Intersections:
The Search for Overlapping Thought Processes in Reading Comprehension and Mathematical Problem Solving

Martha Hopkins
University of Central Florida, Orlando, Florida

Karri Williams
University of Central Florida, Orlando, Florida

Patricia Ratanapraphart
University of Central Florida, Orlando, Florida

Increased national attention on student achievement in reading and mathematics has led to increased emphasis on these subjects in most elementary schools. For many teachers this has translated into additional time planning and teaching reading and mathematics. And yet, student achievement does not seem to be showing marked improvement. One possible explanation could lie in the fact the children are being asked to think differently in each of these subjects Is it possible that the thought processes used when solving a mathematical problem overlap with those used to comprehend text? The purpose of the present study was to determine the amount of intersection that exists between thought processes in reading and mathematics.

Introduction

Beginning and pre-service elementary teachers are often overwhelmed with the number of different taxonomies of processes and behaviors they are required to learn. Each of the disciplines included in the elementary school curriculum (reading, mathematics, science, social studies, language arts) is typically taught as a separate course in which students are required to develop lesson plans that address processes and behaviors specific to that discipline. Due to their individual pre-service experiences, new teachers seldom see connections between disciplines, particularly reading and mathematics.

Each day the children in their classrooms experience a set of disjointed activities from a variety of disciplines each of which uses its own vocabulary and thought process. Increased national attention on student achievement in reading and mathematics has led to
increased emphasis on these subjects in most elementary schools. For many teachers this has translated into additional time planning and teaching reading and mathematics. While the emphasis has increased on these subjects, student achievement does not seem to be showing marked improvement. One possible explanation could lie in the fact the children are being asked to think differently in each of these subjects. Is it possible that the thought processes used when solving a mathematical problem overlap with those used to comprehend text?

Mathematical problem solving processes emerged as early as 1957 (Polya) and have continued to be refined throughout the past 55 years, first as a part of the mathematics curriculum (Garofalo & Lester, 1985; Hyde, A.A & Hyde, P.R. 1991; Whitin, D.J., et.al., 1990) and most recently as the goal of mathematics instruction (NCTM, 2000; NCTM 2006). Similarly, reading processes have been the focus of much of the professional literature (Olshavsky, 1976; Duke & Pearson, 2002; Keene & Zimmerman, 2007). Most recently researchers have begun to explore possible relationships between processes used in reading and mathematics (Hyde, A., 2006; Fogelberg, et.al., 2008; Siena, 2009; Brummer & Macecee, 2010; Sammons, L., 2010; Halladay & Neumann, 2012). Careful inspection of recent literature reveals, however, that whereas authors are suggesting the use of reading processes to teach mathematics, there is scant evidence that thought processes used to unlock meaning of text are the same as those used to solve mathematical problems.

The purpose of the present study was to determine the amount of intersection that exists between thought processes in reading and mathematics. To that end, teacher educators in each field were identified and asked to think aloud while solving mathematical problems and reading text. Identified as “experts,” these teacher educators were responsible for teaching pre-service and beginning elementary teachers about the processes involved in reading and/or mathematics at the elementary level. It was assumed that these “experts” were aware of the cognitive processes they use in their own reading and mathematical problem solving. Each expert completed one reading and one mathematical think-aloud. Audiotapes and written work produced in these interviews were analyzed to determine the extent to which common explicit and implicit cognitive processes were used across disciplines.

Thus, the purpose of this article is to report on the first phases of the current study: the analysis of the think aloud protocols to develop procedures and agreement for identifying the cognitive processes. Because Hyde (2006) developed a list of mathematical thinking processes that parallel reading comprehension processes described in Keene and Zimmerman (1997), the researchers began with those processes as the starting point for analysis: questioning, connecting, visualizing, inferring, predicting, determining importance, synthesizing, and metacognitive monitoring. As we analyzed protocols, we identified the process used by the expert and whether that process was explicit or implicit.

As with many research studies, we began to ask new questions before we could address our original question related to intersections across reading and mathematics. We realized very early in the analyses that we had to more clearly define what we thought were easy to identify processes. One of us labeled a process as predicting, while another labeled it as inferring. Our discussions yielded guidelines for coding and interpreting. In order to establish a reliable coding system, researchers coded separately, then met to compare and
resolve coding differences. We coded the same protocols separately again to ensure that our new guidelines yielded increased reliability.

