Mathematics Lesson Observation

When I was in grade 3 and 4, I loved learning about perimeter and area. Although I enjoyed the tasks, I never understood why it related to real life or, more importantly, my life. There were never any connections to real life, or chances for me to develop an understanding for myself. The content was strictly for a mathematics class with no personal relevance to my classmates and me. The assignment instructions were always clear and simple, but the activities involved rote memorization and busy work. We did not get the opportunity to work in partners for these assignments, nor did we get a chance to share our answers with the class. Reflection took place after we completed a test and received our grades, without an explanation as to why we got the answer(s) wrong or how to get the correct answer(s).

This semester I have observed a grade 3/4 mathematics classroom that demonstrated that approaches to teaching mathematics, such as those mentioned above, have changed. The lesson I observed for this project encompassed various techniques and tools that I wish my teacher would have used to help me understand measurement concepts. First, I review the educational objectives and standards used in the lesson, then I analyze the conceptual development, reflective inquiry, connections between different concepts and possible subject integrations and the use of technology.

Strand: Measurement
Topic: Perimeter and Area (reinforcement lesson)
Grade Levels: 3/4 (Ontario)

By grade 3 and 4, students have had some exposure to perimeter and area with regards to two-dimensional shapes (Ontario Ministry of Education, 2005). This lesson was meant to build on prior knowledge and to reinforce previously learned knowledge.

Educational Objectives and Standards

To help students better understand different types of measurement, specifically perimeter and area and their relationship, students must have hands-on, problem-solving experiences to explore these concepts. As suggested by the Ontario Ministry of Education (2005), these concepts and skills are practical and applicable to students' lives and the world in which they live. In grades 3 and 4, measurement units, such as standard metric units (i.e., centimetres), are utilized by students to help them explore relationships among different rectangles. This concrete experience develops a valuable foundation students need in order to use and apply their understanding of such concepts and skills in real life (Ontario Ministry of Education, 2005). The focus of the current lesson was on how to create different two-dimensional rectangles, represented as different playgrounds, with the same perimeter and how the area changes as the perimeter changes, using Centicubes and centimetre grid paper.

The following objectives were followed in the observed lesson:

- *Grade 3:* Estimate, measure and record the perimeter of two-dimensional shapes, through investigation using standard units; and
- *Grade 4:* Estimate and measure using a variety of tools and strategies, and record the perimeter and area of rectangles; Determine, through investigation, the relationship between the side lengths of a rectangle and its perimeter and area; Compare, using a variety of tools, two-dimensional shapes that have the same perimeter

Materials used:

- Document camera
- Centimetre grid paper
- Pencils
- Centicubes
- Rulers
- Calculators

Procedure:

1. Students were put into groups of two and given two pieces of centimetre grid paper.
2. On the document camera, the teacher presented a centimetre grid paper. She explained that the school wanted to add a new playground and that the perimeter must be 18. She then asked students how they would create a playground with the perimeter of 18 and what the area was of the playground. She then asked how they got their answers. She re-explained why the perimeter was 18 and computed the area through modeling.
3. Students were instructed to create as many different playgrounds/rectangles as they could with the Centicubes with a perimeter of 18 through trial and error, and a calculator if necessary. These rectangles were to be drawn on the centimetre grid paper, using a ruler if necessary. Afterwards, they were to compute the area, showing all of their work and writing what they saw, including number sentences.
4. The teacher had students repeat what the activity instructions were and made sure not to give any help in order to allow students to investigate and explore independently in their groups.
5. When they were finished, students shared their work and displayed their Centicube models to the class using the document camera. They explained how they got the different shapes, perimeters and areas. Some answers sparked discussion.
6. The teacher assessed students' work through observation of their independent work and their explanations using the document camera.

Conceptual Development

As mentioned by the National Council of Teachers of Mathematics (NCTM; 2014), students from kindergarten through grade 12 must "understand measureable attributes", such as perimeter and area. More specifically, students in grades 3-5 are expected to explore and understand what happens to the perimeter and area of a two-dimensional shape, such as a rectangle, when it is changed in some way. This was done in the lesson and the students investigated why these changes happened. Students were able to explain why these changes took place (for instance, why the area changed if the perimeter changed through explanations/descriptions of the dimensions of the rectangles). As such, it seemed as if students understood the conceptual aspect of perimeter and area through the use of an active, engaging, hands-on activity.

