

William G. Davis Public School

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Action Research Question: How do differentiated techniques affect intermediate students' attitudes, engagement and achievement in Mathematics?

Setting the Stage

In a typical classroom, students range in significant ways in their abilities and interests. While some students have difficulty learning, others achieve at very high standards. In order to provide effective instruction for all, it has become increasingly important to differentiate instruction for our students so that they have opportunities to learn and thrive in challenging learning environments. As populations become more diverse, the need to tailor instruction to students' needs becomes an essential piece of equitable education.

Recognizing the changing needs of students in our classroom, the Ministry of Education has provided in-service and professional resources to support teachers in their abilities to differentiate in the classroom, for example, "Education For All". Committed to providing equitable learning opportunities for all students, the Ontario government aims to provide "all students with the supports they need to learn, grow and achieve". Differentiation is recognized by the Ministry as a way of providing engaging learning opportunities that respond to the needs of all students.

Teachers are encouraged to investigate ways to provide choices in classrooms to fully support students in their learning. Teachers can consider students' readiness, interests, or learning profiles when differentiating. Instruction can be differentiated by content, process, product and learning environment. The content may be differentiated in the following ways: using reading materials at varying readability levels, and putting text materials on tape. When students follow different steps/methods to develop their understandings or acquire learning, the process is differentiated. Some ways of differentiating process are: using tiered activities through which all learners work with the same understandings but proceed with different levels of support, for example, offering manipulatives or other hands-on supports to assist students in their learning. Differentiation can also occur with respect to the classroom environment. Making sure there are places in the room to work quietly and offering students opportunities to move around during learning time are examples.

The Greater Essex County District School Board believes that opportunities for meaningful learning resulting in equitable education are only possible when differentiation is at the core of planning, instruction, and assessment. In order for teachers to support students in realizing their learning potential, these differences must be understood to inform instruction and support student learning. Differentiation yields many benefits for all students and when these differences are considered and choices are

provided in the classroom, students experience more success in school and find the learning experiences more satisfying (Csikszentmihalyi, 1997, Sternberg, Toff & Grigorenko, 1998, Vygotsky, 1986).

Our Goal

In light of these statements, our Professional Learning Community (PLC) at Wm. G. Davis Public School, decided to establish an Action Research Team to investigate the benefits of implementing differentiated instruction and learning techniques in the area of Mathematics. More specifically, the committee's leading question was as follows: **How do differentiated techniques affect intermediate students' engagement and achievement in Mathematics?**

Context

Wm. G. Davis Public School is a junior kindergarten to grade 8 school with a current population of 417 students.

Based on Stats Canada, characteristics of Wm. G. Davis Public School include:

- high transience
- low household family income
- high single parent household
- ethnically, culturally, and racially diverse
- less than 10% of parents have completed University Education
- 15% of school population are on Individualized Education Plans

Based on school data, characteristics of Intermediate Students include:

- 14% are on Individualized Education Plans and integrated into the regular classroom setting
- 23% received Learning Support

Implementation – Action Taken

A Professional Learning Community was established consisting of intermediate teachers, LST, LNST and administration. This committee met frequently to examine various research-based methodologies to support differentiation in Mathematics. During meeting time, the group also discussed and selected data-gathering tools and techniques to assess the impact of differentiation over the course of the research project. The team continues to meet regularly to discuss teachers' progress and strategies to further support student learning.

In the classroom, teachers and students discussed and created mixed groupings to engage in various Math-related activities. Students were empowered to choose from various problems to solve and they determined ways in which to demonstrate their understanding. The opportunities for learning were based on theories of Multiple Intelligences. These were also embedded in a Choice Board (see Appendix A) to engage students in learning.

Students were also encouraged to make regular use of manipulatives and other available materials in the classroom.

Data Collection

The Action Research Team used the following methods to collect both qualitative and quantitative data from a student focus group. The focus group consisted of 16 intermediate students of varying Mathematical abilities with both genders equally represented.

Multiple Intelligences Survey

Students completed a Multiple Intelligences Survey to determine ways in which they learn best. The purpose of this tool was twofold: metacognitive for the student and as a means to support the teacher in providing opportunities for student learning.

- Multiple intelligences inventory indicated that students' learn best through activities that involve bodily kinesthetic intelligence, interpersonal intelligence, musical intelligence.
- This data suggests that students learn best in group settings, with opportunities for manipulatives, movement and music.

Student Journals

Student journals were used to assess the depth of global connections to student understanding in Mathematics. Students responded to the following question in their journals: "How is Math used in your everyday life and in the real world?" The research team collected and analyzed the focus group's responses both prior to the inception of the project as well as several months into the research. The team noted trends and changes in depth of global connections based on evidence in the journals. The data collected was organized into five real world categories: global connections, shopping, employment, daily application, and cross-curricular academic connections (for graphed results see Appendix B).