We negotiated through the coding process until we reached 100% agreement. Table 1 includes our definitions and guidelines for identifying the most frequent processes. We realized that if we were having these kinds of discussions about identifying processes, then our pre-service teachers must have even more challenges when presented with these lists of processes for which they are accountable. Their use of these processes results in superficial mentioning or question asking (e.g. “What do you infer?” “Write your predictions.”) instead of engaging their students in the “how to” of these processes. In other words, they know to ask their students to perform these processes, but they may not understand enough about the processes themselves to engage their students in how to perform the processes.

Preliminary research results indicate that there is an overlap between the thought processes involved in reading and mathematics. Experts in both disciplines make connections, ask questions, visualize, infer, predict, determine importance, evaluate, and actively monitor their thinking when unlocking text and solving mathematical problems. The most frequent processes used across both reading and mathematics were monitoring, inferring, and connecting; the least frequent across both was determining importance.

Our research has now moved to the second phase where (1) additional teacher educators in each field will complete think-alouds in an effort to confirm the preliminary results; and (2) teacher educators will model the think-aloud processes they use in their pre-service classes. If areas of intersection within the thinking processes continue to be salient across disciplines, researchers will develop programs/courses that help pre-service teachers experience and embrace the commonalities and learn how to make use of the commonalities in their lesson planning. As a result, it is hoped that learning in the elementary school will become more effective and teaching more efficient.
Table 1. Guidelines for Identifying Thinking Processes.

<table>
<thead>
<tr>
<th>Process</th>
<th>Definition and Guidelines</th>
<th>Explicit Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting</td>
<td>Activating prior knowledge and relating text to other things that have been read or experienced. In math, prior knowledge is demonstrated through arithmetic. If in doubt as to whether connecting or inferring, consider that inferences require use of prior knowledge. (See “Inferring”).</td>
<td>I know...,I connect..., In my background..., This reminds me of...</td>
</tr>
<tr>
<td>Inferring</td>
<td>Interpreting information and possibly drawing conclusions. Inferences include prior knowledge in varying degrees. If prior knowledge is used to interpret text then label as inferring. If prior knowledge is just mentioned as “I know this...” or “reminds me of”, then label as connecting.</td>
<td>I’m guessing..., I’m inferring..., That means...</td>
</tr>
<tr>
<td>Predicting</td>
<td>Separate from inferring. Involves hypothesizing. Can be stated as an expectation. If think aloud statement is interpretation of current or past event in text/problem, then that is inferring. If statement includes what might happen next, then that is predicting.</td>
<td>I predict..., I think ...will happen</td>
</tr>
<tr>
<td>Questioning</td>
<td>Asking questions, wondering, demonstrating uncertainty, considering options. If “I wonder” can be placed in front of the think aloud statement, then it is a questioning event. Inflection sometimes indicates a question.</td>
<td>I’m questioning..., I’m asking the question..., I’m wondering...</td>
</tr>
<tr>
<td>Visualizing</td>
<td>Imagining the event or problem and creating mental/physical pictures or images. In math, participant refers to items drawn or written; writing numbers to represent concepts; charts, tables, graphs.</td>
<td>In my picture..., I’m imagining..., I’m visualizing.. In my scenario....</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Thinking about thinking; keeping track of thinking; adjusting thinking.</td>
<td>I’m confused by.. I don’t understand... I’m surprised by. I don’t know.. I got it...Let me think...</td>
</tr>
</tbody>
</table>
References


Author Note

Martha Hopkins, Ph.D. is a Professor in the School of Teaching, Learning and Leadership in the College of Education at the University of Central Florida, Orlando, Florida.

Karri Williams, Ph.D. is an Associate Professor in the School of Teaching, Learning and Leadership in the College of Education at the University of Central Florida, Orlando, Florida.

Patricia Ratanapraphart is a graduate student in the School of Teaching, Learning and Leadership in the College of Education at the University of Central Florida, Orlando, Florida.

Copyright (2012), Hopkins, Williams & Ratanapraphart and Florida Association of Teacher Educators Journal.

Article Citation
