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Differentiated Physical Learning Environment

Alisha Thiessen

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by

Alisha Thiessen

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Action Research Report Submitted in Partial Fulfillment
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Abstract

This research study examines the correlation between student academic growth in mathematics in a differentiated physical learning environment and whether or not a differentiated physical environment affects students' attitudes in mathematics. Previous studies have shown that students gain a deeper connection to the curriculum and have a greater enjoyment of the subject matter when a subject is differentiated (Sondergeld &Schultz, 2008). This study looks specifically at differentiating only the physical learning environment and how this affects student academic growth and attitude towards in mathematics. This study found no statistical evidence of greater academic achievement for those students who were part of a differentiated physical environment. This study concludes that students who are in a differentiated physical environment will not have higher academic scores that those who are in a non-differentiated physical environment, though there is a strong student preference for a differentiated physical environment.

Differentiation is a systematic approach in education where content, process, product, affect, and environment can all be adapted to meet the needs of the students in a classroom (Tomlinson, 2003). Differentiation is a time consuming process that takes years to fully incorporate into a classroom. Differentiation is a dynamic process that is always dependent on student need. For these reasons, researchers like Sondergeld and Schultz (2008) recommended that teachers only differentiate a few units each year. However, the extra efforts that a teacher expends to implement this approach are far outweighed by the student learning results.

Before differentiation can begin in a classroom, the teacher must learn about each child in their class. Teachers need to discover and document each student's readiness level, interest, and learning style as they develop a learning profile for each student. There are a variety of assessments and processes available to assist teachers in developing a learning profile for each student. There are also a variety of learning style inventories available for educational use. Through the results of these inventories and assessments, teachers are able to develop learning profiles that provide the data needed for making decisions on how to implement differentiated instructional practices.

There are many ways to implement differentiated instruction in one's classroom: content, process, product, and environment. This study looked at the differentiation of the physical environment of the classroom. Differentiating the physical environment is a process that could happen in every classroom, and it could be the first step in teachers adopting this student-centered method of teaching. The purpose of this study was to examine the possible relationship between student academic growth in mathematics and a differentiated physical classroom environment.

Research Questions

The analysis for this study was focused on two parts. First, this researcher was interested in discovering whether there was a correlation between student academic growth in mathematics and a differentiated physical classroom environment. Second, this researcher was interested in whether a differentiated physical learning environment had an affect on student attitude towards education. The following questions were addressed:

1. Is there a correlation between student academic growth in mathematics and a differentiated physical environment within the grade five classroom?
2. Does the use of a differentiated physical environment in the grade five classroom affect the student attitude to the academic subject?

Definition of Terms

The following definitions are provided to promote clarity throughout the study. All definitions are the researcher's unless otherwise noted.

Differentiation - "the systematic approach to planning curriculum and instruction for academically diverse learners" (Tomlinson, 2003, p. 3).

Learning style - "the way that students of every age are affected by their (a) immediate environment, (b) own emotionality, (c) sociological needs, (d) physical characteristics, and (e) psychological inclinations when concentrating and trying to master and remember new or difficult information or skills" (Carbo, Dunn, & Dunn, 1986, p. 2).

Physical environment - refers to the physical elements that make up the classroom such as design (desks, tables, and chairs), light, sound, and temperature.

Literature Review

Differentiation

"Differentiation is the systematic approach to planning curriculum and instruction for academically diverse learners" (Tomlinson, 2003, p. 3). Tomlinson, the author of many books and articles on differentiation, stated that differentiation requires teachers to increase their understanding of who they are teaching and what they are teaching. Differentiation is a way of respecting and honoring each student. It allows teachers to recognize the learning needs of each student and maximize each student's learning potential. Differentiated instruction allows teachers to assist students as they develop the unique gifts they have been given (Tomlinson, 2003).

Teachers can differentiate five aspects of the classroom to increase the possibility that each student will learn as much as possible: content, process, product, affect, and learning environment (Sondergeld &Schultz, 2008). *Content* refers to what is being taught and how students are able to access the information. Differentiating content can be done through providing materials at varied abilities and grade levels. *Process* refers to how the information is understood by students. It is the knowledge, understanding, and skills that the students have gained. The process can be differentiated by providing activities that are designed to meet the readiness or interest level of the students. *Product* refers to how the students demonstrate their understanding. Product differentiation can be demonstrated through the choice of how students show their knowledge and skills. *Affect* refers to how students are able to link thought and feeling in the classroom. *Affect* is really the climate of the classroom; that the classroom is a place where all students are welcomed, accepted, included, and valued. Differentiating for affect is dependent on the teacher recognizing when the classroom needs to change so that all students

feel that their individual needs are being addressed. Finally, *learning environment* refers to the feel and function of the classroom. Differentiating the learning environment can come from creating quiet places and group work stations as well as having a classroom that allows for movement and places to sit still (Tomlinson, 2003; Sondergeld &Schultz, 2008). By differentiating these five elements of the classroom, teachers are able to increase the possibility that each student will be able to learn in a way that is best suited for his or her individual needs and preferences.

