22). Our Independent Study Projects met these 5 Cs, although these seemed to be lacking in complexity for some students. By layering the PBL approach over our existing I.S. projects, we were able to help students create more complexity in their projects. All students in the study stated a need for complexity in their learning. "They sought novel, authentic, abstract, open-ended experiences" (2003, p.24). Students enjoyed tasks that allowed for high-level critical thinking and questioning that allowed them to express their emotions and/or interests.

Strategies We Discovered that Improved our PBL Experience

In reviewing what we have learned through our research, the following Steps emerged from our study as useful ways to promote effective PBL in our classrooms.

Step 1: Front-end loading (prior to kick-off event) individual classroom activities/lessons (approximately 1-2 weeks ahead)

First, our study found that we could improve student learning by teaching note-taking skills that helped students organize their research notes and helped them translate more complex documents into their own words. We found that teaching this skill was also beneficial throughout the year in other subject areas. To teach this skill, we reviewed Bloom's Taxonomy and focused on asking students questions, especially higher level questions, to help prepare them to write their Big Question. We also worked with students to turn their topics into questions.

We engaged a PFL (Possibilities for Learning) survey from Lannie Kanevsky in our grades 4 and 5. However, for the purposes of this project, using this survey did not add value to choosing the Big Question and focusing research questions, which we had hoped. However, we found that citing works for research about activities specific to

grade level helped us introduce the 9 themes that added complexity to research as recommend by Kanevsky. We also used these to group students for collaboration.

Second, our study found that increased communication with parents prior to commencement of IS was helpful. Specifically, each teacher sent a memorandum to parents regarding the following: (a) nature of the project; (b) how the project was tied to curriculum; (c) expectations for project during school as well as outside of school; (d) appropriate ways for parents to assist students in the project; and, (e) additional information such as student resources and project components.

Step 2: Kick-Off Event

Three TedTalk choices were offered, and our students signed up for one of these. These choices were authentic examples of how young people conducted meaningful research. Students watched and then collaborated in small table groups to come up with possible themes and Big Questions that could result in the end product (TedTalk). Then, at each grade level, students were provided time to come up with a Big Question from their topic and then assign a possible theme that question would fall under.

Step 3: Proposal Writing for Research (planned focus for inquiry)

The focus in this step was to write higher-level questions to guide sustained inquiry. The summative assessment for this would be a written proposal. Grades 4-6 attended a seminar titled Creating Higher Level Questions. The seminar showed students how to take “lower-level (less) thinking questions” (knowledge and comprehension on Bloom’s taxonomy) and turn them into “higher-level (more) thinking questions” (application, analysis, evaluation, and synthesis). After the seminar, students did two classroom activities to follow up: these were (a) Answering Questions - Little, More, Most and (b) Raising the Question Level. Additional instruction occurred at the classroom level for specific requirements at each grade level to help students prepare questions for their proposals.

Before submission, students engaged in a Fishbowl collaboration activity to share their proposals for critique and revision (PBL Component). This activity proved to be really helpful, but we came to see that more attention to student groupings and a more time modelling should be spent on how to provide good feedback. Students were allowed time to make revisions before handing in the proposal two days later.

Step 4: Research

The focus of this Step 4 was to help students gather information to answer their guiding questions. We began the research phase with a seminar on using library resources before visiting our local Strathcona County Library. The seminar included instruction and practice determining and using keywords while searching for resources. We then had students go onto the online library catalogue to look for sources and record their call numbers. Students also explored the online reference centre and we discussed the importance of gathering valid sources and suggested encyclopedias as a good starting

place for their research. Students were given a template for properly citing sources and were reminded to cite sources as soon as they began recording information from them. At the library, we divided students into groups of 4 and 5 with a parent volunteer to help locate and sign out books and other sources.

After our library visit, students were given approximately two weeks to read and record research findings. Students were encouraged to adjust their questions and research focus based on information needed to allow students to answer their deeper-level questions as part of sustained inquiry. Students met during this time using the Peer Critique Protocol (see supporting documents). The purpose of using this protocol was to foster collaboration as well as provide an opportunity to critique and revise research (PBL elements). The collaboration was useful for those students who were at a further point in their research. Some students did not feel they had gathered enough information to collaborate at this point and they suggested that, in the future, a longer research period might be useful along with a later collaboration so that information could be more thoroughly assessed and more useful feedback given.

At the time, it was felt that a full week of research was enough for students to complete their research; however, after presentations, it was clear that students needed longer sustained inquiry to fully answer their deeper questions. Grade 6 also needed more time both due to a greater number of higher-level questions being required and because they needed additional time to set up the expert interview required for authenticity at this grade level. Students were provided research organizers for recording research and grade level rubrics to help guide their inquiry and communicate their projects' criteria in relation to Alberta Education Program of Studies. (These items are also included in the supporting documents.)

Step 5: Presentation

A number of different information sessions were presented to students. All grade 4-6 students attended a seminar on Google Slides, which focused on slide show etiquette and using Google slides as a presentation tool. Grade 4's attended a classroom presentation on Do's and Don'ts of presenting in front of an audience. Grades 5 and 6 engaged in a classroom discussion and instruction on presentation skills. In general, we found that students seemed to need more assistance in the area of presentation skills because many had difficulty demonstrating these skills at a proficient level on the presentation rubric.

In general, we found that more time was needed to allow students to both prepare and practice their presentations. The Fishbowl protocol occurred too early and did not allow students to prepare and practice their presentations and to receive valuable feedback.

Presentations were held over a series of afternoons with the IS Fair on the last afternoon. Both were open to parents and students signed up for presentations they wished to watch. In discussing our work as teachers, we came to believe we should assign presentation dates and times earlier so parents would have adequate time to

make arrangements to attend the presentations and to inform teachers of student absences.

A Google Doc was shared with all students that provided a short synopsis of the content of their presentations. An online software application was used (School Interviews.ca) for students to sign up for presentations. This application did not work as well as we hoped because it was complicated to set up and difficult for students to use. An alternative needs to be found.

Additionally, students prepared a booth based on their Big Question. This IS Fair (which was an hour long) was a public affair open to all students and parents. We found this fair provided an authentic aspect for students. However, an hour was not long enough; so, in the future we decided to give students an additional hour so they could participate to view other booths. We observed that many students would have benefited from additional direct instructions about how to prepare a good booth. We will include such directions in the future.

Step 6: Student Self- Reflection

Reflection was the final key aspect of Gold Standard PBL and we wanted to provide students opportunities to reflect on the process and their own learning. A Google Form Survey was sent to students that included questions about the various aspects of the project. These surveys were completed independently so students could comment on their own performances during the inquiry process. We found that, although some students found this step useful, more time should be allotted to review the questions with students and for more thoughtful reflection. This aspect was new to the Independent Study Projects and worked well. (The survey is included in the supporting documents.)

Our Data

We collected qualitative data using teacher self-reflections and teacher conferences to compare and contrast our past Independent Study projects with the project-based learning model as shown in the chart below. We wanted to see how our original format of Independent Study projects compared to Project-based Learning activities so we could see what areas needed to be changed.

Independent Study prior to PBL	**Independent Study using PBL approach**
Individuals working in individual Classes without collaboration	Multiple grades collaborating together using *critique and revision*

Teacher check-in on progress	Teacher check-in, self and peer check-in on quality of research using *protocols*
Topic Based	Question/Inquiry-based
Individual research based	Individual research based
Student voice and choice	*Student Voice and Choice*
No focus base for complexity	Theme base for complexity
Grade Specific instruction	Grade specific instruction and multi-grade seminars
Individual class presentation	Multi-grade ted talk style *public presentation*
Assessment on research process and presentation	Assessment on research process and presentation
Project began with instruction	Project began with Kick-off activity
Information organized under headings	Information organized under questions
Specific number of questions required	Focus on answering *challenging problem or question* using appropriate number of smaller question
Knowledge/Comprehension level questions (Bloom's Taxonomy) drove research	Synthesis/evaluation level question drives research
Sustained Inquiry	*Sustained Inquiry*
Reflection more focused on content	*Reflection* focused on research and

	collaboration process as well as presentation skills.
Limited authenticity	Increased *authenticity* due to larger scope of audience

Italics indicate gold standard PBL by John Larmer

At each stage of the project we collected qualitative data through teacher observations, informal discussions with students, teacher conversations and through assessing student work using teacher-created rubrics based on the Alberta Program of Studies for Language Arts. To keep track of our conversations and observations, we created a Google doc that included a timeline of activities and due dates for the various components of the project. Using a Google doc was the best method for recording this information, because it was easily accessible and viewable as a collaborative document. In this document we added our reflections and observations at each phase of the project so that we could keep track of what worked well and what could be changed in subsequent years. This document was completed collaboratively with all three teachers contributing based on the conversations we heard during student collaboration as well as when working individually with students at the different stages of their research.

Research Findings

Our study began with a focus on technology and PBL, but realized the vastness and complexity of such a project. Because our school is on a Google platform, we narrowed our research to Google applications/tools and the PBL focused on our Independent Studies. Critically analysing the way we deliver the Independent Studies outcomes, we realized that we needed to find out how to move this program to a more PBL approach. We used the Gold Standard for PBL and its seven essential elements to guide our remodelling of the Independent Studies program.

We found a small number of key things to do to move from a more independent topic-based study to a question and collaborative-based study. Specifically, we came to believe we should:

1. Provide instruction about how to ask deeper-level questions.
2. Provide tools to collaborate on individual projects effectively.
3. Include Google tools and applications to enhance the PBL approach.
4. Provide more authenticity.

To help students ask deeper-level questions, we delivered a seminar on how to ask deeper level questions with several follow-up activities specific to grade level. This

seminar provided the necessary Big Question or Guiding Question for PBL to ensure the complexity and depth of the research.

Throughout the project, we used several Google applications and tools. One useful collaborative activity was the sharing Google Documents between students. Additionally, students received a seminar about how to use Google Slides effectively so they could improve their presentations and also ease sharing this with their teacher and classmates. Delivery of materials to students was more efficient and effective using the Google Classroom application and Gmail. Using a Google Form for the student self-evaluation allowed us to compile data in a more efficient format to analyze.

Collaboration protocols such as the fishbowl and table talk provided students with vehicles to collaborate about key components of the project such as creating questions for the proposal, sharing research, and presentations. This fishbowl, coupled with the Google sharing, enhanced the collaborative process.

Our current Independent Studies already were authentic in the sense that there was much student voice and choice with regard to the research focus. Additionally, students had to deliver a presentation to their peers. To improve this presentation, we increased the audience scope by setting up presentations as a seminar or Ted Talk style open to not just their own grade, but grades 4-6. Students would sign up for presentations they wished to attend. Parents were also invited to these seminars. Following the presentations, all students and teachers and parents from the school were invited to an IS Fair where students created a booth revolving around their Big Question to demonstrate the key learnings from their research.

Overall, the changes we made helped move our current Independent Studies program to a PBL approach. We found that our current program did have some key components of PBL, but was missing a collaborative approach. This aspect was probably the most problematic to incorporate because each student had his or her own Guiding Question rather than all students focusing in on the same question. We turned to some gifted literature to help us find a means to group students. Using the nine themes for guiding complexity in research provided us with this means. With regard to student engagement, we noticed that students were more invested in the presentation portion and IS Fair booth. The authenticity of these two aspects held students more accountable, but also seemed to be the portion the students worked the hardest on and enjoyed the most.

For next year, we intend to make the following changes:

1. More front-end loading on creating good questions because we found the quality of research really depended on this aspect.

2. More time provided for students to research. If students changed their topic or had difficulty obtaining resources, they were short on time.

3. More focus on presentation skills and allowing more time for students to prepare. Students need more direct instruction about what good presenting is and more time to prepare visuals and practice.

4. Allow more time for students to prepare their presentations before collaborating. Many students did not have the basics for their presentations completed, so the feedback during this process was insufficient.

5. Smaller groups for the fishbowl collaborations. Students lost focus and the time required to collaborate was too long.

6. Add a peer evaluation component for the presentations. With regard to the feedback on the Student Reflection survey, students did not have a good sense of how well they presented.

7. Change some of the Student Reflection questions to better reflect data we needed and to focus on the skills and process, and also go over the survey with students to clarify what aspects they should consider before answering the questions. After looking at the survey results, we realized some of the questions were ambiguous and/or did not focus on what we wanted to analyze to improve the process.

Key Learnings

Project-based learning activities typically start with one big question that all students collaborate on throughout the research process. For our project, students created their own big questions to research and then used a PBL approach to explore these questions. Through this action research project, we learned that it is possible to successfully move Independent Studies projects toward a PBL approach provided there is enough time to complete all aspect of the project effectively. There were many benefits to PBL and using this framework for our independent study projects allowed our students to develop and practice key 21st Century skills. Student engagement increased through this process and students took more ownership over their work because there was more accountability as a result of collaboration and peer feedback.

