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3 Critical Reviews: Patterns, Relations, and Algebraic Thinking in Elementary

Polly, D. (April 01, 2011). Technology to Develop Algebraic Reasoning. *Teaching Children Mathematics*, *17*, 8, 472-478.

Drew Poll's article entitled *Technology to Develop Algebraic Reasoning* focuses on how to effectively use technology to engage students in mathematically rich tasks. This article provides an example of grade 3 teachers using the pan balance program from the Illuminations Web site (http://illuninations.nctm.org/ActivityDetail.aspx?ID=33) to teach algebraic reasoning. These teachers used the pan balance to create mathematically rich tasks. Students were able to focus on the math concept (relationship between the weight of different shapes) in experiencing math first hand by easily manipulating and generating representations of concepts. Secondly students were asked to write descriptions and transform them into equations (analyze) based on the feedback the program provided from the manipulations. Thirdly, the students determined the value of the shapes (evaluating). Fourthly, students were to create new equations for other shapes from the information of the three known equations (creating).

I think all teachers could benefit by reading this article because it provides an example of a lesson that engages students and effectively uses technology in teaching and learning. Most importantly, this sample lesson focuses on promoting higher-order thinking in students by requiring them to analyze, evaluate, and create (which are the highest levels on Bloom's Taxonomy) with technology.

In conclusion, I believe that this is a very rich article because it is very practical but also firmly backed up with research. This lesson can be used by teachers because it is well planned

and detailed, provides suggestions for extension activities, differentiation, and encourages teachers to have students work in supportive collaborative environments with rich mathematical conversation.

Stump, S. L. (March 01, 2011). Patterns to Develop Algebraic Reasoning. *Teaching Children Mathematics*, *17,* 7, 410-418.

"Mathematics is often called the 'science of patterns,' making patterns more of a defining quality of mathematics than a topic for inclusion" - Bay Williams (2001) (p.137)

Patterns to Develop Algebraic Reasoning by Sheryl Stump is an article about the important role patterns play not just in algebra, but as a foundation in mathematics. This mathematical thinking should be taught starting in Kindergarten and continued through grade 12. Stump presents Kaput's clarification of the two components of algebra: core aspect A is generalization (patterns) and core aspect B is syntactically guided actions on symbols (symbolic manipulation). Both aspects are essential and intertwined, but the former tends to be neglected due to the emphasis of the latter in algebra.

Stump emphasizes the importance for teachers to create problems that focus on change (how the pattern could change) to promote algebraic reasoning. For example, *"What would the 48th block be?"* This causes the students to use what they are given (an ABBB block pattern) to figure out how the pattern could be extended. Unfortunately, teachers often do not include questions about change but instead pose questions like: *"What kind of pattern is this?"* or *"What*

geometric shapes comprise this pattern?" which focuses on satis (the current state of the pattern).

This article is very academic in nature, is well sourced and has much research behind it. It is difficult to understand at times and is not directly practical to teachers in the sense that there are no lessons that they can use with their students. However, I think it is beneficial because it explains what algebra is, and how it should be taught to promote higher-order thinking. Teachers will develop themselves professionally by reading about the experiences and discoveries of other teachers in PD sessions. This article emphasizes the importance for teachers to experience mathematical thinking themselves in algebra by problem solving individually and collaboratively. There are examples of preservice and inservice teachers being asked to create and write problems that focus on the aspect of *change* in algebra to express generalizations. Several teachers commented saying that after these sessions, they realized that it is more important to have students solving problems that require higher-order thinking and explaining their process using mathematical language than just focusing on getting the right answer.

In conclusion, I recommend this article to all math teachers. I hope other teachers will be as encouraged as I was after reading this article. I am more informed about teaching algebra effectively and am excited for the opportunity to teach patterns in the classroom.

3) Schultz, J. E. (May 01, 1991). Implementing the Standards: Teaching Informal Algebra. *Arithmetic Teacher*, *38*, 9, 34-37.

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Schultz's article I*mplementing the Standards: Teaching Informal Algebra* focuses on the importance of developing algebraic thinking from K-12 education, since the language of Algebra is pertinent in communicating most mathematical concepts. It is important for students to develop Algebraic thinking and the concept of variable gradually, beginning with completing concrete patterns with manipulatives or visuals. As students mature, they transfer to more abstract questions and representations which then lead to equations. However, even in seventh and eighth grade classes, students should have extensive practice with area models, tables, graphs, and calculators before being introduced to symbolic equations.

Although this article does not contain specific lesson plans, suggestions for evaluation or differentiation, it demonstrates effective ways to teach algebra across the grades and how to concretely represent algebraic equations using objects, pictures, ideograms, tables, and graphs to introduce and explain equations. It also encourages and demonstrates how to make algebra more relevant and comprehensive for students. For example, creating graphs using the speed and time it takes for airplanes to arrive at their destination to introduce the concept of slope and intercept. In addition, Schultz's demonstrates how technology such as graphics calculators can greatly aid students in making connections between relationships by providing a visual representation of equations.

I would recommend this article to other math teachers for several reasons. First of all, it is very brief and easy to read so it does not take too much time from busy teachers' day. Secondly, it shows how to use various manipulatives and concrete representations to teach algebra so that students can understand and communicate proficiently using algebra: "the mathematical language by which most of mathematics is communicated." (1989, 150)

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-*NCTM Curriculum and Evaluation Standards for School Mathematics*