In order for teachers to differentiate in the classroom, they must learn about their students. There are three characteristics that will help teachers learn about their students: readiness, interest, and learning profile (Tomlinson, 2003). *Readiness* refers to the background knowledge and understanding a student has when beginning a new school year, subject, or content area. Being conscious of what a student already knows helps the teacher differentiate the content by making it more or less challenging for the students depending on their readiness level. *Interest* refers to what the student enjoys learning about, thinking about, and doing. A way to differentiate learning based on interest would be to help students make connections to the content based on things they find engaging, fascinating, pertinent, and useful. The *learning profile* refers to the student's preferred method of learning. The learning profile is affected by the learning style and intelligence preference of the student, as well as variables such as gender and culture. Differentiating instruction based on learner profiles help students to learn in the ways that they learn best (Tomlinson, 2003). Teachers who take the time to learn about their students are better able to meet the needs of the students in their classroom and are able to differentiate the five aspects of the classroom with greater success.

Sondergeld and Schultz (2008) explain that “differentiation provides students with opportunities to approach curriculum from their strengths, as varied as these might be” (p. 35). A classroom where differentiation is taking place is a classroom of inclusion for all students, inclusive of all academic abilities. When students face limitations, differentiation allows for these limitations to be addressed without drawing negative attention to students. A similar situation is true for gifted students who need to be challenged.

Sondergeld and Schultz (2008) conducted a case study of how differentiation can accommodate students’ differences and abilities. The setting for their study was a third grade science class. The focus during this science unit was on differentiating the content, process, product, and environment. The content of the unit was differentiated based on student readiness. The teachers differentiated the process through tiered lessons as well as a differentiated product assessment that allowed for the various needs and abilities of the students to be met. The layout of the classroom was altered to meet the needs of students who preferred to work as independent learners or in small groups.

As part of the study, students were interviewed to find out their feelings and attitudes towards the differentiated science unit. A majority of the students said that they liked the unit more than the non-differentiated unit that was taught prior to the differentiated unit. Students found that the differentiated unit was more enjoyable, they liked the choices they were given, felt as if they learned more and gained a better understanding of the unit content, were able to work at their own speed, and were given the opportunity to experiment and create. Only one student found the differentiated unit distracting. (Sondergeld & Schultz, 2008).

At the end of the unit, Sondergeld and Schultz (2008) stated that students were able to “gain a broader and deeper connection to curriculum and [were] able to apply their learning

beyond the classroom walls" (p. 40). By differentiating the content, process, product, and learning environment in a science unit, the result was an appropriate education for all students because the diverse needs of each child were taken into account.

Sondergeld and Schultz (2008) found it notable that the learning environment was one of the classroom aspects chosen for differentiation. Other researchers have also noted the impact that the learning environment has on successful teaching and learning. "Organizing the learning environment is a critical component of successful teaching and learning. Even the best content, taught with an appropriate learning process in mind, will be unsuccessful if the classroom environment is not conducive to learning" (Miller, 2002, p. 82).

Creating a classroom environment that is conducive to learning incorporates the social elements as well as the physical aspects. The classroom needs to be a place that fosters respect, encouragement, acceptance, and joy (Gartin, Murkick, Imbeau, & Perner, 2002). These four social characteristics will have the most affect on the atmosphere of the classroom and should be the goal for every inclusive classroom.

According to Gartin, Murkick, Imbeau, and Perner (2002), the physical aspects of an effective learning environment recognizes that students need access to their peers, adequate space, mobility, and a distraction-free space. These researchers suggested the use of study carrels or private offices for quiet work. Other suggestions included having multiple work areas, such as group work areas and work stations, to aid in developing a conducive, physical learning environment. Student desks need to be placed strategically around the classroom to support learning, and the classroom arrangement needs to be flexible enough to apply differentiated instructional activities. The reduction of textures, sounds, and smells in the classroom will help to minimize the distraction these have on some learners.

In summary, differentiation is a philosophy of teaching as well as a systematic approach to instruction. It is the recognition that students learn best when they are known by their readiness levels, interest, and a learning profile. Once teachers have a solid understanding of their students, they are able to differentiate content, product, process, affect, and learning environment. Differentiating the learning environment is something that can be accomplished at the beginning of the school year and can remain intact all year long. It is one aspect of differentiation that can be accomplished with little time but has the potential for great student reward throughout the school year.

