ETEC 512: Lesson Plan Critique:

Newfoundland and Labrador Grade 5 Math Curriculum

Stephen Walsh (87810140)

University of British Columbia

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Introduction

The subject of my analysis is the Newfoundland and Labrador Grade 5 Math Curriculum. I will be focusing specifically on the prescribed outcomes and suggested activities of the unit called "Patterns in Mathematics (p. 167)." This is the curriculum followed by all public schools in the province. I will be critiquing this document through a constructivist standpoint as well as its merits and weaknesses from an information processing and neurological perspective. I will give an introduction of each learning perspective as it relates (or does not relate) to this Math unit. Finally, I will recommend further activities or changes to existing ones that will help the unit align more closely with the theoretical perspectives.

Content

Patterns in Mathematics for Grade 5 has the general purpose of building on students' abilities to recognize and utilize patterns as a tool for solving problems. This unit is also a primer for later algebraic concepts. Students will work with patterns represented by numbers, pictures, symbols, manipulatives, as well as examples in the real world. They will also have to explain and extend patterns using words, pictures, and numbers. The curriculum guide provides a detailed list of outcomes and suggests activities through which they are to be acheived. There are also links to suggested resources. The beginning of the guide outlines the teaching philosophy, learning goals, assessment strategies, and other resources to help teachers to theoretically and practically establish the document as a useful tool.

Constructivist Perspective

This math unit lends itself nicely to constructivist teaching and learning. Many of the activities have the students continuing patterns to see what emerges. Analysts of constructivist perspectives say that, "to understand material well, learners must *discover* the basic principles (Schunk, 2012)" and "knowledge is actively created or invented by the child, not passively received from the environment (Clements & Battista, 1990)." That is, the information must not simply be given, but rather discovered by the student. There are a number of ways to do this. On page 175 it is suggested that students fold a piece of paper once and observe the squares produced. Then they continue folding and counting squares to observe the resulting pattern. The teacher is not telling them the doubling principle. The students find it out through their own observations. From a constructivist perspective, this discovery activity will facilitate authentic learning.

Most of the activities in this unit have a generative focus. The student must take some initial information and generate a result for something projected from it. An illustrative example has students predict what the 7th shape will look like in Figure 1:

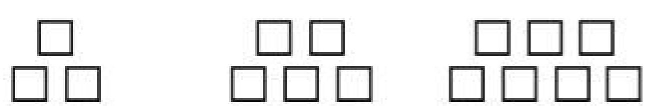

Fig. 1

Developing this ability is what Piaget would call operative knowledge. Von Glasersfeld (2008) puts it this way:

> *Operative knowledge is not associative retrieval of a particular answer but rather knowledge of what to do in order to produce an answer. Operative knowledge is constructive and, consequently, is best demonstrated in situations where something new is generated, something that was not already available to the operator.*

The use of the balance scale (from page 184 onward) to concretely investigate equal amounts and relate it to algebraic equations is another effective activity that allows discovery/inquiry learning. By physically investigating how $n + 6 = 14$ plays out on a scale with colored cubes (and other, more interesting materials), they will be guided to make the connection between the concrete and abstract aspects of algebra.

Improvements:

There are a number of improvements that can be made to align this curriculum more closely with a constructivist perspective. Let us look at the type of problem represented by Figure 1 above. Simply finding the fourth shape is the least a student can do. We could find multiple ways to arrive at the answer; growing the shape or adding two squares each time, for example. Then students could discuss their methods, adding a social discourse element that is central to constructivist learning (Clements & Battista, 1990). Furthermore, discussing their thought process will encourage reflection. As Von Glasersfeld (2008) puts it, “the more abstract the concepts and operations that are to be constituted, the more reflective activity will be needed.”

Information Processing Perspective

The curriculum document outlines a variety of strategies that can be considered efficacious from an information processing theoretical standpoint. Students are expected to engage with patterns in a variety of ways, through numbers, pictures, and symbols. They are also asked to verbally describe patterns and manipulate concrete materials. This multi-modal approach encourages a variety of connections amongst the material and increases the chances of it being stored in long-term memory, in what Schunk (2012) refers to as "spreading activation." Further connections are encouraged by way of making associations with literature and real life. On page 189, for example, manipulating equations is translated to a relevant real world problem.

Fig. 2

All these modes of engaging with the material increase the likelihood that concepts will be remembered (Lutz & Huitt, 2003).

Improvements:

Although the lesson makes reference to building upon work of the prior grade, there are no activities that explicitly get students to reflect upon what they already know about patterns. However, reflection can help a learner to connect a current topic with prior knowledge, therefore helping it to be encoded more successfully. Lutz & Huitt (2003) note that "the incoming information must be acted on and through existing structures and incorporated into those systems in some way for acquisition to occur." It is hard to overstate the need to link what they are learning with what they already know.

Secondly, the lesson gives little explicit opportunities for students to develop metacognitive strategies. Students could be encouraged to talk about their method of getting answers and extending patterns. For example, on page 176, students are asked to use the following pattern to decide what 9 x 999 would be.

$2 \times 999 = 1998$

$3 \times 999 = 2997$

$4 \times 999 = 3996$

$5 \times 999 =$

$6 \times 999 =$

Fig. 3

This solution to this problem can be found in a variety of ways. Discussing their method and hearing the explanation of others will help them verbalize their thought process and aid in information processing.

Neurological Perspective

The lesson plan gives ample iterations of the pattern identifying and creating activities. It also has plenty of practice manipulating algebraic equations in a variety of ways and contexts. This variation and repetition is important as it physically changes structures of the brain and visual cortex, aiding in future recognition of similar and more complex patterns (Schunk, 2012). However, the breadth and scope of the activities could be improved.

Improvements:

Diversifying the types of activities will help to maintain a student's attention. Any teacher with classroom experience can attest to the brevity of a student's attention span. Schunk (2002) describes a variety of classroom methods that are drawn from their neurological effectiveness in arousing, maintaining, and directing student attention. First, the student needs to feel that the material is important. Therefore, I would add more activities with real world context and topics that students are likely to be interested in. It can be as simple as the addition of local names to problems with geographic references as in Figure 2. Second, novelty can help maintain attention. Activities should include new and exciting experiences. Technology such as apps and games can be utilized more frequently in these lessons. Finally, lesson material needs to be integrated into the students lives in some way. Activities that discover patterns in the real world could be added. Field trips could be facilitated to add more novel, real-world experiences that use technology and are integrated into their lived experience. Various manufacturing processes require the adherence to patterns and utilize algebra. An art museum is a natural fit for pattern treasure hunts. Universities have many facilities where these principles can be explored. Finally, nature itself can be an environment for exploring patterns in math, with the proper preparation. To further extend the activities and utilize technology, have students capture the patterns with cameras and showcase them with presentation software.

Conclusion

This lesson plan goes a long way to increasing a student's awareness and flexibility with patterns in mathematics. There are numerous and varied activities for teachers to utilize and the document makes a firm attempt to couch the material in a constructivist framework. In this short critique I have made some suggestions as to how this curriculum guide may be improved from a constructivist, information processing, and a neurological perspective. You can view the redacted portion of the guide annotated with my additions in red with this link. Where possible, I have made hyperlinks to the suggested sites.

I don't feign to assume that my additions have fundamentally improved the curriculum document. It already has a basis in constructivism and demonstrates many strengths as seen through the lens of neurology and information processing. What I have tried to show, however, is that small changes in the activities that we plan for students can allow lessons to further benefit from some of our most compelling theoretical perspectives.

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