Students must also "apply appropriate techniques", and in grades 3-5 this includes using the correct standard units (in this case, centimetres) and tools to calculate perimeter and area and understanding and using the correct formulas to find the measurements of rectangles. The teacher's use of modeling and think-aloud helped students develop their conceptual understanding of perimeter and area. It demonstrated metacognitive skills, such as understanding how and why specific steps are taken to calculate perimeter and area and how students should think during the activity. For instance, the teacher thought aloud about how to calculate perimeter, and how this information can be used to calculate area (i.e., "If I count and add all four

sides of the rectangle, I can figure out the perimeter. Then by knowing the length and width of the rectangle, I can figure out the area because area = length *x* width"). However, the teacher only summarized required steps for the activity after the students shared these ideas with her. During the observation, I noticed students using the techniques that they suggested and that the teacher used during her think-aloud. Therefore, it appeared students were using and developing their own trial and error and metacognitive skills to solve an ambiguous problem.

This lesson also demonstrated that there can be multiple answers for one question and that what may seem like a simple question may not have a simple answer through the use of informal (using tick marks to count how many centimetres a rectangle had to calculate perimeter, or using repeated addition to calculate perimeter) and formal methods (calculating area using the appropriate formula *length x width = area*). By combining informal and formal methods, students were able to develop their conceptual and operational understanding in groups and with the class.

Finally, placing students in groups allowed students to share and exchange their ideas. If one student did not understand another student's idea, he/she verbally explained their idea, which helped develop their understanding of the concept/skill. Also, one student may have thought of an answer that the other student did not think of, which helped expand their thinking. As mentioned by Walle, Karp and Bay-Williams (2013), working in groups builds a community of mathematics learners that can learn and grow from each other.

Reflective Inquiry

This learning community allowed students to feel comfortable in the lesson due to various contributing factors (Walle, Karp and Bay-Williams, 2013). They were interested in the task because they loved the problem and context (creating their own playground). This generated a familiar and exciting activity. Students were also excited to show me their solutions and how they computed them. If they had not computed all possible answers, I prompted them to find more. Thus, by introducing students to a question that involved multiple answers, students were able to use multiple approaches, engage in a productive struggle together (Walle, Karp and Bay-Williams, 2013) and transfer skills to a new mathematics problem.

As mentioned, students were able to test out and communicate their own ideas with a partner. Because the teacher allowed students to think of and test out their own ideas, she communicated that students' ideas are valuable and useful. Throughout the lesson, students were comfortable asking questions such as, "Can you explain that again? I didn't understand" or "What do you mean by that?" or "Why do we have to do this?" When students are able to ask their own questions, the classroom truly does become a learning environment, as was demonstrated during this lesson. Although the teacher/curriculum controlled what information was to be learned, the students controlled what they took out of the lesson. This lends to the fact that if students ask their own questions, they can help guide their own learning and comprehension (Ha, personal communication).

Moreover, allowing students to work through mathematics problems through trial and error is an excellent way to develop their understanding of the concept as well as thinking and reflective skills. If a proposed solution did not work, students had to reflect on why it did not work. Partners had to explain and defend their solutions if the other partner did not understand or accept the solution as correct. The teacher and other students also constructively critiqued students' solutions during their presentations. It was interesting to hear students' solutions and critiques of each other because it helped the teacher and I gauge students' understanding of the concepts. When a student's solution was incorrect, the teacher would ask prompting questions to allow for reflection.

Importantly, Walle, Karp and Bay-Williams (2013) mentioned that higher level thinking includes comparing, explaining, exploring, solving, verifying, constructing, developing and

describing, which were encompassed in the lesson. While the teacher did model the activity, she constantly asked for student input and instruction and then re-explained what they had suggested. Because the students were able to think of and use their own ideas/techniques, the classroom and lesson became student-centred rather than teacher-centred. As such, I believe they felt more comfortable sharing their ideas and more competent in the techniques that they used.

Connections between different concepts

Within the Ontario Mathematics Curriculum and the NCTM, it is stressed that students are able to understand and use concepts and skills associated with perimeter and area. Perimeter is intertwined with area and what affects one will affect the other; thus their relationship must be understood. They are not isolated skills or concepts. Asking students to create and draw different rectangular shapes with the same perimeter clearly demonstrated how one can affect the other. It also helped clearly define the differences between the two concepts, as explained by one student: "The perimeter is basically how many centimeters are around the border of the playground, and the area is how many squares or centimetres are inside of the playground. It's how big the playground is." Moreover, students also connected addition and multiplication through the use of formulas and repeated addition to calculate area and perimeter, and they had the option of measuring the perimeter using a ruler.