Learning Styles

"A learning style is the way in which individuals begin to concentrate on process, internalize, and retain new and difficult information" (Dunn, 1995, p. 353). Searson and Dunn (2001) defined a learning style as a "biologically and developmentally determined set of personal characteristics that make instructional environments, methods, and resources effective for some and ineffective for others" (p. 22). In order for teachers to successfully differentiate their classroom, they need to know the ways that students learn best.

The Dunn and Dunn learning style model is based on the following principles: 1) All individuals can learn. 2) Students are a diverse group of people and they respond differently to educational aspects. 3) Everyone has different strengths. 4) The learning style preferences of individuals can be measured. 5) Teachers can use learning styles as a basis for their teaching. 6) Most students who understand their learning styles, can use this knowledge as they encounter new and difficult information (Searson & Dunn, 2001). These principles are important to understanding the development and the use of their learning style model.

According to Dunn and Dunn (1992), a learning style is an individual's reaction to 21 elements classified into five categories of stimuli: environmental stimuli (sound, light, temperature, and design); emotional stimuli (motivation, persistence, responsibility, and structure); sociological stimuli (peers, self, pair, team, adult, and varied); physiological stimuli (perceptual, intake, time, and mobility); and psychological stimuli (global/analytic, hemisphericity, and impulsive/reflective).

This study focused on the elements identified within a classroom's environmental stimuli. Each student reacts differently to these environmental elements. It is important that the classroom teacher understands each element and notice how students react to them.

Everyone reacts differently to sound. Some students can work easily with noise because they are able to block out or completely ignore sound. Some students need some noise because the absence of noise allows them to detect sounds that they do not typically notice, causing a distraction. Some need total silence, and yet others need specific types of sound (e.g. classical music or the sound of a fan) to work effectively.

Light is another factor that has an effect on students. Some students are light sensitive and can tolerate only subdued lighting while others need bright lights. For those who find light to be either too bright or not bright enough, functioning effectively can be difficult.

Some students concentrate better when the room is cool because they feel drowsy when it is too warm. Some students cannot concentrate when it is cool and need a warmer temperature; cooler temperatures can cause physical or emotional discomfort.

Some students prefer an informal workspace. They prefer couches and comfortable chairs to do work and find that a formal workspace can suppress their motivation and creativity. Other students have a preference for a more formal workspace. These students need a hard chair at a

table or a desk in order to concentrate. For some students, the workspace is dependent on the task being completed or it just does not matter at all.

Dunn (2001) stated that the stronger preference students have for a particular element, the more important it is to provide compatible instructional strategies. When teachers are able to change their methods of teaching to fit with the learning style preferences of their students, many students' attitude towards learning improves. When a student shows a preference towards content differentiation, the teacher can adjust the reading and/or interest level of the content to meet the student needs. Adapting the activities of the subject, such as having projects or hands-on activities, will reach students who have a preference towards a particular process. When students are able to demonstrate their knowledge in different ways, such as through research projects, presentations, posters or dioramas, the teacher is allowing students with a preference towards a differentiated product to excel. When students have a preference towards a particular environment, the teacher can make adjustments to sound, light, temperature, and design as needed. Dunn (1995) also noted that "students with strong learning-style preferences show a greater academic gain as a result of congruent instructional interventions than those students who had mixed preferences or moderate preferences" (p. 358).

In a case study conducted on students in grades six through eight, Rayneri, Gerber, and Wiley (2003), noted the impact that teaching to learning styles has in the classroom. All of the students took the *Learning Style Inventory* by Dunn and Dunn. Classroom teachers were provided with different instructional strategies to use to meet the diverse needs to their students. New content was taught as concept-based units that utilized tactile activities. Tactile learners were given manipulatives and three-dimensional materials. Through this type of instruction, class discussions became more effective. Students were allowed to plan, demonstrate, report, and

evaluate with models and real objects. Students were encouraged to keep written or graphic records as well. At the conclusion of their case study, Rayneri, et al (2003) stated that "student learning styles are important to consider when developing instructional strategies and providing effective environments for learning. Not all students learn in the same way, nor do they respond to the same classroom conditions" (p. 203).

It is important to understand the learning styles of all students in order to be an effective teacher. By having this knowledge, teachers are able to adjust curricular material so that each student can excel academically at a developmentally appropriate level. Making adjustments to the environmental aspect of the classroom can take time, though it is a change that can be effective all year long, across all subject areas. Recognizing and understanding the different aspects of the environment, and making adjustments to the design to meet the varying needs of students can be beneficial to all students.