As we discussed and reflected on our project as teachers/researchers, we found time was the biggest factor in determining success or failure at each step of the process. From start to finish, students were given five weeks to complete the project and at many points we found ourselves wishing we had provided more time to the students. PBL requires sustained inquiry to be effective and, while students were engaged in the process for a significant amount of time, there were still areas where more time was needed. For example, we found students needed more scaffolding at the beginning to be able to ask higher-level questions; so, additional time would have been beneficial to ensure student understanding. The time students needed to research their questions seemed too short, and many students commented that they would have liked more time to gather information and organize their notes. Throughout the entire project, we found that finding ample blocks of time for students to collaborate and being able to schedule

that time around other curricular obligations proved challenging. Students appreciated the collaboration time, but the sessions often felt rushed: more reflection time would have been helpful. We also found that students wanted more time for collaboration and planning and organizing their presentation.

In the future, we think it would be beneficial for any teacher planning such individual PBL to begin the instructional portions (creating good questions, use of Google tools, note taking and organizing skills) of the project well in advance of the actual project so students would have ample time to practice and hone these critical skills before more independent inquiry.

What's Next?

This action research project allowed us to determine that Independent Research projects could be moved toward a more PBL approach. One future area of study that could emerge from this research project might include gathering and analysing data on student engagement throughout the process. Teacher observations and informal class discussions suggest evidence that students were more engaged in this form of PBL research than in previous years, but statistical data was not collected to corroborate this. Another area for future study might be in the acquisition of 21st Century skills. Although students demonstrated these skills throughout the project, it is not clear to what extent this project taught and/or improved these skills in students.

This project opened our eyes to the power of authentic learning activities and the importance for allowing choice and voice in student learning. These have always been a part of our regular classroom teaching; however, we will definitely be more thoughtful to include these aspects into other areas of our teaching practice.

Supporting Documents

We have the documents listed below, but many of them are specific to our environment/project. If you are interested in any of these, please request copies via the contact information below.

- Themes (Lannie Kanevsky)
- Proposals 4-6 with rubric
- Creating Higher Level Questions Google Slide
- Fishbowl Protocols
- Google Slides Presentation and notes for seminars
- Creating and Answering Questions - Little, More, Most Slide Show and supporting activities
- Research Organizers
- Research Rubrics
- Bibliography and Citation student materials
- Presentation Guidelines and Rubrics

Contact Details

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Ziegler, C. (2015). Leadership New Horizons School Professional Development on Project-based Learning slideshow and materials from the session. Offered on September 25, 2015 available online at http://bit.ly/1hV2Ow1

Google Chromebook Implementation at Aurora Academic Charter School: An Action Research Study

Ian Gray

Ian Gray is the Director of Technology at Aurora Academic Charter School. Following a successful 13 year career as an elementary school teacher, he spent eight years as principal of Aurora Charter School before taking on the challenge of engaging students, teachers, and parents with the implementation of technology with his school division. Ian believes strongly in action research and thinks that some of the best learning is done right on ground level.

Acknowledgements

I would like to thank my colleagues, most of all, for their support. I would also like to thank the school for its assistance, giving time and resources and encouraging me to learn and grow both as a teacher and a researcher. And most of all, I would like to thank my family for their continuous and loving care in everything I pursue.

Key Words: Chromebook, technology, students, teachers, professional development

Abstract

Aurora Academic Charter School, a K-9 school in Edmonton, Alberta, Canada, hosting approximately 700 students, has had significant growth in the past few years with regard to the implementation of new technologies. This study attempted to answer some critical questions about how best to measure and improve this implementation while still progressing in the direction of growth.

We endeavored to answer the primary question of "How can Chromebooks help improve student learning and the acquisition of 21st century competencies?" as well as examining a number of other relevant queries related to technology use in schools.

Context

Aurora Academic Charter School has now completed twenty-one years as a public charter school. Charter schools were established in Alberta in 1994, and shortly thereafter, in 1996, Aurora opened its doors. With a mandate of traditional education, the school had no difficulty enrolling students, whose parents were interested in finding educational opportunities not available in the larger public system. In Aurora's early days, technology was purposefully limited because the focus was on literacy and numeracy, even having developed its own phonics program derived from the Rigg's Institute's *Road to Reading and Thinking*.

Over twenty years later, however, with a provincial mandate of innovation and a changed student demographic, the school Board has moved to a more progressive

learning approach, with technology becoming an increasingly driving factor. Significant money has been allocated for technology purchases (hardware, software, and professional development) with the intent on improving student learning and equitable access to learning tools.

Aims and Objectives

With increased funding and emphasis on technology at Aurora, we felt it was important to guide this development to best serve the needs of our students.

Our initial focus was to measure how best Chromebooks could be used to help improve student learning and the acquisition of 21st century competencies, as detailed in Alberta Education's *Framework for Student Learning*. Other key questions we examined prior to beginning this study were:

Are Chromebooks an effective means of delivering lessons?

Is there a need for Chromebooks?
Do Chromebooks support current and desired lesson plans?
Are there other solutions that address the issue?
How will Chromebooks benefit students? Parents? Teachers?
What is the learning curve for individuals involved in the project?
What are the associated costs?
In what ways, if any, do teachers use Chromebooks to differentiate teaching or learning?

To some degree all these questions were addressed during the course of the research project. We selected the question of the acquisition of student competencies because it was thought that it could best answer all of the other questions, as it was not only a critical question but is also a key outcome for our school.

Although our primary question was still relevant by the end of the study, other questions became more relevant due to immediacy of need as well as the logical progression of stages in change implementation. It became obvious fairly early in the study that the question we started out with could be answered, but would require more time than the present design allowed, and that we would have to develop one or more shorter-term measurable objectives.

To that end, the project shifted to in-class support and teacher efficacy. After reviewing our initial feedback from teachers, and by spending time in classes from grades one through nine, we determined that the deviation in focus of the project would be on teacher education and support rather than student acquisition of competencies. This decision was not easy, because I, and my team, have maintained a philosophy of student-oriented decision-making. We found, however, that we had to put some foundational supports in place before we could even fully consider the results of student learning.

Following this decision, the project now tried to answer the question, “What steps are needed to ensure students have a fair, thoughtful, excellent experience in learning how to use Chromebooks in their classrooms?”

Related Literature

Antecedent to initiating research in this area, we combed through existing literature on the utilization and implementation of Chromebooks in schools. Because it is a fairly new technology, there is good, current research on the topic; but for the same reason, there is little historical data to refer to. Almost all the articles associated with Chromebooks are user opinions and short, magazine-style articles, which makes it difficult to compare. Here is a list of some of the best research currently available.

Chromebook Teacher Professional Development and Evaluation Programme

In this research project, twelve teachers from six different European schools were asked to implement learning scenarios that utilized Chromebooks and associated Google Apps and to report and measure their progress. A number of their findings related directly to our own, and the majority of their findings could be compared to our own. For instance, issues regarding student-usage policies and practices needed to be addressed. After making cloud-based computing somewhat ubiquitous, it becomes necessary to consider how to regulate student usage in schools. Also, technical support for teachers became an increasing consideration for all the European schools. Interestingly, although they also had a twelve-month project, they similarly struggled to answer questions regarding the improvement of personalized learning for students. One key difference between their study and our own, however, was the need to ensure there was a funding model in place, particularly with broadband and Wi-Fi. Although Aurora does not yet have exceptional Wi-Fi and broadband, our board is supportive of having the tools we need in place to make this initiative successful.

Google for Education Pilot Guide: Bringing Chromebooks to Your School

This pilot guide was developed from interviews with schools in the United Kingdom that had implemented Chromebooks. It is a guide that offers “how to’s” and even suggests strategic planning and parent communication as components in the program. It lists some research but does not go into detail about the success of their implementation. Although it is not a research article as such, it does categorize and chart how to proceed with Chromebooks in schools and describes elements of teacher preparation that we found useful in our own study.

Manaiakalani Evaluation Programme

The Manaiakalani Evaluation Programme is an in-depth analysis that measures how technology has affected student academic results in the areas of reading, writing, and mathematics. This three-year study of students in primary, intermediate, and secondary schools in Auckland, New Zealand, highlights the benefit of using Chromebooks and Google Apps. It also illustrates that the technology per se is less important than how that

technology is being used, and suggests professional development for teachers as crucial to the success of any program.

International Research Collaborative

Mark Dilworth, technology lead for Zurich International Schools in Switzerland, is part of the International Research Collaborative, and was gracious enough to share some of his data, although not yet compiled in a study, with us, regarding the use of Chromebook technologies in Switzerland. This longitudinal study, five years in, promises to collect significant information with the intention of examining and evaluating "the role and impacts of educational technology on teaching and learning." The data shared directly with us illustrates commonalities with our own, such as teacher beliefs about the use of technology and their own competence. One element found in his studies that we did not include is how much technology is used at home by students.

An Evaluation of How 1:1 Technology Can Support Student Success in the IB

John Falino, Marion Halberg, and Candace Reim of Dobbs Ferry High School in New York completed an action research project about how technology, specifically Chromebooks, support student success in their high school. Their findings were found in a summary document chronicling their movement into a 1:1 environment. Many of their initial questions were similar to ours, particularly their main objective of discovering how Chromebooks could improve student learning. Although they have some excellent take-aways as to how Chromebooks are successful, there are no comparatives to draw from, thus making it difficult to determine whether student learning indeed improved. They summarized by stating that their action research is a work in progress.

Strategies

To begin this research project, I created a Droptask account and profile, which helped me to define a visual direction and scope. This profile included the following:

1. Forerunner
2. Development of Research Question
3. Knowledge of the Issue
4. Data Collection
5. Analyzing Data
6. Reporting

The forerunner component was a series of conversations and collection of information prior to formally beginning the study. It involved discussions with the principals of both the elementary and middle schools to ensure I had their support in drawing from their students, finding teachers who had interest in utilizing Chromebooks in their classrooms, and setting up meetings to discuss how we should proceed with the plan. Following this section, I built a small team consisting of one grade one teacher, one grade two teacher, one grade three teacher, and one grade six teacher. I also had the

support of other grade one through nine teachers as I visited their classrooms and assisted with professional development.

Following the forerunner, we determined that we should pare down the research question. This work was accomplished mainly through discussion in the Aurora Action Research Committee, along with other teachers and administrators who were actively developing their own research projects. I also had the advice of the Aurora Action Research Committee lead, who helped me narrow the focus of the project.

Although the literacy review (knowledge of the issue) was originally slated to follow the development of the research question, much of it was done beforehand, and some of it during. The communications with Mark Dilworth from the International Research Collaborative occurred throughout the process, for example. Because this is a burgeoning application in schools, we were constantly looking for and adding to our knowledge base with online readings and through professional development opportunities involving technology.

The data collection component consisted of:

- Technology Integration Self-Reflection Assessment (Pre)
- Chromebook Utilization Form
- Teacher Class Request for Chromebook Support
- Technology Integration Self-Reflection Assessment (Post)

These tools assisted in giving structure to the Chromebook pilot and informed our initial research question, as well as giving us future direction.

Some of our research strategies were more successful than others. The technology integration self-reflection tool provided us with a starting point; however, because only teachers were surveyed, their answers reflected their own beliefs rather than reflecting student learning. In the end, after the project's scope moved from student learning to considering teacher efficacy and professional development, this happenstance turned into a blessing. Unfortunately, neither teacher survey truly addressed student learning, which was from the outset the central question of the study. All this said, the surveys provided useful information about a number of areas that helped us understand the needs of our school with regard to technology.

The Class Request for Chromebook Support, which was a shared Google Form created to allow teachers to book professional support with Chromebooks in their classrooms, was an unexpected success. Originally intended as a booking sheet only, it served to calculate the number of times Chromebooks were requested outside of the already existing sign-out form. This illustrated the need for teacher support rather than only for machines. The Chromebook Utilization Form also showed positively that Chromebooks were in demand by teachers in multiple grades.