The team reviewed the journals, and found:

- Students on Individualized Education Plans connected their learning in Math to more cross-curricular activities
- Students at varying levels discussed Math as useful in terms of employment
- Most students expanded their responses and connections in their second journal entry across all categories of entries

Mathematics Attitude Survey

Students completed a Mathematics Attitude Survey to explore their feeling and efficacy level in Mathematics. The survey was administered at the beginning and end of the term. The tool consisted of evaluative statements about Mathematics to which students were

prompted to indicate whether they agree, disagree, or were undecided. The questionnaire provided a 5-point rating scale indicating student attitudes. Of the 15 questions, the team selected 4 key questions on which to focus (see Appendix C). These included:

Mathematics is enjoyable and stimulating to me.

- Overall, students found Mathematics more enjoyable and stimulating with the differentiated techniques in place. The results indicated that 33% of the students who initially indicated that they did not enjoy Math or find it stimulating, later indicated that their attitudes towards Math had changed positively

In Mathematics, you can be creative and discover things by yourself.

- The data did not indicate a significant change with respect to this prompt. A slight change was noted by the team showing that a small number of students found Mathematics can be less creative or independent than initially thought. The team considered a possible rationale for this shift could be that students were interpreting Math as a collaborative task.

Mathematics is less important to people than literature.

- A small percentage of the sample population indicated that they value Math more than they did previously.

Mathematics is a solitary activity, done by individuals in isolation.

- The data indicated that fewer students viewed Mathematics as an independent activity. More students saw value in collaborative problem-solving.

Student Interviews

Teachers met with focus group students individually to discuss their perceptions of the differentiation strategies. Students were asked a series of open-ended questions (see Appendix D). Their responses were analyzed and several themes were evident.

- The interviewed students expressed that they valued having choice and variety in their learning opportunities.
- Most students explained that being a member of a group impacted their achievement and attitudes
- Overall, students indicated that they were more engaged and interested in Mathematics
- Students expressed that they were proud of their completed assignments
- Students enjoyed the activities and felt empowered by the choices

Teacher Anecdotal Observations

Throughout the research intermediate classroom teachers regularly recorded their observations of student engagement during differentiated Math activities. The team analyzed their anecdotal records for observed changes in student attitudes, engagement, and achievement. The team found:

- All students participated in the activities
- Students responded well to the choices provided for them and the collaborative approach to learning.
- Students were smiling, talking and having fun
- Students remained focused and on-task
- Many students explored the manipulatives
- Students who were reluctant with pencil and paper tasks participated more willingly in these activities.
- Members of student groups participated in varying ways; some were more involved than others.
- Students expressed that they were highly motivated, had a better grasp of the concepts taught, and enjoyed the opportunities provided.
- Students who naturally excel in Math chose tasks that were more challenging or abstract

Assessments

The achievement data that was used for analysis were report card marks. The team compared prior achievement with current evaluation data in Math. The researchers found:

- 0% of students experienced a decline in achievement in Math
- 53% of targeted students experienced an improvement in most to all strands of Mathematics
- 47% of targeted students experienced no change in their Mathematics achievement

Conclusion

This research study showed that overall most students found Mathematics to be more enjoyable and stimulating with the differentiation techniques in place. It was determined through examining the data collected that using differentiated techniques does have a positive effect on intermediate students' engagement and achievement in Mathematics.

Initially, most students viewed Mathematics as a solitary activity. Over the course of the research period, many of the viewpoints changed to recognize the importance of collaboration with a partner or a group.

Students were asked to reflect upon their use of Mathematics in everyday life and in the real world. The majority of students identified the importance of cross-curricular/academic connections, impact on employment and global connections through their personal journal entries.

Report Card data was also examined and it was noted that 53% of the targeted students experienced an improvement in most to all strands of Mathematics. None of those students experienced a decline in their overall Mathematics achievement.

In conclusion, implementing differentiated instruction in the intermediate mathematics program has had a positive impact on student achievement, attitude and engagement. Continued differentiated instruction will be used in the Mathematics programs at W.G. Davis Public School.

Next Steps

- Plan and share strategies with colleagues across divisions
- Seek administration and specialist teacher support for differentiated instruction in the classroom
- Develop and implement additional differentiated instructional strategies in the classroom such as; using technology, math centres, using graphic organizers, problem-based learning, co-operative learning, role play, think-pair –share activity, and games
- Develop ways to differentiate across the curriculum

Appendix A

<h1>Choice Board</h1>

Circle how you plan to work:

Working Alone

Working with a Partner

Working in a Group

Directions: Choose one or more activities to complete.