Methods

Previous research has shown that students who are taught in a differentiated classroom, based on learning styles, are able to demonstrate higher achievement than those taught in the traditional classroom. In addition to their academic growth, students gain a greater appreciation for education. This research study attempted to discover if there was a difference in academic achievement between students who were taught in a classroom that differentiates the physical environment based on student's learning styles versus a more traditional classroom environment. This researcher also examined student attitudes in a classroom that differentiates the physical environment. This study attempted to narrow previous studies to the specific aspect of learning

styles and differentiating the physical learning environment. The following questions were addressed in this study:

1. Is there a correlation between student academic growth in mathematics and a differentiated physical environment within a grade five classroom?
2. Does the use of a differentiated physical environment in the grade five classroom affect the students' attitudes to the academic subject?

Participants

The participants in this study comprised of 47 grade five students, ranging in age from 11-13, from an urban Christian school. There were two grade five classes at this school, and the assignment of each class was determined by the previous grade teachers and principal. One of the grade five classes was the treatment group, (Group A), while the other was the control group (Group B). All 25 students in the treatment group had signed parental informed consent forms (see Appendix A). The participants' demographic make-up was largely homogeneous in terms of age, ethnicity, and socioeconomic status as the students were middle class, Caucasian, and resided in an urban setting.

Instrumentation

In order to determine learning style preferences of the students in the treatment group, the Learning Style Inventory (see Appendix B) was taken. The Learning Style Inventory is based on the Dunn and Dunn model. The Learning Style Inventory, or LSI, has been classified with "good or very good reliability and validity" (Dunn, 1995). The results of the inventory were kept confidential to the researcher. The results were detailed, giving the researcher a clear indication as to where each student's preference occurred in the 24 different categories that are part of the Learning Style model.

The curriculum taught in both fifth grade classrooms during the study was written by the teachers based on the required learning outcomes set forth by the province. The pre- and post-tests were written by the researcher (see Appendix C), and were based on the curriculum that was to be covered during the two units. The researcher also used unit tests that were used in previous years in the grade five classes at this school. Both the researcher and the teacher of the control group agreed that the tests were fair and were pertinent to the curriculum that was covered during the units.

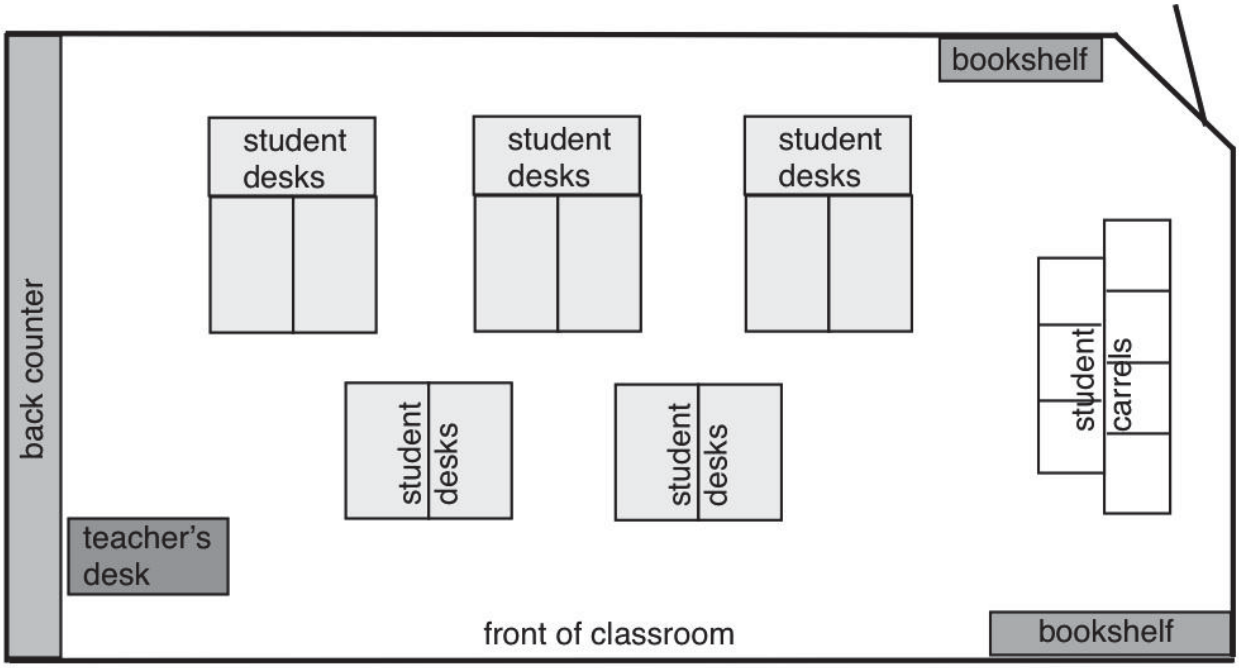
Procedure

The design of this research study was quasi-experimental as the classes were created prior to the study. The research design was a non-equivalent, control group design, where one class of students (the researcher's class) was the control group. The independent variable was the physical learning environment. The dependent variable was the difference in scores on the pre- and post- math unit tests.