Because all the interventions pointed us toward teacher professional development and support rather than student learning, the project gradually turned in that direction. I

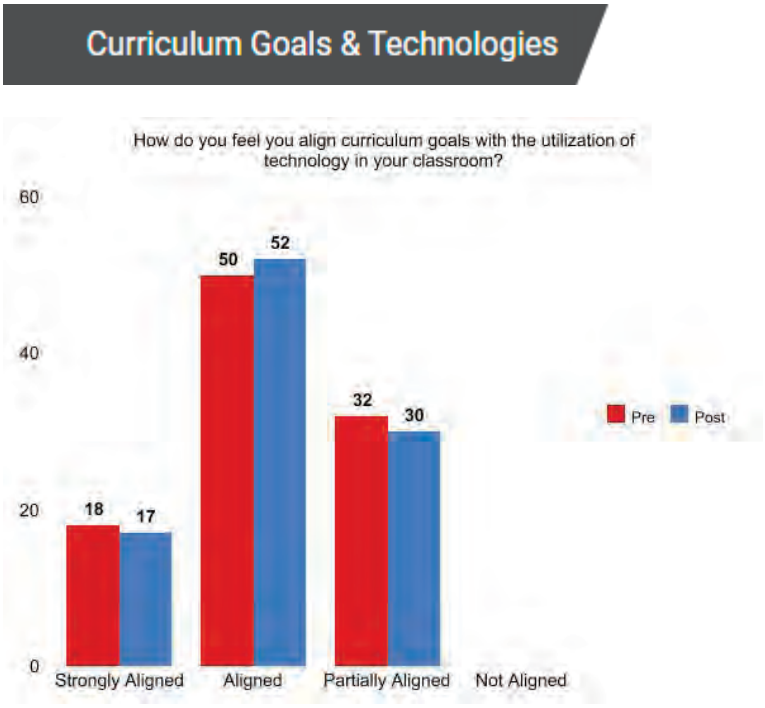
increasingly found myself in classrooms, assisting teachers and students with specific lessons involving Chromebooks. It was interesting to note there was no stipulation on Chromebooks as a necessary tool; we could have use iPads or laptops as well, or other technologies, but with few exceptions, Chromebooks were the tool of choice.

In keeping with this change, it became apparent that the most innovative changes involved using specific applications in individual classes to teach specific skills or curricular objectives. For example, Screencastify was used by students in various grades to record video for presentations, which were directly streamed to their own Google accounts for viewing and editing. Another example was a grade four class that worked on shared story writing using Google Docs sharing.

The strength of the change centered on our ability to be flexible to the needs of teachers with regard to the lessons they were teaching and the objectives they wished to fulfill.

Data

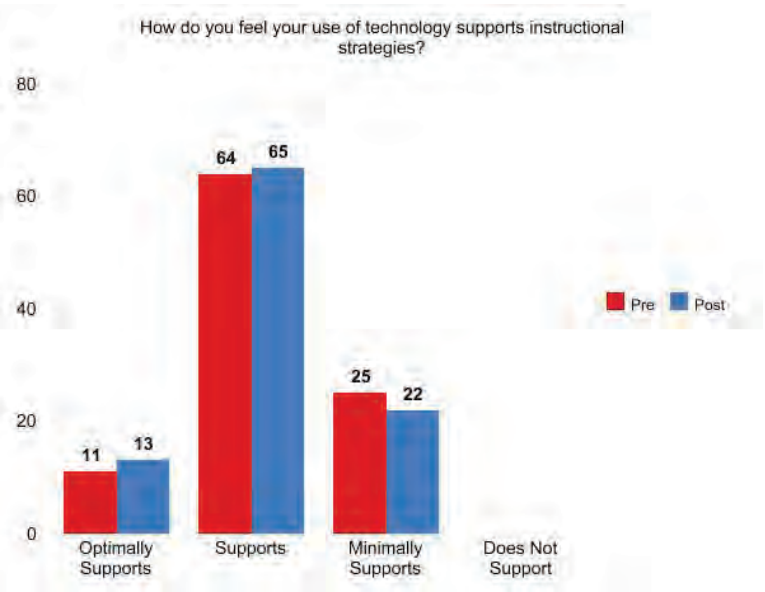
The Technology Integration Self-Reflection Assessment (Pre) and Technology Integration Self-Reflection Assessment (Post) data is summarized below. All numbers are percentages. It should be noted that, of the 28 respondents on the pre-test questions, only 23 teachers completed the post-test. This is likely due to the post-test being administered toward the end of the school year, when teachers generally have busy workloads.



From this graph, we see that there is no sizable change from teacher beliefs about the alignment of curricular goals from the beginning to the end of the year. Overall, 100% of

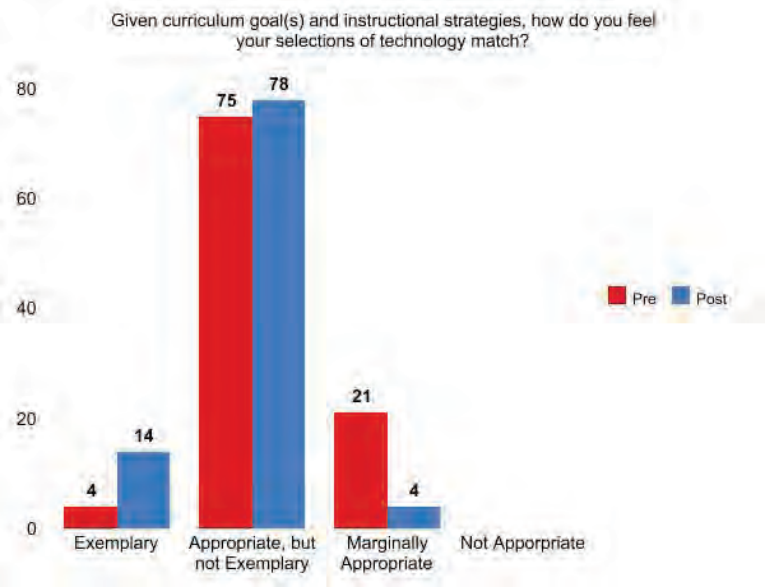
teachers believe some alignment exists between the use of technology and their curricular goals.

Instructional Strategies & Technologies



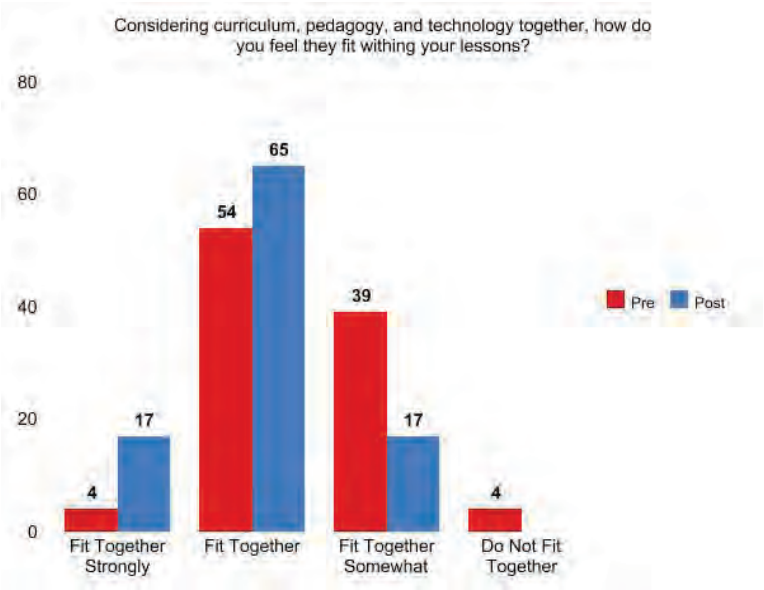
This graph shows that teachers showed no significant change with their beliefs about technology supporting their instructional strategies.

Technology Selection(s)



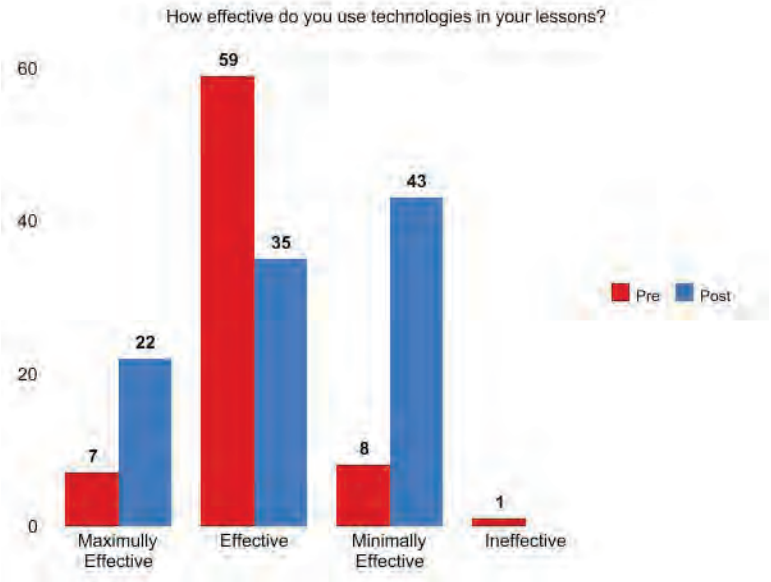
At the high end, teachers believed their selections of technology more closely matched their strategies at the end of the year.

"Fit"



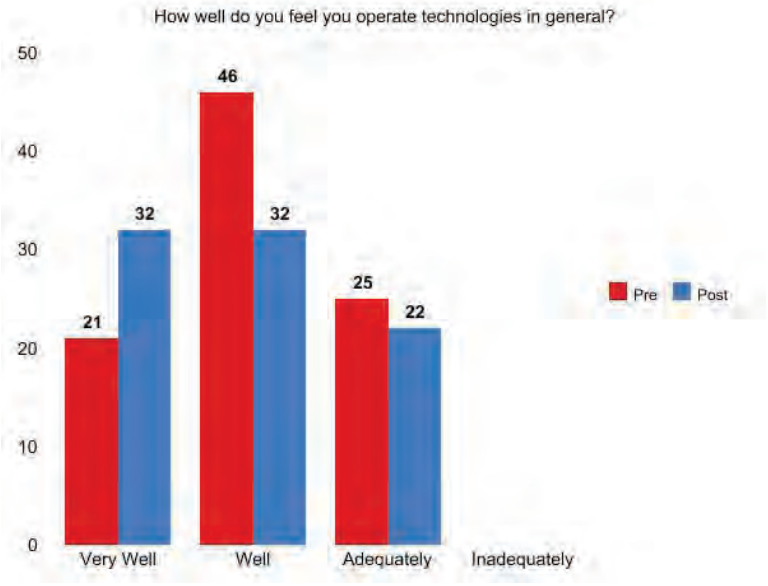
Again, between the pre- and post-tests, teachers showed an increasing belief that technology fit within their lessons.

Instructional Use

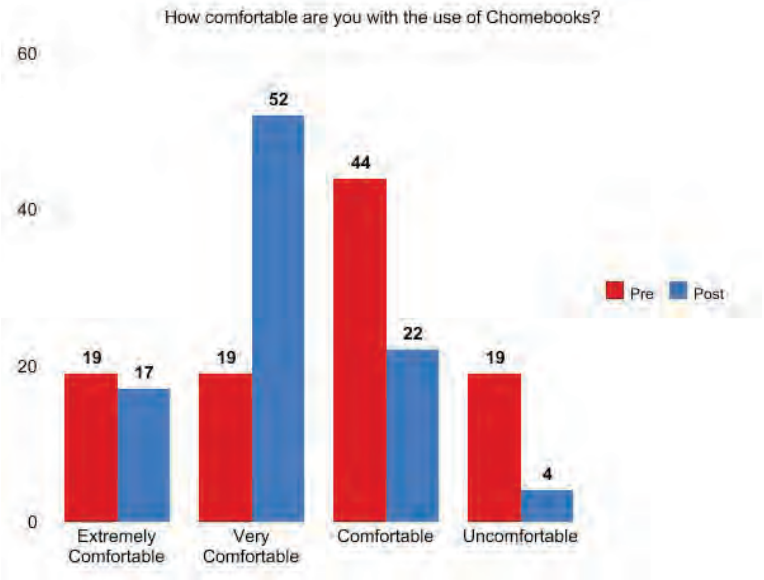


The change in this statistic was greater than in any other, with teachers showing a marked increase in how effective they feel technology use was in their lessons. Teachers reported more than triple the percentage feeling they are maximally effective, and almost double believing they are effective.

