

Creating tessellations with pavement chalk

Implementing best practices in mathematics

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Implementing best practices like cooperative learning, using concrete manipulatives, problem solving, technology, active learning, multi-age grouping, and team teaching have shown benefits for students when learning mathematics concepts within the curriculum (Zemelman, Daniels & Hyde, 1998; NCTM, 2000). What started as a professional development teacher improvement exercise by a Year 2 and Year 4 teacher has turned into a powerful learning experience for the teachers, students, and the school. Teachers teaching together from different year levels and backgrounds of kids working together are finding great success. This article will explore a lesson on geometry and spatial sense and tessellations which turned into a memorable experience for all the students and teachers. Teachers are beginning to see what really works to get students thinking like mathematicians and enjoying the discipline.

What started out as professional development as part of school improvement

The author opted to engage in the *Accomplished Educators Assessment*, which includes a school improvement objective and a professional growth objective. The objective

was that 80% of students would show a 10% increase in their Mathematics scores. To increase the teachers' knowledge of various ways to use concrete manipulatives, the author approached Dr Furner to team teach with their classes.

As part of a university and school professional development partnership program called *Genesis Academy of Teaching Excellence* (GATE) at Florida Atlantic University with local schools, Dr Furner was assigned to work with Indian Pines Community Elementary School in Lake Worth, Florida. Dr Furner is the school liaison and works one full day a week in the school. He is a Maths Methods professor at the local university. Mrs Goodman and Mrs Meeks were interested in enhancing their teaching in the area of Mathematics. The author decided to team teach with a Year 2 class and a Year 4 Drop Out Prevention (DOP) class. Each teacher was encouraged by Dr Furner to keep a journal and reflect weekly on at least one Mathematics lesson they taught, discussing strengths, weaknesses, and aspects they could improve on or try differently. Team meetings occurred on a weekly basis, where lessons were discussed and team teaching lessons were planned to respond to student needs. Lessons were geared towards the Year 4 level in content, but the methodology was varied so that it was appropriate for both Year

2 and 4 levels.

On reflection, the importance of professional growth and on-going teaching reflection and improvement is recognised. As educators, we must strive to implement best practices into our teaching and work toward student achievement in a world that has become so globally competitive (Zemelman, Daniels & Hyde, 1998; NCTM, 2000). As part of a school improvement process, Professional development can be an effective means to enhancing teaching skills, making school to university connections, and most importantly engaging students with mathematical ideas, and increasing student achievement.

The initial lesson on tessellations

A tessellation can be defined as a pattern of one or more shapes, completely covering a plane without gaps or overlaps. There are three regular polygons that tessellate. They include the square, equilateral triangle, and hexagon. M. C. Escher is famous for his artwork and geometric illusions and designs and is famous for many tessellating patterns, most which were non-polygonal tessellations (Britton & Britton, 1992). Through rotation, reflection and/or translation, many shapes can be made to tessellate, Escher was famous for his lizards. Children can learn a great deal about geometry and spatial sense by studying tessellations. Concepts like two-dimensional shapes, area, symmetry, rotations, reflections, translations, and repetition are just a few of the important ones. NCTM (2000) emphasises the importance of geometry and spatial sense skills and concepts early on in the curriculum. These are important and can help students to then build on larger ideas of reasoning and proof as they advance mathematically. It is also important to show students that mathematics, and geometry in particular, can also be art. We need to make these connections for students, and move away from the notion that mathematics is only concerned with computational skills.

To begin the tessellation lesson with the students, Dr Furner showed a video explaining how tessellations are part of everyday life. After watching the video, the students were excited to discover tessellating patterns in

their classroom and all around their school, and to discover how to form tessellating patterns.

As part of the team teaching lesson on tessellations, the lesson was started using the Maths Vantage video called 'Tessellations'. The video is very upbeat and explains in detail what tessellations are, using vocabulary like fundamental region, congruency, reflection, rotation, translation, hexagon, square, equilateral triangle, etc. The video also introduces three people with very different careers and discusses where and how they use tessellations in their work.

After showing the video as discussion was held about where the children may find tessellations in the classroom, the most obvious being the ceiling and floor. Students also found them in the calendar on the wall and a student's blouse. Students were then challenged to use attribute and pattern blocks to cover a plane (a piece of paper) with the same shape. They had to trace their shape to cover the sheet of paper with no gaps or overlaps. The students then could colour their tessellation art work in any way they pleased. The results were amazing and some are included as pictures here. One class worked on a writing activity as part of their tessellation design.