From the start of the school year, the classroom's physical environment was differentiated (see Figure 1). There were seven student carrels in the classroom. Students could select a lamp from the back counter in the room to use at their desk. There were a pile of cushions available for students to use either on the floor or at their seat. Some students listened to music during class time. These students either used their own mp3 player or used the class iPod. Students were given class time to experiment and try sitting in different areas in the classroom at the start of the school year, though once the research began, students sat in their predetermined locations or used items (lighting, music, pillows) as determined by the researcher.

Figure 1

Diagram of Classroom



In November 2010, students in the treatment group were given a total of one and a half hours over the course of one week, to complete the Learning Styles Inventory online. The researcher then took the results of the inventories, observation notes from the first two months of school, and students' personal preference to determine the best physical environmental setting for each student.

In April and May 2011, the treatment and control groups were taught a measurement unit and a pre-algebra unit in mathematics. Before either unit began, all students took a pre-test (see Appendix C). This test was used to see the level of knowledge students had prior to engaging in the unit. Because of the layout of the classroom, students in the treatment group sat at their desks during instructional time and were placed in the differentiated physical environment during work time. Students sat at student carrels, sat on the floor, sat at their desk with a pillow, listened to

music, had additional lighting, or had no change to their workspace in the classroom. At the conclusion of both units, all students took a final unit test (see Appendix D).

At the completion of the two math units, the students in the treatment group completed a survey that was written by the researcher (see Appendix D). Students responded using a Likert scale with responses ranging from “not at all” to “a lot.” The survey was used to determine the attitude of the students with regard to the subject area of mathematics, and how they thought they might feel towards education in general if the differentiated physical environment was applied to other subject areas.

Results

Data Analysis

Difference scores were used to analyze the results of the two mathematics units. The pre-test score was subtracted from the post-test score for each unit to reveal a difference score. An independent, 2-tailed t-test was then conducted using the mean of average gain scores between the two groups and a t-test was run for significance. An alpha level of $p<.05$ was used to show significance. Any probability less than .05 suggests that the likelihood of that outcome randomly happening would occur less than 5% of the time. Thus, for results less than .05 the null is rejected. For this study, the null hypothesis was that there would be no difference between the treatment group and the control group.

Findings

No significant difference was found between the Group A (M = 46*)* and the Group B (M = 39) regarding the academic achievement of the students during the measurements unit, (t = +1.53, p = 0.39). The results of this analysis are displayed in Table 1.

Table 1

Differences in Measurement Unit Test Scores

	n	m	t	p
A	22	46	1.53	0.39
B	25	39		

No significant difference was found between the Group A (*M* = 99.2727*)* and the Group B (*M* = 92.32) regarding the academic achievement of the students during the pre-algebra unit, (*t* = +0.93, *p* = 0.069197). The results of this analysis are displayed in Table 2.

Table 2

Differences in Pre-Algebra Unit Test Scores

	n	m	t	p
A	22	99.2727	0.93	0.069197
B	25	92.32		

The results of the survey that was conducted at the conclusion of this research found that that majority of the students felt that the differentiated physical environment was beneficial to them. There was a significant preference toward the use of a differentiated physical environment amongst the students. The survey was completed in a 1-5 scale, one meaning “not at all” and five meaning “a lot.” Table 3 shows the results of the survey.

Table 3

Findings of Student Survey

	one (not at all)	two (rarely)	three (sometimes)	four (usually)	five (a lot)
Question 2	21%	17%	33%	21%	8%
Question 3	13%	29%	21%	13%	25%
Question 4	4%	29%	21%	13%	25%
Question 5	50%	25%	21%	4%	0%
Question 6	13%	17%	25%	21%	25%
Question 7	21%	8%	21%	8%	42%
Question 8	13%	4%	25%	29%	29%

Discussion

Summary

In summary, this research study found that there was no statistical evidence of greater academic achievement for those students who were a part of a differentiated physical environment. There was, however, strong student preference for this type of classroom physical environment. Many students expressed their enjoyment of mathematics because of where they sat in the classroom or what they were able to use. Almost all students felt that the differentiated physical environment helped them to stay focused during class as compared to the traditional setting of the classroom. A majority of the students also felt that applying this differentiated physical environment to other classes would help them to enjoy school more and would help them to stay focused.