Appendix B Journal Entries

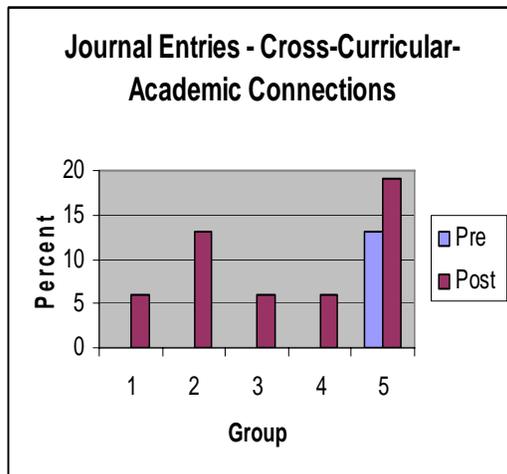
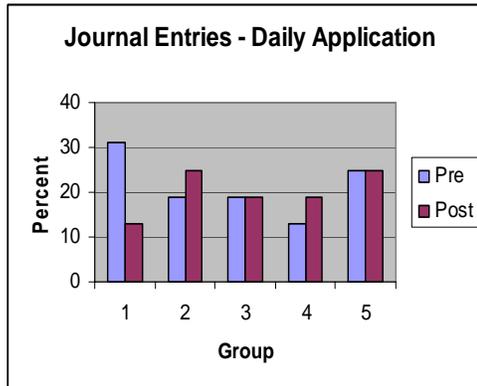
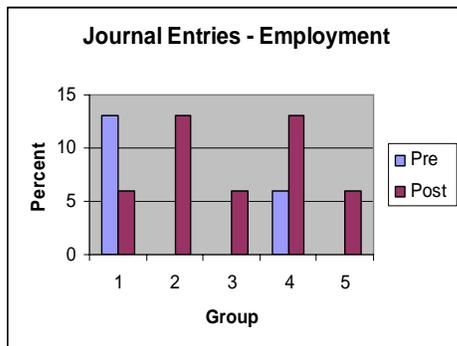
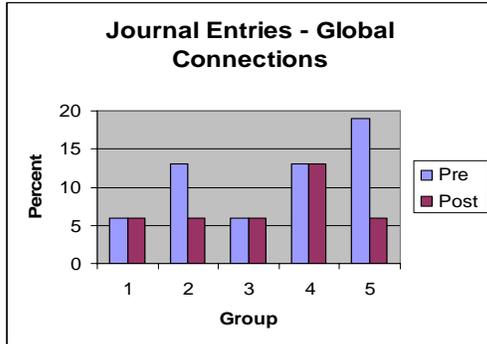
Group 1- Individual Education Plan