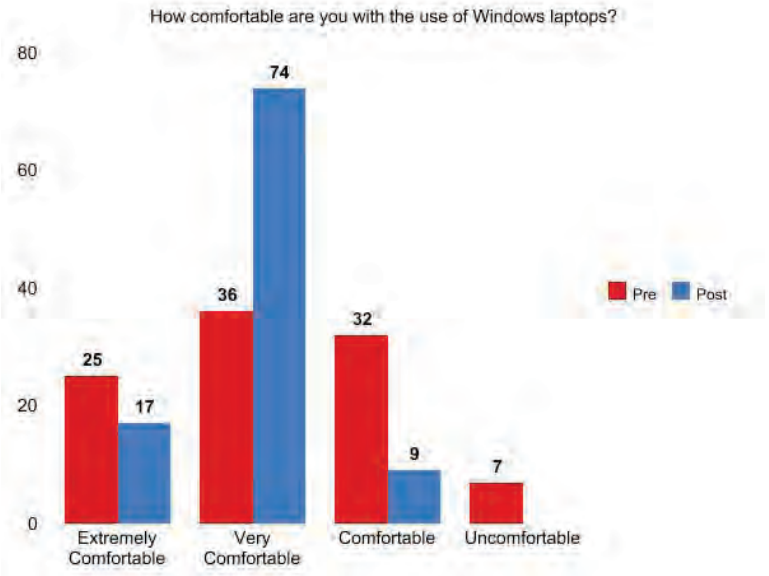
Technology Logistics



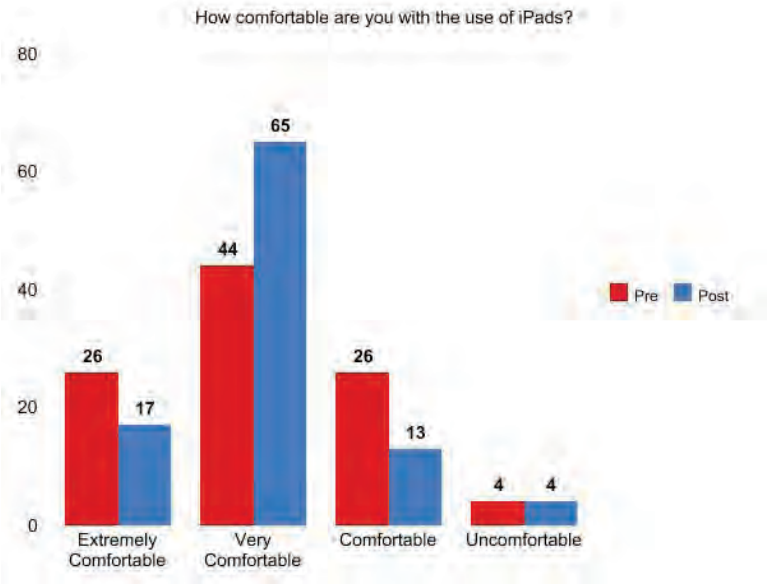
This graph shows that the middle group, who once found themselves operating technology “well”, have moved into the “very well” grouping.



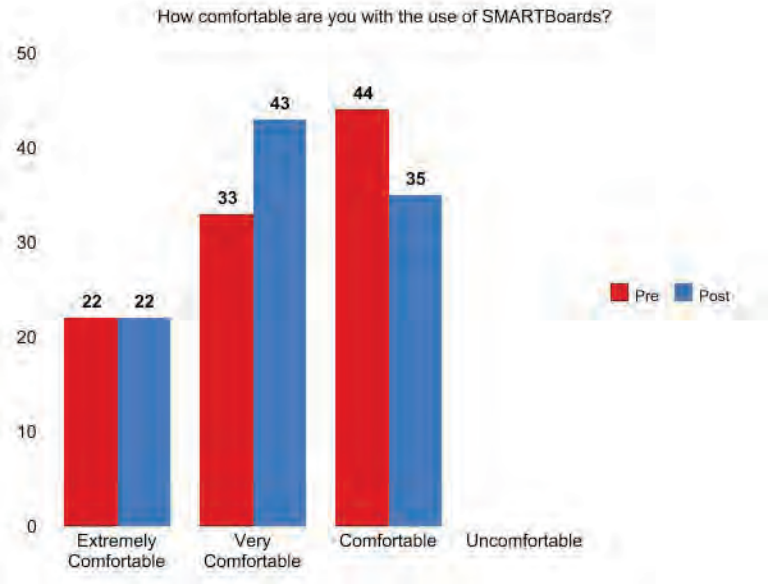
Although teachers are not yet showing a move to the “extremely comfortable” range, there is significant movement from the “uncomfortable” and “comfortable” range to “very comfortable” (a 33% increase).



Because we were initially looking to measure how technology impacts student learning, we examined various devices. The data regarding Windows laptops provided us with information we did not expect; although the increase to “very comfortable” is positive, there was a drop to “extremely comfortable.” I had also anticipated a stronger “very comfortable” response during both the pre- and post-tests.



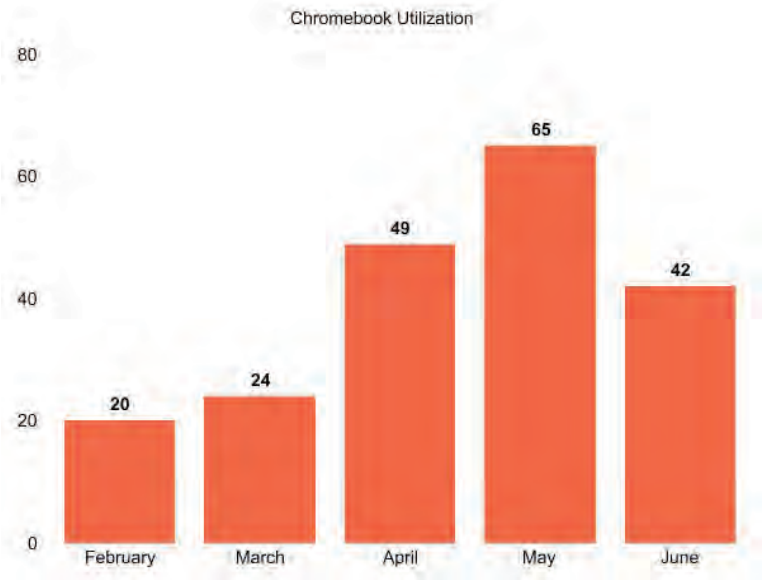
The results regarding teacher self-perceived efficacy with iPads did not undergo significant change, although it is interesting to note a fall from “extremely comfortable” to “very comfortable.”



Interestingly, there was limited change in the degree of comfort with SMARTBoards, with the “comfortable group” moving into the “very comfortable” space by the post-test.

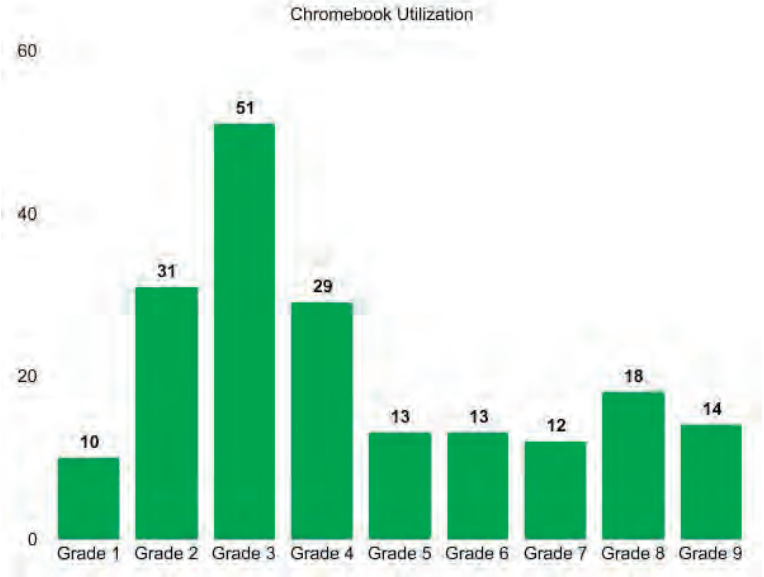
At the beginning of the pilot, we decided that the Chromebook carts would reside in the classrooms of teachers taking a direct role in the project. It was readily apparent, however, that other teachers also interested in using the Chromebooks in their classrooms, so I therefore created a booking system for such cases. Because the form was created almost in the middle of this this research study, the results may not be considered complete, but they do show a trend in interest.

The Chromebook Utilization Form measured how many times Chromebooks were booked by teachers who did not have a cart residing regularly in their classrooms. Each booking counts for one block of time, and there are eight blocks per day, for a total of forty in a week. Thus the average month of school would have approximately 142 full blocks.



There was a noticeable increase in utilization every month, until June. My estimation for this dip is that June is typically booked with exams, field trips, and end-of-the-year activities, and that there would be a corresponding dip in academic lesson need for technology during this time.

In addition to this monthly breakdown, we also listed interest by grade:



This data illustrates the inequitable distribution of Chromebooks. Specifically, at the beginning of the study there were two shared carts for the elementary students, and by the end of the study there were four. The middle school students (grades five through nine) had only one cart to share, and it was located in a space students had to travel to, rather than having the ability to take the cart to their classrooms. The chart also depicts

a trend showing teacher interest; where the bars are high, individual classroom teachers used the Chromebooks more frequently.

Outcomes

We achieved number of outcomes from this pilot process, some were small and some had the potential to be significant. In the end, I do not believe we made convincing progress toward measuring student learning with regard to 21st century competencies, but we did learn a number of things that will lead us to that path.

Throughout the project particular elements continued to rear their heads, either pushing us down a particular path or obstructing our view of our intended one. Each time we tried to focus on student learning, we faced the following conundrum; students will not use Chromebooks (or technology in general) if teachers do not provide opportunities, and teachers will not provide opportunities if they are uncomfortable with the technology. This dilemma made the goal of examining student outcomes difficult, except in the few cases where there was keen interest from specific teachers who were willing to take learning chances with their students. Because of this problem, we followed a logical, though progressive, path toward our original goal. It will just take longer to get there.

Knowing this, we became aware of changes to our practices that we could undertake. We have already changed some of these practices, such as implementing direct teaching support in classes. Although it was not part of the original pilot plan, this practice showed immediate positive results. We also know that increased professional development was appreciated by teachers and benefitted them in their classrooms. Student feedback, though anecdotal, showed that students are excited to try new technologies when they became available. Thus the increased focus on teacher professional efficacy.

When the study began we proceeded with two elementary classes as bases for the Chromebooks, with the intention of keeping them tied to those classrooms. We thought that, if we could find positive, early adopters, they would share and excite other teachers. This did not happen as rapidly as I predicted, because the usability of Chromebooks in the lower primary grades became apparent and teachers opted to often use traditional, comfortable methods that seemed efficient. As we altered the project to allow for more teachers to use the Chromebooks, utilization grew and, as evident in certain grades (grades two and three especially), other teachers were eager to try the Chromebooks, particularly when there was teacher support. This finding helps explain the high utilization rates of Chromebooks in grades two and three and, if I were to predict high numbers for next year, I would expect them to follow those teachers. Noticeably other teachers in those grades followed suit, to a lesser degree to be sure, but still higher than in other grades. The change of allowing Chromebook usage based on teacher interest increased student use quickly.

Key Learnings

1) Teacher comfort. Teachers who were comfortable using the technology readily booked Chromebooks for their classrooms.

2) Teacher preparation. Both pre- and post-reflection surveys teachers shared that teachers are not entirely sure how to use Chromebooks or apply them to their lessons. Time given for teachers to learn how to use the devices and to use them for teaching would be extremely valuable.

3) Teacher support. We changed the structure of this pilot due to obvious need. Teachers were happy to have the Chromebooks in their classrooms if they had someone available who could help them, not only with the technical aspects of the computers but with educational ones as well. On average, I spent a quarter to a third of the past three months of the school year not only supporting teachers in their use of the Chromebooks, but actually helping teach their lessons. I found that, after three or four lessons, teachers were comfortable using the technology on their own.

4) Equitable distribution. There was considerable difference in usage among classes. This difference was due to two factors: (a) availability of Chromebook carts and (b) the number of Chromebook carts. The elementary started with two carts and finished with four, while the middle school shared only one, and that one had to be used in a designated non-classroom space. I am certain that, with more access to Chromebooks, this statistic would level off.

What's Next?

Although we did not achieve our aim of measuring student learning and 20th century competencies, I would like to continue this project, even informally, and suggest that we work further on teacher efficacy. As this develops the technology will organically grow with the students and the teachers. With continued funding, both for the technology and for the structures to support it, including teacher professional development, I am convinced we can demonstrate the value of Chromebooks in supporting student learning at Aurora Academic Charter School.