Conclusion

This researcher recognizes the value of implementing a differentiated physical environment in the classroom. This type of differentiation demonstrates to students the acknowledgement of their individual needs and that teachers are willing to adapt the classroom to help students learn in the best environment possible. Although this research did not show any statistical difference in academic achievement, the increase of student enjoyment was noteworthy. Mathematics is typically a subject that students either enjoy or do not, and during the two units that this research took place, there were a greater number of students who were enjoying mathematics class. Many students wanted math classes to last longer, or were disappointed if math class was an instructional class and there was no work time.

In the future, this researcher would like to implement the use of a differentiated physical environment into other subject areas. Language Arts is one subject where students spend time working independently, which would work well with a differentiated physical environment.

Implications

The implications of this research are valuable for education. Although there was no statistical evidence of a change or difference in academic achievement, there was an increase in student enjoyment of mathematics. Through the differentiation of the physical elements of the classroom, teachers are able to serve their students in a more meaningful manner. Teachers can use the evidence from this study in other subject areas to help students increase their enjoyment of education.

Limitations

Some of the confounding variables of this study were the teacher, the prior knowledge of students in each group, and the IQ level of the students. The teachers and the students were not

able to be randomly controlled as they were pre-determined. Although the teachers used the same teaching material, they had their own methods that were used in teaching the mathematics units. Ideally having one teacher teaching both classes would have helped control for this variable in this study.

Two major limitations in this study were the issues of space and money. The classroom that this research was conducted in was originally designed with the traditional classroom (desks in rows) in mind. Because of the limited space, a couch and/or chairs were not able to fit in the classroom. Students who sat on the floor had to do so in limited space where they were often close to other people. Students who worked in the student carrels did not have enough space around them to move in and out easily. Money is often not available to provide an informal setting, such as couches and chairs. There is usually a lack of money and/or resources to provide students with music to listen to (if they do not have their own source of music) and/or provide music that is enjoyable to each student. Money was also needed to conduct the Learning Style Inventory, and at a cost of $5 per test, this expense could be difficult to meet.

Further Study

This research provides many opportunities for further study. Some suggestions would be to try a differentiated physical environment in other grade levels and in other subject areas. The testing for this study was only done during student work time during mathematics; it would be interesting to see how incorporating a differentiated physical environment would affect students during teaching time as well. One other aspect to look into for further study would be to offer other means of informal design in the classroom.

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Appendix A

Parental Consent Form

Dear Parents,

I am currently in the process working on my Master Project, which is the final step in completing my Masters degree from Dordt College. The purpose of my study is to see how changing the physical environment of the classroom can affect student achievement and student attitude toward school. There will be no extra work to the students who are involved in the study. Achievement indicators will be taken from pre-tests and post-tests from academic subjects. The marks from the tests will be kept confidential between the parents, students, and teacher. The results from the tests will be kept confidential, no names will be given, for compiling the results of the research.

It is completely up to you and your child whether or not he or she can participate in this study. There will be no harm or risk to your child. The results of this study will hopefully influence the classroom environments at Calvin Christian School. Your child, with your permission, has the right to withdraw from this study at any time.

If you have any questions about this study, please contact me at Calvin Christian School at 338-7981 or via email at thiessena@calvinchristian.mb.ca. If you have any questions in general about the ethics of this study, feel free to contact Dr. Sherri Lantinga, Chair of the Dordt College Institutional Review Board, at 712-722-6301. If you and your child have decided to let him or her participate in this study, please read the statement below with your child and both sign your name.

Thank you very much for your help,
Alisha Thiessen
Hank VandeKraats, Principal, Calvin Christian School

I understand the information on this page and am willing to allow my child to participate in this study. I understand that he or she can withdraw at any time and his/her results will not be used. **Please have your child return this form to school by…….**

_____	_____	_____
Printed name of child	Printed name of parent/guardian	Date
_____	_____	_____
Signature of child	Signature of parent/guardian	Date

Appendix B

The Learning Styles Inventory can be found at www.learningstyles.net.
There is a fee of $5 USD per inventory