Group 2- Level 1 Students

Group 4- Level 3 Students

Group 3- Level 2 Students

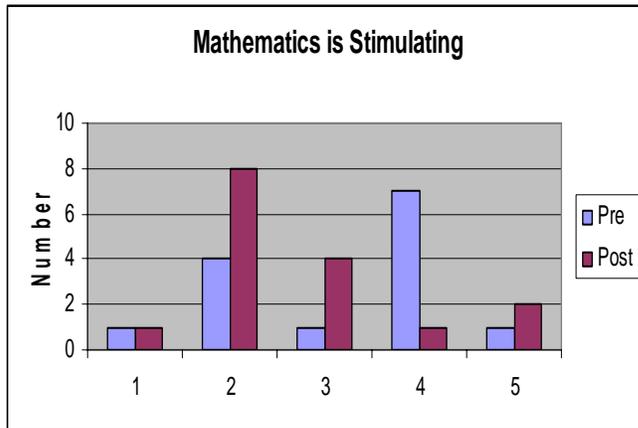
Group 5- Level 4 Students



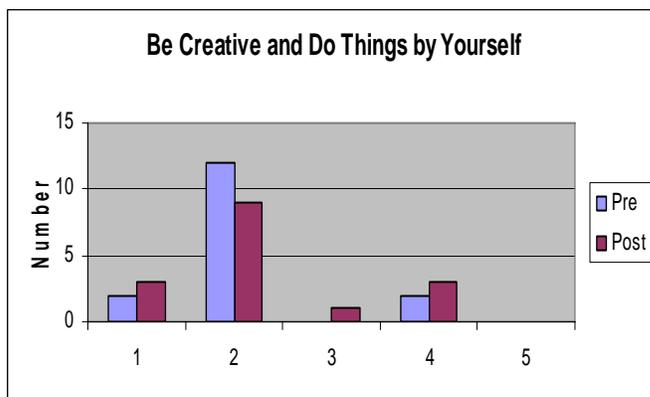
Appendix C

Mathematics Attitude Survey

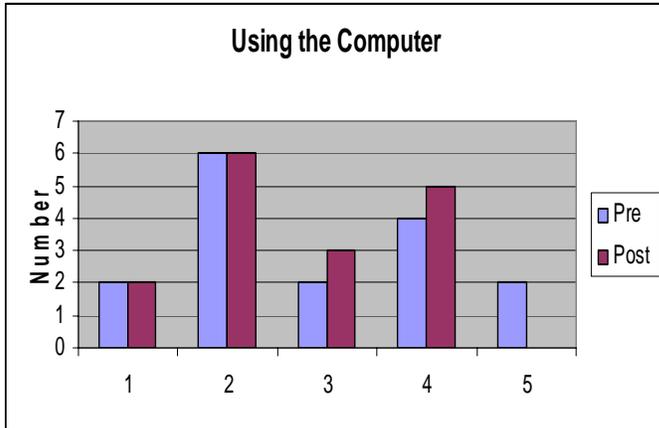
1. Mathematics is stimulating to me.



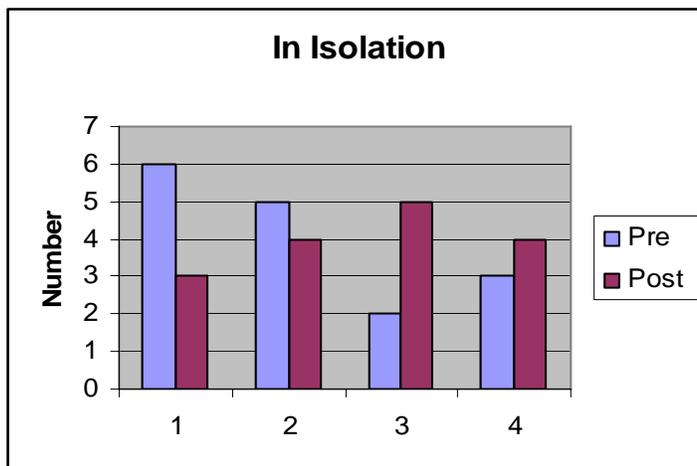
2. In mathematics you can be creative and do things by yourself.



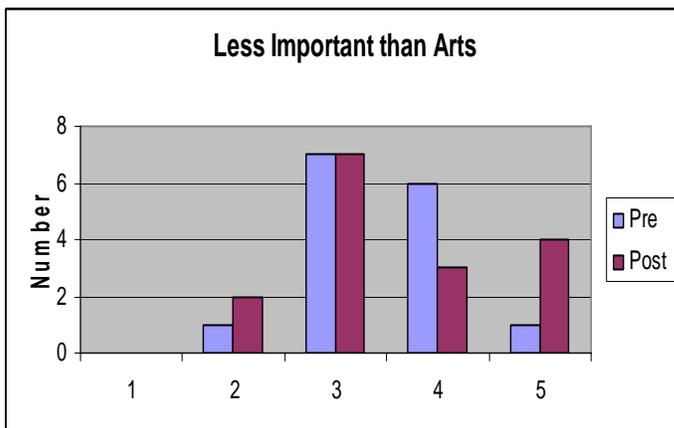
3. Using the web (or a computer) is a good way for me to learn mathematics.



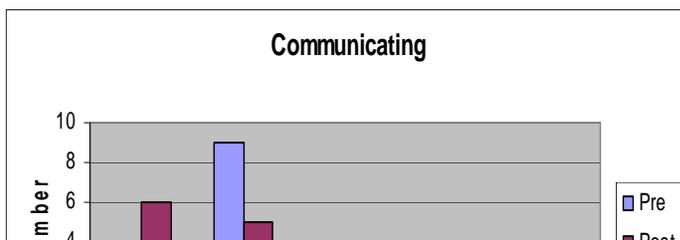
4. Mathematics is a solitary activity, done by individuals in isolation.



5. Mathematics is less important to people than art or literature.



6. Communicating with other students helps me have a better attitude towards mathematics.



Appendix D

Student Interviews

- 1. What are your favourite parts of Math class? What do you enjoy about Math Class?**
- 2. What is the difference between a Math lesson that has choices and a Math lesson that does not have choices?**
- 3. What kinds of choices are you being provided in Math class?**
- 4. What strategies do you like to use during Math class to learn, show what you know or solve a problem?**
- 5. How have these choices helped you learn, solve a problem or show what you know?**
- 6. What is something you have done in Math class lately that you are proud of? Tell me about that.**
- 7. When you think back to Math class last year or the year before, has your attitude toward Math changed?**