Multi-age grouping

One may ask why multi-age mathematics grouping with Drop-Out Prevention (DOP) students? The multi-age mathematics grouping not only provides the 'students at risk' with the foundation for learning and achieving in the classroom, but also for learning and achieving in life, as well as character building. The regular classroom students and the DOP students' self-esteem has improved tremendously by working together.

The students gain confidence in the world of mathematics which promotes a more positive attitude, as it developed their mathematical aptitudes and attitudes. The students are excited, happier, and less frustrated. Students at different year levels and backgrounds can both benefit from using a cooperative problem solving approach to learning mathematics together, both with

things to share and gain from the experiences of working together.

The author found that teaching mathematics fits into three major dimensions:

- something to be learned;
- the action by which students learn it; and
- the degree of the students' receptivity for learning the experience.

With this multi-age setting, the students are now familiar with these three dimensions. The DOP students and the regular students have put other thoughts or actions about learning mathematics in a more coherent fashion with a much greater understanding.

The students during the tessellation lesson were organised into multi-age groups. The students follow cooperative learning procedures and roles and were expected to work with and help each other. A successful outcome to this multi-age teaching has been a real boost in self-esteem for the DOP students as they assisted and work with the Year 2 students while creating their tessellation designs.

Enrichment and parent involvement

Both enrichment and parent involvement were important. Parent involvement offered an opportunity for extending each lesson, and learning experiences beyond the classroom. This also helped students experience and value the importance of mathematics in everyday life.

Through this continuous learning experiences, the students self-confidence was enhanced in the classroom. Students are better able to brainstorm possible strategies for problem solving and predicting outcomes on their own. Parent involvement in the child's world of mathematics helped the young mathematician to explore their interests, share their experiences, and develop a lifelong love of mathematics.

As part of the tessellation lesson with the Year 2 and 4 students, the teachers had planned to send home a handout with the students explaining complex tessellations similar to the work of M. C. Escher. This had potential as an activity to involve parents, as a follow-up to our in-class lesson on tessella-

tions. The handout (refer to Appendix A) instructed students to start with squares, as shown on the video they watched, modelling what they did to one side they would do the opposite on the other side. Hence, they would cut out something on the square on one side and on the opposite side they would tape on what they had cut out originally. By doing this, they created a shape that tessellated, or that will fit together and still maintain the 360° so that each fundamental region would create a repeating set of tessellating patterns.

Using pavement chalk to make it hands-on and fun for kids

As a reinforcement activity, students were asked to make their own tessellating pattern, recalling the three ways the pattern could be moved in order to form a tessellating design. They asked the teachers if they could bring in their pavement chalk and make a repeated tessellating design with the chalk on the pavement out on the school courtyard. The teachers chose an area in our school courtyard and had each child paired up working with another student and they made beautiful, colourful tessellating patterns on the pavement of the courtyard (see photos).



Adapting and extending the project and professional development

Team teaching and multi-age grouping has been of tremendous value. The students are working in cooperative groups and are respectful of each students' role in working



cooperatively. Support from Dr Furner has been valuable to the author, in making the teaching of mathematics concepts comfortable, and using methods of instruction that make the learning of mathematics skills and concepts fun and meaningful for students.

Before their involvement in this professional development plan, the author taught mathematics concepts, but in some areas did not feel as if they had done as much possible to make the learning of mathematics lasting, interesting, and enjoyable for students. Through the weekly team lessons and reflections, and the use of manipulatives in teaching mathematics concepts, students are able to have the concrete as well as abstract involvement in learning skills. It has improved students' retrieval of knowledge when concepts are reviewed.

This lesson on tessellations was a memorable experience for all the teachers and students at Indian Pines Elementary School. What started as a professional development project between two teachers and a Mathematics Education professor has turned into a powerful learning experience for all involved. Students are learning in ways that are meaningful and exciting while also being challenged. The teachers are growing professionally and also learning new mathematics content that they were at one time unsure of themselves. They are beginning to feel more confident as teachers using concrete manipulatives, cooperative learning, and a problem solving approach.

References

- Maths Vantage Video Series (1996). *Tessellations* [video]. Produced by the Nebraska ETV Network and the Nebraska Mathematics and Science Coalition.
- Britton, J. & Britton, W. (1992). *Teaching Tessellating Art: Activities and Transparency Masters*. Palo Alto, CA: Dale Seymour Publications.
- National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.
- Zemelman, S., Daniels, H. & Hyde, A. (1998). *Best Practice: New Standards for Teaching and Learning in America's School (2nd Ed.)*. Portsmouth, NH: Heinemann.

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