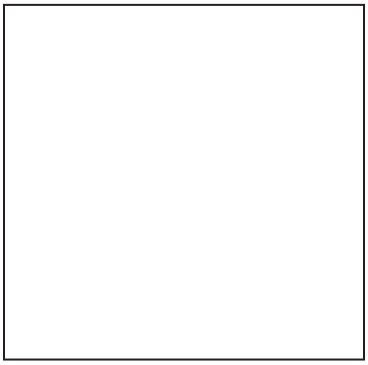
Appendix C

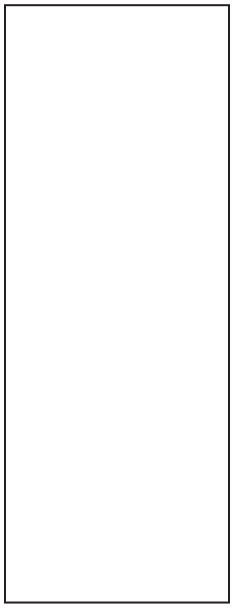
Measurement Pre-Test

A: Matching

1. _____ perimeter	A. The amount a container can hold.
2. _____ length	B. The amount of space a 3D object takes up.
3. _____ area	C. The shortest side of a rectangle.
4. _____ volume	D. The longest side of a rectangle.
5. _____ capacity	E. The distance around a figure.
6. _____ height	F. The measurement that describes how tall a building is.
7. _____ width	G. The amount of space an object covers.

B: Find the perimeter and area of each rectangle to the nearest whole number.



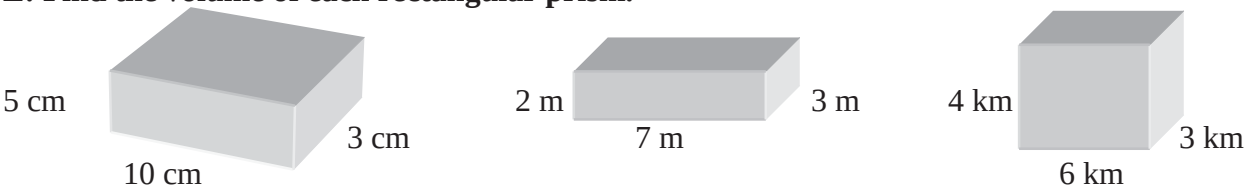


C: Complete the following

1 cm = _____ mm	9 m = _____cm
10 cm = _____dm	4 cm = _____mm
100 cm = _____m	3 dm = _____cm
20 cm = _____dm	12 m = _____cm

D: Draw 2 different rectangles with a perimeter of 12 cm. Find the area of each rectangle and write the answer inside.

E: Find the volume of each rectangular prism.



1. _____ 2. _____ 3. _____

F: Using the following units, decide which would be the most appropriate to measure each distance or amount.

mm cm dm m L mL

1. _____ width of this paper
2. _____ The capacity of a large pop bottle
3. _____ The amount of salt needed in a cookie recipe.
4. _____ The length of the classroom.
5. _____ The height of 3 dimes
6. _____ The length of your foot.

Appendix D

Measurement Test

Part A: Fill in the blank with the appropriate word.

area	capacity	volume

1. _____ An amount of space occupied by an object. It is measured in cubic units.
2. _____ The of a figure refers to the number of square units that can cover it.
3. _____ Is almost a synonym for volume. It tells how much something can hold.

Part B: In the space beside each group of words, write down the <u>unit</u> that would be used to measure each distance. Choose from these units: mm, cm, dm, m, km.

1. _____ the perimeter of Winnipeg
2. _____ the length of your desktop
3. _____ the width of our classroom
4. _____ the thickness of a penny
5. _____ the height of a blue chair

Part C: Make the following conversions between units.

1. 35 km = _____ m
2. 30 mm = _____ cm
3. 8000 m = _____ km
4. 70 cm = _____ dm
5. 5 dm = _____ mm
6. 6 L= _____ mL
7. 21 kL = _____ L

***Bonus: 4 km = _____ mm

8. 5 cm = _____ mm
9. 900 mm = _____ dm
10. 20 dm = _____ m
11. 60 cm^3 = _____ mL
12. 12 dm = _____ cm
13. 86 mL = _____ cm^3

*14. 1.5 L = _____ cm^3

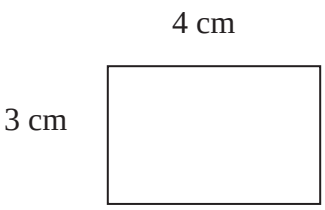
Part D: Use your ruler to find the actual measurement of each of the following:

1. Find the height of this test paper to the nearest centimetre: _____

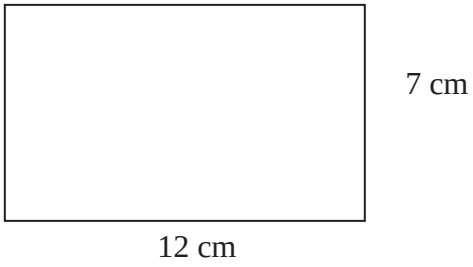
2. Find the perimeter of this paper to the nearest decimetre: _____

Part E: Find the area of these rectangles. Show your work.