Contact

If you have any questions regarding this research, please feel free to contact me at Ian Gray [igray@auroraschool.ca]

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Supporting Documents

Google Chromebook Implementation Presentation: June 2017

https://drive.google.com/open?id=14YU6p1KAH6-eZAgUOEdbnZS9TLeEUXlUlXubKPdQFfU

Chromebook Teacher Professional Development and Evaluation Programme

http://fcl.eun.org/chromebook-pilot

Google for Education Pilot Guide: Bringing Chromebooks to your School
http://goo.gl/C5GkD5

Manaiakalani Evaluation Programme

https://drive.google.com/file/d/0B4fvdFmhMq7cSkR1bVhHZG8ySVE/view

International Research Collaborative

http://www.ircollaborative.org/overview.html

An Evaluation of How 1:1 Technology Can Support Student Success in the IB

http://www.ibo.org/contentassets/ef4f3c159e21444a9727ef9b7555681c/saturday-11-15am---how-one-on-one-technology-can-support-students---john-j-falino.pdf
Action Research Guide for Alberta Teachers

https://drive.google.com/open?id=0B2NNrntVd3JiSUFFU3plakJxU2M

Chromebooks for Education Pilot Guide (EMEA)

https://drive.google.com/open?id=1Cf2IZN1x1MZnwn8WjO0B6tCkryld2jroSjtMoSVLjoQ

Alberta Education: Framework for Student Learning

https://drive.google.com/open?id=0B2NNrntVd3JiSkNOdTMxemJhdWs

Creating Opportunities for the Growth of Student Success

By Vanessa Tran and Amanda Joblinski

Vanessa Tran and Amanda Joblinski are Middle School Teachers at Aurora Charter School

Keywords: student success, parent - teacher - student communication, stress management, time management, study skills, exam preparation

Abstract

Our question "How and what supports can be provided by the school to assist middle school students increase success at Aurora Academic Charter Middle School?" continues to be investigated as new data is included into our research, allowing us to provide a more thorough analysis of our findings and key learnings.

Qualitative and quantitative data collected from six different types of informational evenings indicated all information sessions were helpful to Aurora families. Information provided at the sessions involved how students could utilize technology to become more successful (time management, online review and resources provided), as well as bringing awareness to parents about Internet safety and boundaries online. Additional information related to preparing for science fair, provincial exams and transitioning into high school was also made available to students and parents. Feedback was overall positive with some suggestions for improvement in future sessions. Following the looping process of action research, a summative, comprehensive online survey was conducted to gather information about interests in future sessions and possible different methods of delivery that may include online tutorials or videos to share and make the information more accessible to a wider audience of Aurora families. These findings identified valuable sessions to continue to provide for our families as well as new sessions as different needs arise while our school continues to grow and change.

Introduction

Context

Aurora Academic Charter School is divided into an elementary and a middle school. The Middle School is made up of three classes each of Grade 5, 6, and 7 and two classes each of Grade 8 and 9 during the 2015-2016 school year. The school is growing by one additional class per year with two additional classes of Grade 7 in the 2016-2017 school year. The students that attend the Middle School come from a large capture area that encompasses the entire city of Edmonton and the surrounding area. Most students are bussed to the school. During the 2015-2016 school year, there were 299 students attending from Grades 5 through 9. Out of the 299 students attending in 2015-2016, 39 students have been identified as English Language Learners (ELL). Aurora's philosophy that it "is the best choice for traditional public education in Alberta" with the mission to

"provide an orderly and structured environment, with properly sequenced teacher–directed instruction and strong home/school partnerships, where average children can excel in an academically oriented program" drive the direction of our classroom teachers. As a publically funded school, Aurora follows the Alberta Education's program of studies and includes an embellishment program for multiple subjects in all grades.

Aims and Objectives

In reflecting over the last five years, we had noticed a change in the day-to-day vocabulary of parents and students in relation to student's schoolwork and experiences. As a staff, conversations in the hall revolved around how students were identifying stress as something holding them back from completing work, doing well on exams, and managing their time. It became evident that the 'tool box' students were using to navigate their day-to-day schooling was missing some key elements or had some of the tools that they needed, but they did not feel empowered to use them. The same observations were made during parent meetings and communication, at parent-teacher interviews and also identified as areas of concerns for parents and students through the annual school survey and Aurora board goals. Parents were identifying stress as a roadblock to student success and cited issues such as not knowing how to prepare for exams in different subject areas or Provincial Achievement Tests as a concern for both the student and the parents.

The aim was to create opportunities for both parents and students to find success and to not only build skills, but to empower them to use the skills they have to improve and work towards their personal best. Around this time, a colleague, Jennifer O'Connor, had suggested a parent information evening centered around the Grade 6 Provincial Achievement Tests to inform parents about the test format, schedule, and tips for preparation. This was the impetus for the action research project, to address creating opportunities to build student success, helping them accurately identify stress and methods to handle the level of stress and develop lifelong skills for anxiety and stress management. We also wanted to create a resource for neophyte and veteran teachers to access to assist their students in areas that will help them to increase their achievement and well-being in a school context.

Through these opportunities, we hope to be able to strengthen the relationship between parents, teachers and students towards a common goal: developing lifelong skills for personal success.

From our experience, we plan to continue to offer and improve the current support and information sessions as well as finding ways to make the information more available to our families through technology such as online videos.

Related Literature

Students' math anxiety and achievement are influenced by parent's anxiety levels (Maloney, Rameriz, Gunderson, Levine & Beilock, 2015). Parental involvement is an

important factor for student achievement especially at Aurora where we work with a strong home-school partnership. Maloney et al. (2015) found a negative relationship with low math achievement when high math anxiety parents frequently help their children with math homework. Thus, there is a need to create structured activities to allow parents to positively interact with their children in an effort to change their math anxiety level while helping their children. Parental involvement continues to be an important factor for student achievement and these suggestions to create a positive environment and improve the assistance a child receives at home may be one of many tools for children to get the needed support to effectively lower their anxiety level and succeed in school.

Students respond differently to stress and stressors in their environment. Omizo, Omizo and Suzuki (1988) developed a stress scale to quantitatively measure stress levels and qualitative data for different symptoms of stressors and then categorized into four classifications: psychological, physiological, behavioral, and emotional indicators. The results of this study clearly indicate that the effects of stress management and intervention strategies is worth being researched among different school age groups to help identify methods of stress management and the need for interventions for middle school students.

Self-efficacy is an important factor as observed by Usher (2009), where students who had a history of successful performances continued to have higher self-efficacy, while students who required to put more effort into math had lower self-efficacy. Self-efficacy is developed over time and small negative experiences may hinder a student's achievement. Therefore, it is imperative that teachers and parents provide adequate positive support to students throughout their learning to help them become better learners and increase their self-efficacy perceptions. Teachers spend a large amount of time with students and will be able to identify students' strengths and weaknesses. Thus, it is important to continue to work with a strong home-school partnership as teachers and other adults in influential positions need to be aware of explicit and implicit messages sent to students and work with the student at their current abilities to further strengthen those skills and develop life-long learning strategies (Murphy & Torre, 2014).

Tests and examinations continue to play an important role in measuring student achievement and school effectiveness and as a result, students are increasingly identifying themselves with test anxiety. Von der Embse, Barterian and Segool (2013) found in their literature review for studies from 2000 to 2010 of different test-anxiety interventions that students with high test-anxiety often perform poorly on tests and multiple different test-anxiety interventions with elementary and secondary school students were reviewed. Important advances in understanding test-anxiety and effective intervention strategies to treat it continue to be developed for utilization in schools to improve student overall achievement. As each school identifies with different populations and student needs, individual schools will need to create their own strategies to assist their students in their success.

Strategies

Creating a starting point came from considering the areas that teachers were identifying as areas of concern for students and parents. School surveys had indicated that some families felt the homework load was too high and anxiety around government exams was also a common theme at parent meetings. Conversations at subject and division specific staff meetings centered around skills that students needed to be more successful including time management, study skills, dealing with anxiety and stress related to exams and major assignments, organization, and improving communication between the tripartite of parents, students, and teachers. This project came about informally in 2014-2015 prior to becoming a more formal action research project in 2015-2016. Initially, the Grade 6 PAT Preparation Evening (first run in 2014) as suggested by J. O'Connor was run and led to the creation of a Grade 5 and 6 Orientation evening in the fall of 2014. From there, it began to develop as a series of evening information events with supported classroom resources. At the beginning of the action research course that was offered, this was not the initial project but emerged as a relevant topic that was chosen to continue to support student learning and success.

A looping process of reflection occurred as we spanned a two year period and were able to run a number of the offered information sessions. At the conclusion of each session, informal and formal feedback was received through email, face-to-face commentary, and exit surveys. The timeframe allowed for tweaking and improvements prior to running the session in a concurrent year. Feedback that led to changes came from parents and teachers. A mixed-methods approach provided both quantitative and qualitative information from surveys that could be analyzed and used for further development as well as to inform the researchers about what support materials would be beneficial in the classroom for teachers and students to use.

Survey data was collected through exit surveys at the conclusion of the Grade 6 PAT Information Evening, the Grade 9 PAT and High School Preparation Information Evening, the Stress Management and Study Skills Parent and Student Session, Science Fair Help Night and the Cyber-bullying Session. Information was obtained from the annual Aurora Academic Charter School survey as well as a concluding summary survey of Aurora Middle School families in the spring of 2016. This mixed methods approach allowed for analysis of data and the use of qualitative feedback to guide future developments in formalizing a student success series of information sessions.

Data

Grade 5 and 6 Parent Orientation Evening

The purpose of the orientation evening was to introduce and welcome Grade 5 and 6 families into middle school and ease them into the transition and help them acclimatize. During the orientation evening offered prior to the start of the school year, there was a brief presentation for parents and students to welcome them and provide information about what to expect in Grade 5 and 6, from school supplies to homework, lockers and teachers. From the 22 surveys received, the qualitative data collected for the questions were compared and categorized into character concerns and academic concerns.

Things parents wanted to share with teachers to know about their child included personality traits, hobbies and general interest. Only one parent did not have a response. Altogether, there were 14 character related responses and 10 academic related responses. Student concerns about the start of the year for Grade 5 and 6 were mostly academic concerns, with 12 academic related and only two character related concerns. Nine students indicated they had no concerns. On the contrary, parental concerns for the start of the year for Grade 5 and 6 were mostly character concerns, with eight character-related and only two academic related concerns. Eleven parents indicated they had no concerns.

Additional information parents provided included six character concerns and one academic concern with 15 parents indicating no additional concerns. Categorizing the descriptors and phrases from the surveys suggest that parents tend to have more character related concerns including students having low confidence and high expectations, whereas students voiced academic related concerns, focussing on exams, homework and not academically ready for particular subjects.

Informal feedback included a request for Grade 4 students to tour the middle school in June and perhaps pair up with a Grade 5 buddy to learn how to use a combination lock and some tips about preparing and how to be successful in Grade 5.

Cyber World

Presented by the Saffron Centre, the information evening covered topics including internet safety and boundaries online, cyber-bullying, common websites and apps, how youths use the internet and technology to define themselves, how to communicate with youths about internet safety and parental controls. Eleven responses were received from parents in Grade 5 (four families), Grade 6 (one family), Grade 7 (seven families) and Grade 9 (three families).

All 11 families indicated that the provided information was helpful and learned new information. Many responses involved learning more about parental controls and new websites and apps available and targeting youths. From the 11 families, nine indicated they monitor their child(ren)'s online activity and two did not. Families provided positive feedback and indicated they were interested in more related information.

Grade 9 PAT and High School Information Evening

Students in Grade 9 were frequently posing questions and requesting information about high school registration, which prompted the organization of the Grade 9 Provincial Achievement Test and High School Information Evening in early February. Twenty-one families submitted an RSVP with a total of 50 attendees and 10 families requested the information afterwards because they could not attend.

From the 20 parent responses and 16 student responses, parents and students both found the high school related information most helpful and parents found the

information related to provincial achievement tests and post-secondary considerations more helpful than students.

The qualitative comments were tabulated and parents and students responses were compared. Although 15 parents indicated the provincial achievement test information was helpful, most of the qualitative comments suggested information related to high school courses and academic challenge programs most helpful. From the surveys, 15 of the 16 students indicated high school courses were most helpful and was reflected in their comments that they found the information provided helped answer their questions about courses in high school and the registration process.

Additional information requested by parents included a request to meet with teachers to discuss their child's high school considerations. Students requested more information related to scholarships and a more step-by-step process for high school registration such as where to find the forms, submit the applications and how to apply.

A general comment that was provided was to host the information evening earlier in the year to provide families more notice to plan to attend open houses and research different schools and programs.

Grade 6 PAT Information Evening

To educate parents about the provincial achievement tests written by Grade 6 students and provide suggestions for them to assist their child to prepare for the test, the information evening was attended by approximately 25 families and 17 surveys were received. The majority of parents felt the evening was helpful in all areas including types of questions (13 responses), review materials (17 responses), subject requirements for the test (13 responses) and general information (15 responses). Only eight found the question and answer period helpful.