Having the ability to calculate these concepts is also important for use in the real world. Students are surrounded by measurement, such as in the playground, and this lesson helped demonstrate that different shapes may still have similar perimeters while having different areas. The task was relevant to their lives because it involved playgrounds, which are familiar and exciting to students. Additionally, the teacher could have also had students search the classroom for objects, such as notebooks or desks, that have the same perimeter but different areas to further establish these facts.

Lastly, perimeter and area can be integrated in other subjects (Ontario Ministry of Education, 2005) including:

- Science – The teacher could have asked how perimeter and area could be used in science. For instance, these measurements are important to know when considering how force, such as hurricanes, can affect building structure.
- Art – The teacher could extend this lesson to an art lesson by instructing students to create a shape and its mirror image (a faucet of geography).
- Language arts – In this lesson, students were told to write out their answers. This helps students take their observations and translate them into written words.
- Social studies – In an extension to social studies, students could explore the different perimeters and areas of different medieval castles or pyramids.
- Physical education – As an extension, students could explore the perimeters and areas of non-rectangular polygons, such as a racetrack or hockey rink and how these much remain the same across different racetracks and hockey rinks.

As demonstrated, perimeter and area are directly related to each other and to real life situations. By relating these concepts to students' lives, they may see how they have personal relevance to their lives and how school is directly related to other aspects of their lives. By demonstrating the value of math, students can become more interested and the teacher can increase students' positive feelings towards the subject, which increases long-term memory and encourages an increased understanding of the concepts being taught (Willis, 2010).

Use of Technology

The teacher used technology such as physical manipulatives, the SmartBoard screen and the document camera. The physical manipulatives, Centicubes, allowed students to physically manipulate and explore different rectangles' perimeters and areas. The students were familiar with the Centicubes because they had used them in previous classes for various purposes. It also made it easier for students to pay attention and stay engaged because they had control of the activity. They were able to draw the physical rectangles on the centimetre grid paper, which students enjoyed because their physical product was transferred and viewed in a different way. In other words, the teacher used mediation because she allowed students to use counting tools and had them draw a picture of the physical object of the playground. This is considered meta-context because they used both physical objects and drawings as thinking tools (Abramovich, personal communication).

Next, the document camera displayed the teacher's example and the students' work on the SmartBoard screen, which allowed everyone to view the work presented. The document camera and SmartBoard engaged the students because the majority of students shared their work. They wanted to use the document camera because they were proud of their work and wanted to share it with classmates. Not only did the document camera give students a chance to share their work, it also helped students verbally explain their answers in a way that made them clear to the rest of the class. It also helped students practice their oral presentation skills. Moreover, because so many students presented their work, it showed eagerness and a strong understanding of the content. Students were confident enough in their answers that they took a chance and presented their work to the class. After a student presented, it sparked a discussion about how the concepts were calculated and why they arranged the Centicubes/drawings as they did.

There are also three computers in the classroom that have various mathematics programs on them, including Microsoft Word and Excel and Geometer's Sketchpad. As a way to further engage students, the teacher could have had three groups use the computers (two students per computer) to use Excel or Geometer's Sketchpad to create their drawings of potential playgrounds. The rest of the class could have gathered around the computers as these students presented their work. The computer-use would have given a different aspect and engaging element in the lesson due to the students' inherent interest in technology (specifically computers!). An interest in computers may lead to an interest in different mathematics computer programs, which could lead to extra practice and exploration of mathematics.

Conclusion

Through the use of a hands-on, engaging activity, technology and student-centred learning, the teacher was able to develop students' understanding of perimeter and area and their relationship. Walle, Karp and Bay-Williams (2013) suggest that "doing mathematics means generating strategies for solving problems, applying those approaches, seeing if they lead to solutions, and checking to see whether your answers make sense" (p. 13) and that is exactly what the students did. Additionally, students were able to discuss, explain and defend their solutions with their classmates to create better understanding and a mathematics learning community. Moreover, the teacher attempted to connect the activity with real-life situations. Because students were able to develop, test and verify their own ideas, students participated in an activity that reflected real-life situations involving mathematics. Through continued practice and development, students will be well versed in this aspect of measurement. If students can thoroughly understand these concepts, then they will also better understand other concepts of measurement through scaffolding.

Using students' prior knowledge and scaffolding also helped the teacher tailor the lesson's message to the students' responses (Searfoss, Readence & Mallette, 2001). Because the students

demonstrated their understanding using various platforms (problem-solving, presenting, explaining), there was less pressure for the students to perform (as would be felt during a test). The learning community created in the mathematics student-centred classroom was successful in that students felt comfortable sharing and exchanging their ideas while practicing and developing their measurement understanding and skills together.

References

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