1. Area: _____



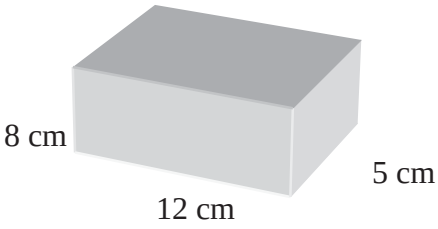
2. Area: _____

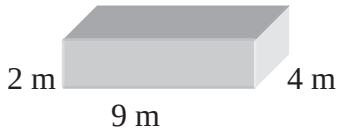


Part F: Using this centimeter paper, draw two different shapes, each with a perimeter of 12 cm.

Part H: Using this centimeter paper, draw two different shapes, each with an area of 9 cm^2.

Part I: Find the volume of the following rectangular prisms. Show your work.





1. _____

2. _____

Part J: Figure out the dimensions of a rectangular prism with a volume of 36 cm^3. None of the sides should be only 1 cm long. Draw the rectangular prism, be sure to label each side with the appropriate dimension.

Volume= 36 cm^3 Length = _____ Width = _____ Height= _____

Part K: Answer the following question in a complete sentence. Show your work.
Bobby was going to fill a 5L jug with apple juice for a party. He had to measure using a 200 mL measuring cup. How many times would he need to fill the measuring cup in order to fill the big jug?

Appendix E

Algebra Pre-Test

Part A: write the operation that would undo he operation in the equation

1) $n - 7 = 4$ _____ **2)** $x + 6 = 10$ _____

3) $9a = 36$ _____ **4)** $\frac{a}{4} = 16$ _____

Part B: Solve each equation

1. $y - 2 = 4$	**2.** $x - 9 = 17$	**3.** $x + 6 = 8$
4. $a + 5 = 10$	**5.** $7 + a = 15$	**6.** $n - 1 = 12$
7. $4a = 12$	**8.** $\frac{n}{3} = 5$	**9.** $2a = 18$
10. $\frac{x}{6} = 3$	**11.** $7n = 14$	**12.** $\frac{b}{4} = 12$

Appendix F

Algebra Test

*denotes exceeding expectations

Part A: write the operation that would undo he operation in the equation

1) $a + 7 = 9$ _____ **2)** $x - 6 = 12$ _____

3) $3n = 15$ _____ ***4)** $\frac{x}{9} = 3$ _____

Part B: Solve each equation

1. $y - 5 = 6$	**2.** $x - 6 = 12$	**3.** $w + 7 = 18$
4. $b + 7 = 9$	**5.** $4 + a = 8$	**6.** $n - 8 = 16$
7. $5n = 15$	***8.** $\frac{X}{4} = 3$	**9.** $2a = 18$
***10.** $\frac{A}{2} = 9$	**11.** $6n = 18$	***12.** $\frac{B}{2} = 7$

Part C: Write and solve an equation for each situation

1. Dana bought a shirt and a sweater for $34. If the shirt cost $12, how much did the sweater cost?

2. Jeb went shopping and spent $5. If he had $7 left, how much did he have before he went shopping?

3. Jeff went shopping to buy five candy bars that cost the same. He spent $20 in total. How much were the chocolate bars?

***4.** Donna had a bag of skittles. She wanted to divide the skittles so that each of the six groups had 8 skittles. How many skittles does she need to have in her bag?

Appendix G

Student Survey

1. Which of the following did you use during your math classes (circle all that apply):
    a. sat at a cubicle
    b. sat at a group desk
    c. sat on the floor or in another relaxed area
    d. listened to music
    e. used ear plugs
    f. had a lamp at my work area
    g. did nothing different, I stayed at my regular seat

On a scale of one to five, one meaning not at all and five meaning a lot, rate the following questions

	1 not at all	2 rarely	3 somewhat	4 usually	5 a lot
2. Did you find that your selections in number one helped your grade in math?					
3. Did you find that your selections in number one helped you enjoy math more?					
4. Did you find that your selections in number one helped you to stay focused during math classes?					
5. Did you find that your selections in number one caused you to be more distracted in math class compared to other subjects or at other times in the school year?					
6. Do you feel that continuing to use your selections in number one in other classes would be academically helpful to you?					

7. Do you feel that continuing to use your selections in number one in other classes would help you to enjoy school more?					
8. Do you feel that continuing to use your selections in number one in other classes would help you to stay focused?					

9. Is there anything you would like to share about your experience during these past math units?

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Education

B.A. in Elementary Education with a Middle School Endorsement, Dordt College, 2004

Academic Employment

Elementary Teacher (5), Calvin Christian School, Winnipeg, MB (2009-2011)

Elementary Teacher (K-8), Rainbow Christian School, Vanderhoof, B.C. (2004-2009)

Presentations

How to use Microsoft PowerPoint – professional develeopment workshop at Rainbow Christian School (October, 2008)