Parents indicated information about the study guide, *The Key*, was very helpful to help prepare their children for the provincial achievement tests. They appreciated information on how to help their children prepare including different strategies and which materials to use to review.

Information parents were interested included how different schools weight the provincial exams as Aurora gives it a weighting of 25% of a student's year grade in the four core subjects: English Language Arts, mathematics, science and social studies. They also requested information about previous results and what we can learn from those experiences.

Supplementary review was suggested by parents to be helpful to prepare for the exams, specifically opportunities to conduct practice exams, increasing student exposure to the writing structure of questions on the exam to become more comfortable, more review materials and other specific subject review clubs. Reducing stress in students was also an area that parents wanted more related information.

Whole School Survey

An annual school survey is distributed to parents in the spring of each school year to collect feedback on various aspects of the school. The questions and responses that prompted this research project included "Are you satisfied that your child is being assigned an appropriate amount of homework? (Table 1) In 2012, 5-11% of parents felt there was not enough and that remained about the same in 2013 with 0-14%. Between 75-95% of parents felt the homework was just right in 2012 and remained about the same in 2013 with 74-90%. In 2012, 7-19% of Grades 5, 7 and 9 parents felt there was too much homework with the most in Grade 5 and that increased to 5-22% in 2013 with no parents in Grade 5 feeling there was too much homework, but the most parents in Grade 9.

In March 2015, a specific survey on homework was conducted to middle school parents asking parents "Are you satisfied that your child is being assigned an appropriate amount of homework (Table 2). 82% of parents in Grades 5 and 6 felt it was just right. Only 32% of parents in Grade 7 felt it was just right and 68% felt there was too much. 66% of Grade 8 parents felt it was just right with 34% feeling there was too much. For Grade 9, the results were similar to Grade 8, with 60% of parents feeling it was just right and 32% feeling there was too much. Overall, 69% of Aurora parents in middle school at that time felt the amount of homework was just right and 25% felt there was too much. As a school, teachers and administration made changes including a homework calendar to indicate major tests and assignments for teachers to communicate with each other and indicating to parents how much time was provided for students to complete homework in class. The satisfaction rate increased to 85% in the 2014-2015 whole school survey asking parents "Are you satisfied that your child is being assigned an appropriate amount of homework?" (Table 3)

In addition, specific parent and student surveys were conducted to gather feedback about the helpfulness of the information sessions offered to Aurora Middle School families. The results provide direction for Aurora Middle School regarding which sessions to offer in the future, the method of delivery and modifications and improvements to the sessions to assist in the increase of student success at Aurora.

Student feedback was gathered from 292 students from Grades 5-9. Approximately 43.3% of the responses indicated the information sessions offered had an impact on their personal success in school (ratings of 4 or 5 out of 5). The information sessions students would like to see offered in the future include Time Management and Study Skills and Science Fair Help Evening. Many of the students prefer the evening sessions with some requesting video information and hard copies of the information presented. There were many qualitative responses that were provided requesting specific subject help sessions, final exams preparation and information, junior high orientation and mental health awareness. There were some students who misunderstood the question and objective of the survey and thus provided irrelevant responses that were not included in the analysis.

Although there were fewer parent responses collected, 20 in total and mostly from Grade 7 parents, they felt the information sessions had a large impact on their child(ren)'s personal success in school (76.5% rating 4 or 5 out of 5). Similar to students, parents also felt the Science Fair Help Evening was very helpful. The other sessions were rated as very helpful, somewhat helpful or not attended. From a parent's perspective, the majority of parents would like to see repeated sessions of the Time Management and Study Skills, Science Fair Help, The Bullying Project and Grade 9 PAT and High School Information sessions. Most parents prefer an evening session or video information. 89.5% of the parents feel the information sessions have improved communication between parents, students and the school. Parents also suggested some future sessions to provide support for issues related to racism, mental health awareness and reaching out to Alberta Health Services or review accommodating an onsite counsellor.

Similar responses were received from the 10 teachers who completed the teacher survey. 60% of the responses feel the information offered had an impact on students' success (rating of 4 or 5 out of 5). All the sessions were selected by at least 50% of the teachers to be offered in the future. Teachers feel evening sessions or information stations set up during parent-teacher interviews would be best methods of delivery. All teachers feel that information sessions have improved communication between Aurora families. Some teachers at the time suggested a Grade 7 information evening for the many new Grade 7 families joining Aurora in the 2016-2017 school year, which was hosted in August of 2016 and well attended by our new families.

Outcomes and Findings

It was evident throughout the course of the action research project that all stakeholder groups; parents, teachers, students; found value in the opportunities provided and an increased level of positive communication between the school and home. The feedback from each information session was specific to the content, but also indicated that it built a rapport between families and staff with a focus towards success for students and ultimately families in supporting their student. The sessions offered facilitated a different tone of communication with families and students that was non-threatening and supportive. A parent reported in a thank-you note that they had learned strategies and skills that would help them in their day-to-day life as well as their children's. In all cases, it was proactive instead of reactive and allowed families to gain comfort being in the school building and meeting with parents.

Feedback from parents attending the Grade 5 and 6 orientation evening involved a school tour as the Grade 5 students would be new to middle school. As a result, an afternoon in June was arranged for current Grade 4 students to explore and tour the Grade 5 classrooms with a Grade 5 teacher, familiarizing themselves with the space, locker and changes. Also, Grade 5 and 6 teachers and classrooms were re-organized to reduce the number of different teachers and travel distance between classes to make lessen the transition from Grade 4 to Grade 5.

Another key finding related to needs expressed by students. Junior high students in particular reported that increased access to a Learning Commons would assist them in working both individually and with their peers to complete work and review material. Parents that were surveyed also expressed an interest in having work space for students before, during, and after the school day to review material and work towards the completion of assignments and long-term projects. At the time of the action research, a new Learning Commons was under construction and was being set up. The intent of the space was to provide the opportunities that students were looking for once the space was completed.

As researchers, another significant finding was that the method of delivery needed to be reconsidered. The majority of sessions were held in the evenings with families coming back to the school from a widespread area. Many students are bussed and the student body comes from all over the metropolitan area. Considering family responsibilities and distance from the school, the transportation time made it difficult for many families to attend despite an interest in the sessions being offered.

Key Learnings

The key learnings throughout this action research project pointed towards acknowledging transition times in student life through school events and opportunities as well as building a resource drive to share materials for other teachers to easily access and use. Epstein (1996), found that middle schools that coordinate transition efforts that bridge the jump from elementary school tend to have more parent engagement. A number of the sessions offered addressed this transition from the Aurora Elementary (Kindergarten to Grade 4) to the Aurora Middle School (Grades 5 through 9). Using shared staff folders, assignments, activities and presentations to address goal setting, study skills, stress management, and other skills related to student success were posted for teachers to use when implementing these learnings into current curriculum. It was recognized that many of these skills met the requirements of the 3Es (Engaged Thinker, Ethical Citizen with an Entrepreneurial Spirit), a ministerial order on student learning, implemented by Alberta Education and assigned to be included as part of each Aurora middle school student's term goal in their health class (Johnson, 2013).

Over time, we found that the learning opportunities and the session content will need and has needed to evolve as school needs change. For example, the Grade 5 orientation evening was initially designed to assist the transition from Grade 4 at the Elementary School to Grade 5 at the Middle School. In the fall of 2016, a full class of Grade 7 students was added to the school. Using the shared files, staff were able to easily use and make minor changes to the Grade 5 orientation to use for a Grade 7 orientation. Part of the shared folders includes 'quick sheets'; an idea borrowed from astronaut Chris Hadfield; to assist staff in attempting tasks for the first time and effectively build opportunities for staff success as well. Some staff also use the idea of 'quick sheets' with students in the creation of study materials.

An important key learning has also been in regards to attendance. At times, low attendance numbers at some sessions were discouraging. On reflection, it was thought that regardless of the attendance numbers, the material covered is valuable to different people in different ways. The goal is to assist student success and to build positive communication. Any growth in these areas is positive. This was also confirmed with the positive survey comments made by students, parents, and teachers regardless of the attendance at a session.

What's next?

We are hopeful that with the resources available to staff and as teachers move to different assignments, the information is there to continue to offer opportunities for student success without having to create new material. Continuing the looping process from year to year to develop a further series of information sessions/opportunities and to refine those that are already created to share with families year after year will be important to continue positive communication. Improving and adding to the materials available to teachers to support classroom learning and teaching to promote student success is being taken on by the staff as a whole as part of a collaborative model. Sharing these resources allows teachers to learn from each other, maximize their time and set clear goals and expectations for students in the areas of homeroom first-day expectations, acquiring study skills and other areas of student organization and success.

One challenge in continuing to offer opportunities for student success will be determining best practices for the method of delivery when offering sessions for students and parents. With the growing capability for technology support in our school, creating videos of the sessions that parents and students can watch at home through a secure school website is our most viable option. This would deal with the distance issue many of our families face as well as letting them review the material as needed and at a time that works best for them. These resources would be available on demand once posted, but would not replace the face-to-face opportunity that at school sessions provide.

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Supporting documents

Grade 5 and 6 Parent Night Survey

1. Who is your child and what do they prefer to be called?
2. What are two things you would like us to know about your child?
3. What (if anything) is a concern for your child about starting grade 5 or grade 6?
4. What (if anything) is a concern for you about your child starting grade 5 or grade 6?
5. What is the best way to contact you during the day? Please provide the number or email address that you prefer we use.
6. What email is best to send school and homeroom information?
7. Is there anything else we need to know?

Cyber World Survey

1. What grade is your child in?
2. Were you able to take away some helpful information from the presentation?
    a. If yes, could you share what you have learned?
    b. If no, what questions did you have that were not answered?
3. Do you monitor your child(ren)'s online activity?
4. Additional comments:

Grade 9 PAT and High School Info Night Survey

1. Please check one of the following, I am a parent or student.
2. Which topic(s) did you find most helpful? Please check all that apply.
    a. Grade 9 Provincial Tests
    b. High School Courses
    c. High School Academic Challenge Programs
    d. High School Open House and Registration
    e. Post-Secondary Registration Considerations
3. What information did you find most helpful?
4. What additional questions do you have that was not answered?
5. Additional comments:

Grade 6 PAT Night Survey

1. Which topic(s) did you find most helpful? Please check all that apply.
    a. What types of questions are on the exams
    b. What materials to use as a review
    c. Each specific subject's requirements for the exam
    d. Information about the PAT in general
    e. Question and answer period
2. What information did you find most helpful?
3. What additional questions do you have that was not answered?
4. What other information would be helpful in preparing for Grade 6 PATs?

Whole School Survey **(Parent, Student and Teacher)**

1. What grade(s) is/are your child(ren) in?
2. Please rate each of the following information evenings (very helpful, somewhat helpful, not helpful, did not attend)
    a. Time Management and Study Skills - Dr. Michele Moscicki (April 23, 2015)
    b. Grade 5/6 Orientation Evening (June 30, 2015, or previously offered dates)
    c. CyberWorld - Presented by Saffron Centre (September 24, 2015)
    d. The Bully Project - Concrete Theatre (In School Presentation)
    e. Science Fair Help Evening (December 4, 2015, or previously offered dates)
    f. Grade 9 PAT and High School Information Evening (February 11, 2016)
    g. Grade 6 PAT Information Evening (March 10, 2016, or previously offered dates)
3. What impact do you feel the information offered had on your child(ren)'s personal success in school? (On a scale of 1-5 with 5 being a lot of change)
4. Which of the following information sessions would you like to see offered in the future?
    a. Time Management and Study Skills - Dr. Michele Moscicki
    b. Grade 5/6 Orientation Evening
    c. CyberWorld - Presented by Saffron Centre
    d. The Bully Project - Concrete Theatre (In School Presentation)
    e. Science Fair Help Evening
    f. Grade 9 PAT and High School Information Evening
    g. Grade 6 PAT Information Evening
5. What is your preferred method of delivery for the information sessions?
    a. Evening presentations at the school
    b. Video information sessions made available through the school website
    c. Hard copy information sent home with students
    d. Information stations set up and available during parent-teacher interview evenings
    e. Other:
6. Did you feel these information sessions have improved communication between Aurora families (parents and students) and the school (teachers, administration, office)?
7. What future information evenings do you feel would benefit Aurora families?
8. What additional resources would you like offered to our families to support student success?

2012-2013 *Aurora School Survey*

		2013			2012		
D7.	Are you satisfied that your child is being assigned an appropriate amount of homework in:	Not Enough	Just Right	Too Much	Not Enough	Just Right	Too Much
	Grade 5 (21 out of 197 responses rec'd)	14 %	86 %	0 %	6 %	75 %	19 %
	Grade 6 (20 out of 197 responses rec'd)	5 %	85 %	10 %	5 %	95 %	0 %
	Grade 7 (18 out of 197 responses rec'd)	0 %	83 %	11 %	11 %	82 %	7 %
	Grade 8 (20 out of 197 responses rec'd)	5 %	90 %	5 %	6 %	94 %	0 %
	Grade 9 (23 out of 197 responses rec'd)	4 %	74 %	22 %	6 %	88 %	6 %

Table 1: 2012-2013 Whole School Survey, Question D7

March 2015 Homework Survey

2. Are you satisfied that your child is being assigned an appropriate amount of homework?

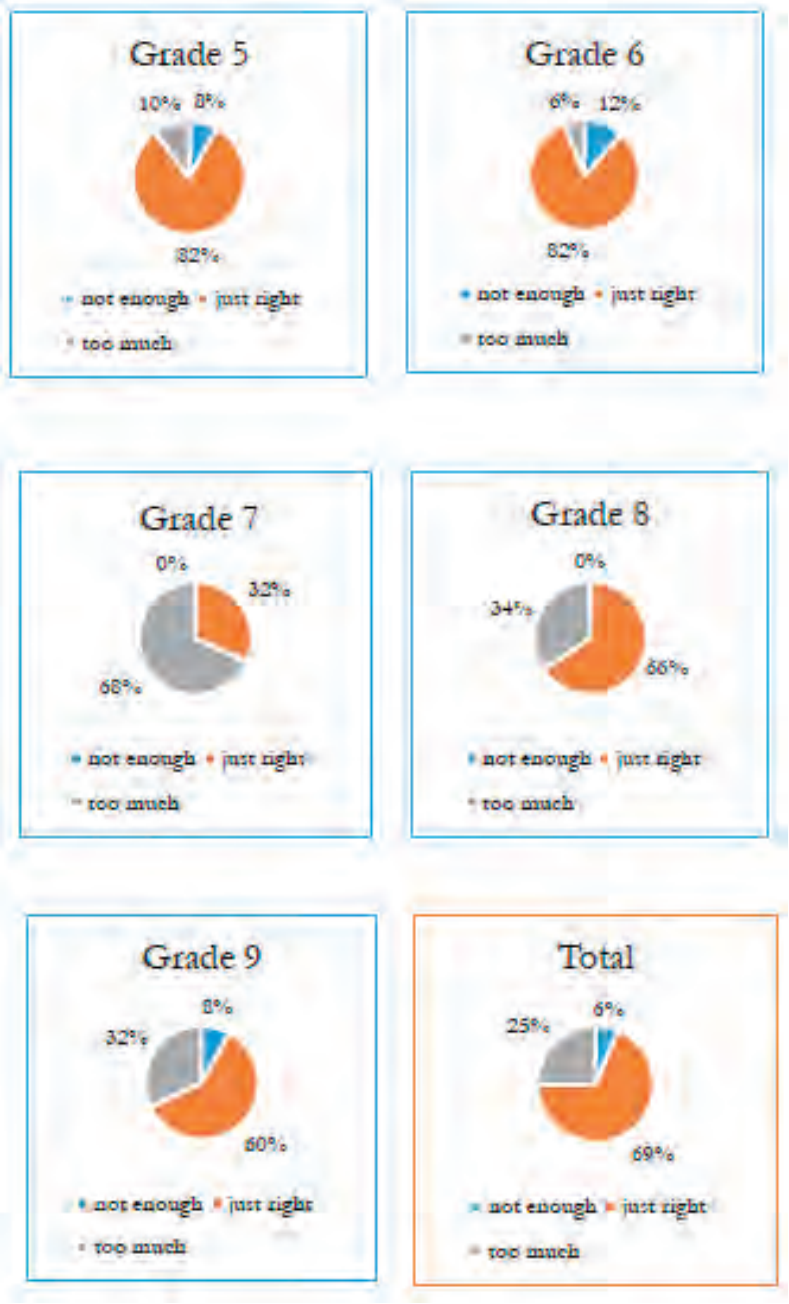

Table 2: March 2015 Homework Survey, Question 2

2014-2015 Aurora School Survey [Table 3: 2014-2015 Whole School Survey, Question D7]

D7	Are you satisfied that your child is being assigned an appropriate amount of homework?	Satisfaction Rate 85%

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Exploring the Efficacy of Flipped Classrooms Compared to Traditional Lecture Classrooms

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Key Words: Inverted Classroom, Flipped Classroom, Google Classroom, Middle School, Lecture Format

Abstract

This study aimed to see if a flipped classroom teaching model would help students learn the material better and make more efficient use of class time. This study analyzed the effectiveness of using online technology for students in four classes across three grades of a middle school in a large metropolitan city in Alberta, Canada. Through the lens of a teacher-researcher, this researcher found that inverting (often called flipped) the classroom led to no significant improvement of student achievement. Paradoxically, using Google classroom as the platform on which he shared digital resources such as lecture videos, PowerPoint slide decks, links to YouTube videos, and practice worksheets, the researcher found that the students *enjoyed* the courses much more using the inverted classroom technique than the traditional lecture format.

Introduction

In a traditional lecture format classroom, the instructor provides a teacher-centered lecture followed by reinforcement work that is usually taken home and due the next class. The flipped instructional paradigm allows students to gain first exposure to new material outside of class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion, or debates. Interest in this topic led me to formulate this action research project question: "How is student comprehension of the topics of an entire middle school science unit affected by the pedagogical approach used in the classroom, comparing the flipped classroom teaching technique with traditional lecture-style teaching used in this researcher's school?" An inverted classroom is a powerful teaching and learning strategy with both significant drawbacks and advantages. As expected, the success of an inverted classroom depended heavily on the technological infrastructure, dedication of the instructor to assemble the resources needed, and the discipline the students needed to learn using such a strategy.

Review of the Literature

Westermann (2014, p. 44) suggested that, in terms of Bloom's revised taxonomy, the flipped classroom method means that students are doing the lower levels of cognitive work (gaining knowledge and comprehension) outside of class, and focusing on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in

class, where they have the support of their peers and instructor. With this dynamic shift away from the lecture-based classroom, Mader and Smith (2015) suggested that these "changes help students progress independently, aided by many free online resources. Screencasting and podcasting technology, for example, allow you [teachers] to create differentiated learning experiences in the flipped classroom, providing students with a more tailored learning experience" (p. 8). This student-centered learning strategy is aptly summarized by the belief that teachers should no longer be the "sage on the stage but rather the guide on the side" (Parslow, 2012, p. 337).

The core target of this research question is whether a flipped classroom is more effective than a traditional lecture-style teaching format. Clark (2015) wrote that the "instruction that used to occur in class is now accessed at home, in advance of class, via teacher created videos and interactive lessons, and work that used to occur outside of the classroom is now completed in class in the presence of the teacher" (p. 93). The idea is to allow the instructor "the opportunity to work one-on-one with each student during the class session while providing more interesting assessments and technology activities while all of the students are together" (Cummins-Sebree & White, 2014, p. 2).

Cummins-Sebree and White (2014) also found strong student satisfaction with this inverted classroom method, and students expressed that they were "more prepared when coming to class, more engaged while in the classroom, and appreciative of some of the distinct features of this course design" (p. 8). However, Clark (2015) questioned this finding with a study of secondary school math students. "In terms of academic performance, no significant changes were demonstrated between the flipped model of instruction students and those taught in a traditional classroom environment" (Clark, 2015, p. 91-92).

Concerns of the Flipped Classroom Strategy

Wallace et al. (2014) stated, "To completely redesign a course around the flipped classroom model requires considerable thought and planning" (p. 259). Planning a flipped classroom is perhaps the greatest obstacle to implementing a successful flipped classroom. As teacher-researchers, it is often difficult to separate the dual roles of teacher and researcher. Another limitation to studies that require student feedback is "that some students were reluctant to be forthcoming with criticisms because I had control over their final grade" (Strayer, 2012, p. 189).

Gunyou (2015) stated, "This model requires students to accept responsibility for completing the preparatory lessons on time to allow their productive participation" (p. 17). Unfortunately, students who did not complete the pre-class work were often behind. The flipped classroom model requires that students must have access to the Internet, and the physical classroom must have the technological capabilities to utilize the instructor's resources.

Lancaster (2013) pointed out one of the most obvious obstacles to implementing the technique in a classroom by saying, "Taking an existing lecture course and flipping it

will require an initial investment of effort" (p. 31). One main focal point of the flipped classroom technique is using pre-recorded screencasts that are posted online for students to preview. But, even having good quality videos or screencasts to post online for the students can be problematic. Herreid and Schiller (2013) surveyed a number of teachers and found that "teachers said that finding good quality videos is difficult" (p. 63).

Some students participating in the flipped classroom did not adjust quickly to their new learning environment, while others were uncomfortable participating in group-learning activities because they preferred working alone. "Others were accustomed to the old method of doing assignments on their own, in the setting of their choice. The radical change was not well received" (Roehl et al., 2013, p.48). DeSantis, Van Curen, Putsch, and Metzger (2015) indicated the "data did not show that utilizing streaming videos as homework and class time as extending and refining sessions improved student learning outcomes" (p. 52).

Test Study Group Context

The school where this study took place is a kindergarten to grade nine school in a large city in Alberta. It is an academically driven and focused school with minimal option classes. Science classes are three 80-minute classes per week. The main target group impacted by the study was junior high students in the researcher's assigned classes. The sample test subjects were students from one class of grade seven, one class of grade eight, and two classes from grade nine which had been assigned to the researcher in the 2015-2016 school year. The results of the study will directly impact how the researcher teaches for the rest of the year, so it was in students' best interests to provide honest responses and feedback to the questions for this study.

Students currently enjoy a relatively high exposure and access to technology at the school. There are four mobile laptop carts and one mobile iPad cart available for classroom use. Wi-Fi is available throughout the building, and the infrastructure is constantly improving. All students have a school-based Google account that allows access to the most commonly used Google suites of apps. Almost all students have access to various hardware such as computers, tablets, smartphones, printers, and Internet at home. Almost all students described themselves as relatively proficient at the use of smartphone apps, Internet searching, website browsing, and downloading materials.

Methodology

To compare the study results, the researcher needed quantitative data such as test results and report card grades as baseline data to use for comparison and analysis. Anecdotal observations from the students' teachers from the previous four years of report card comments and inquiries about the students' learning habits also helped to establish an understanding of the students' behaviors and academic inclinations.

The following is a summary of steps the researcher completed during this action research project:

1. Wrote the letters of consent to parents, principal, and students.
2. Gathered baseline data (grades from previous science units).
3. Posted the current learning materials online and allowed access by the test students.
4. Started the inverted classes study and recorded student grades, performances, and anecdotes from other teachers.
5. After the unit exams, gave post-study survey to students.
6. Analyzed data.

Experiment

The initial data gathering began by collecting baseline that was used to compare to the results of the study. The initial quantitative measurements were students' grades from a previous unit of science in the classroom. Second, comments on report cards and anecdotal evidence from teachers regarding each student's performance, abilities, and work habits from the previous term provided some qualitative basis about each participating student.

Third, during the course of the study, this researcher took careful field notes during each class regarding student performance, with special attention to level of comprehension of each topic as the students proceeded through the unit. It was important to note the students' progress by recording first-hand what was observed (Strayer, 2012, p. 174). This researcher's field notes were organized into separate files for each student, chronicling the observations of each student's learning, struggles, successes, strengths, and weaknesses. Anecdotal evidence from other teachers about these same students provided a pre-study snapshot of the students' previous academic abilities, strengths, and weaknesses. Post-study, these teachers were asked to provide observations of each student in regard to changes in learning style and achievement in their own classes that might be attributed to the flipped teaching model used in Science class. These observations were added to the notes on each student.

Fourth, the post-study instrumentation was a Likert survey created with the popular online survey service, *SurveyMonkey*, that included 15 questions using a five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Five open-ended questions allowed students to type in their comments regarding this teaching format. The survey were made available to students after the unit exam was written, graded, and returned to them and allowed them to completely finish the unit and then reflect upon their own learning before completing the survey. The survey were shared with students to preview and then complete within a 48-hour time frame to allow students to think about their answers and formulate comments. Students completed the survey at their convenience without the pressure of having the teacher present.

Comparisons were done by calculating the difference between each individual student's final grade in the previous unit taught via the traditional lecture format with the final grade in the experimental unit. Each classes' mean grades were recorded and compared. The student participants' grades were all recorded and calculated during the course of the unit using the school's grade-keeping software called PowerSchool. It was simply a matter of transferring the numerical information from PowerSchool to the study data table.

Outcomes and Findings

The grades comparison indicated that there was no significant improvement in tests conducted throughout both the control unit (lecture-style format) and the experimental unit (inverted classroom format). The test students' final averages are condensed and displayed in Figure 1. Although both grade nine classes showed a slight improvement in overall grades, the difference was not significant enough to positively conclude that inverting the classroom is the best strategy. The younger students in grade seven showed the reversed where their grades decreased from the lecture-style format to the inverted-style format. Their results showed the most change of all four sample classes. The grade eights also showed a slight decrease in grades.

The researcher maintained as stringent controls as possible throughout the study. The level of difficulty of tests, assignments, and exams ((as well as the numbers given) were kept as leveled as possible. The units and topics in each unit were taught in a consistent manner with equal emphasis on importance and hands-on activity for reinforcement.

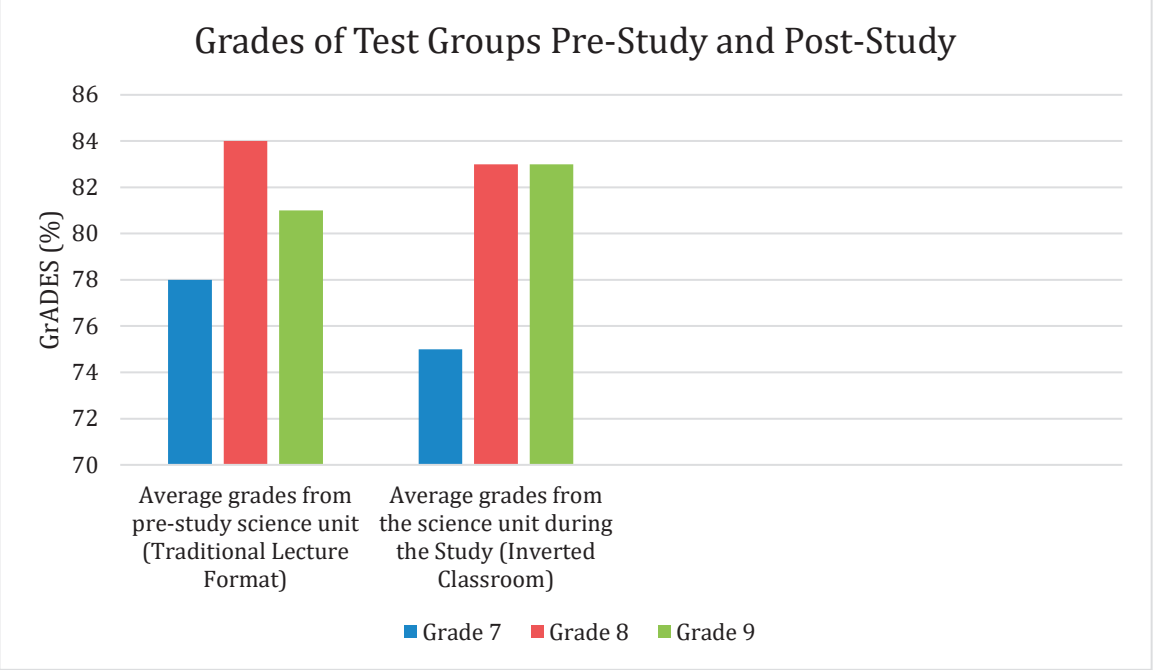

Figure 1. Grades comparison of the sample groups over two science units of study

Upon scrutinizing each student participant's pre- and post-study report card comments and the field notes taken by the researcher, no significant changes were found to the overall students' work habits or general interest in learning. Most students were consistent in their achievement (or lack of), work habits, interest in various subject areas, and behavior in class. The researcher was not surprised given that the grades had not significantly changed. With such a large sample group, there was bound to be outliers. A small number of students had comments that indicated a positive growth in work habits compared to the previous unit (lecture-style format) and some received disapproving remarks from teachers for lack of effort, assignment not submitted, and general decrease in performance.

Parsons, Hewson, Adrian, and Day (2013) suggested that "surveys, either closed or open-ended, are easy to organize in to meaning" (p. 114) and this was true with the use of *SurveyMonkey* to create the Likert-scale post-study survey and then automatically tally each question. The results from the 15 closed-ended questions and the five open-ended questions (Appendix A) are summarized and displayed in Figure 2.

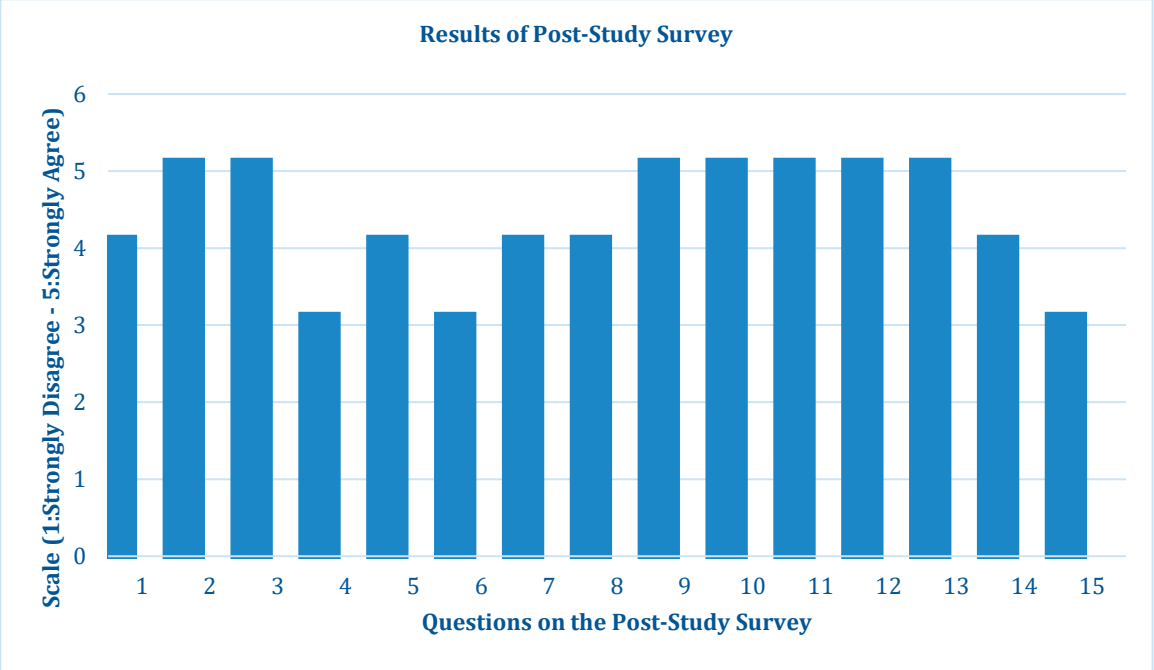

Figure 2. Average results of the post-study survey from all test groups

The results for the post-study survey indicated a not-so surprising trend. As a whole, students overwhelmingly enjoyed accessing the digital materials online (Question # 2 and #7), watching the videos (#13), downloading the lecture notes and then bringing the device of their choice to the classroom (#4 and #6), and having more time using technology.

What was surprising was that the majority of students preferred the teacher to go through the lecture in person. They indicated that they understood the materials better if the teacher lectured in person rather than through a video (open-ended question #4). When pressed for a reason, they indicated that the videos were a good resource for introducing the topic, but hearing the teacher describe the topics, writing notes in real-time in the classroom's whiteboard, and being able to ask questions immediately in class (rather than wait until the next class to ask) made a huge impact on comprehension. Examples of such comments are below:

Student 9G21 (grade 9, girl, student #21) – "I liked it better when I could ask you a question and you explained the answer and clarified it for all of us right away".

Student 7B12 (grade 7, boy, student #12) – "My mom yelled at me for being on the computer too much but she was ok with it after I showed her what I had to do for homework. The videos did not cover everything in the textbook and I am worried that I won't do so good *(sic)* on tests. I'd rather you teach everything at the front of the class".

Reflections of the Data

Despite all efforts to maintain controls, the researcher concedes that too many human factors existed this study.

1. Students reported one thing but grades reflected another. For example, a student might say that he felt he has learned more in this unit using the flipped classroom model than in previous units using the traditional teaching format with the same teacher. However, his grades reflect either no significant change (significant to the researcher is defined as > 10% points) or actually are lower than previous science grades. That is, the numbers may indicate one thing, but the students might say something else.

2. Students might not have watched the lecture videos, completed the assignments posted online, or finished other preparatory worked as required. As a result, a student's performance might have declined due to lack of completed work and understanding and not due to style of teaching.

3. Due to the researcher's lack of skills with software technology, the learning resources might not have been clear, comprehensive, or interesting enough for students to utilize. These lacks might also be a major impediment for the success of the inverted classroom format.

4. The sample students come from a school that is teacher-directed, lessons are delivered in a prescribed traditional lecture-format, generally well disciplined and orderly environment. The inverted classroom is a significant change to the learning style students have used for so many years (some students have been there since kindergarten). Asking them to switch learning style in such a short time might have been asking too much and would create some accuracies in this study.

5. Despite previewing the lecture materials beforehand, students came to class with many questions. The inverted classroom format is designed to have class time for doing reinforcement work with the "guide on the side," but the most common question students asked was "can you explain (insert topic here) again?" These questions led the researcher to spend the bulk of class time re-teaching and clarifying the topics (like the lecturing format) rather than reinforcing the topics with face-to-face work.

Conclusion

The collective results from this study strongly indicate no significant or measurable improvement in student achievement when using the flipped classroom teaching model in the middle science classroom. Confirmation of the null hypothesis that there no noticeable changes in grades from lecture style teaching to flipped classroom style were found; thus, the experimental teaching format was not found to be more effective than the traditional teaching method. "While the findings from the present study do not indicate that flipped lesson planning is more effective than traditional forms of instruction, this does not necessarily rule out the possibility that adapters of the flipped lesson planning paradigm may experience successes in other contexts" (DeSantis, Van Curan, Putsch, & Metzger, 2015, p. 51). Furthermore, there is no evidence that improved comprehension and mastery of content over the course of the study existed. Students seemed to perform like they would normally do without the inverted classroom format.

The most noticeable result was the students' appreciation and enthusiasm for the use of technology as a part of their learning processes. Students often brought their own devices to class with the lecture materials downloaded and their rapid adoption of technology demonstrated the ease with which they utilized modern software, Internet websites, and information searching. They embraced the technology; but, in the case of this sample group, the use of technology in an inverted classroom did not automatically translate into effective learning.

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Appendix A

Questions on the post-study survey given to participants to complete.

Likert scale to be used:

1	2	3	4	5
strongly disagree	disagree	neutral	agree	strongly agree

Introduction Page:

As a student serious about academic success, please answer truthfully and accurately as possible as it relates to you. Don't answer a question based on what you think you SHOULD say, but rather based on what you honestly feel. Remember that I am looking for honest feedback to evolve my teaching style and improve student learning in the new digital age to make learning fun, interesting and relevant to YOU!

1. Compared to the lecture-style teaching format previously used, my grasp and mastery of content in this unit using this newer teaching style is much better.
2. In terms of technology, this flipped classroom teaching style allowed me to use more technology for learning and I enjoyed it.
3. It was easy to access the resources/materials anytime because they were on Mr. Dang's website.
4. The materials (that is the PowerPoints) were easier to understand when posted online instead of Mr. Dang talking about them in a lecture presentation.
5. I would rather have the PowerPoints on paper like we always have rather than digitally on Mr. Dang's website.
6. Having the materials available online was easier for me because I can access it anytime, save it on any device I want, and we do not have to use as much paper.
7. I actually enjoyed having the PowerPoints digitally on my device rather than on hardcopy.
8. I am unable to bring an electronic device with the PowerPoints on them to school to use in the classroom.
9. I feel that we saved more time in class by having the materials available online and then working on other reinforcement work in class.
10. I have found that there was less homework assigned using this new style since we did some of it (or at least started it) in class.
11. I feel that I learned better by reading the PowerPoint online at home and then doing reinforcement work in class.

12. I learned better using this new system because Mr. Dang was available in class to help me when we were working on assignments in class rather than at home when he is not there to help me.
13. The short videos of the lecture helped me understand the content even more.
14. The inverted classroom teaching format allowed more collaborative work with classmates and I enjoyed these types of activities because of the social interactions.
15. Whether I enjoyed learning using the flipped classroom technique is not relevant because my grades in this unit went up.

Open-ended:

1. Overall, how did you find this new system of teaching versus the older lecture style?
2. What did you enjoyed the most in this flipped classroom system?
3. What did you enjoy the least in this flipped classroom system?
4. If you had a choice, which teaching style would you prefer Mr. Dang to use for your Science class?