

Extended Thesis Abstracts

Analyzing and Addressing Common Mathematical Errors in Secondary Education

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After much research and discussion with mathematics educators, it is apparent that secondary education students make many common errors in mathematics. As a result, it is important to analyze what causes and how to address these mathematical errors so that teachers can correct and prevent these errors within the classroom. For my honors thesis, I briefly researched and analyzed the causes of mathematical errors in secondary education and ways to address students' errors. Then, through research, classroom observations, and discussions with secondary education teachers, I compiled a list of common student errors in mathematics and created activity sheets that address each error individually. To coincide with my research findings, the activity sheets confront each error conceptually and incorporate various mathematical representations.

Categorizing Students' Mathematical Errors

Based on my research, I was able to classify students' mathematical errors into three main categories: calculation errors, procedural errors, and symbolic errors. Calculation errors can be generalized as mistakes in addition, subtraction, multiplication, and division of numbers. Carelessness and lack of attention can result in calculation errors. Procedural errors occur when a student computes

or applies a procedure incorrectly. These types of errors suggest that students do not understand the concept related to the procedure. As a result, students do not have an understanding of why or how a procedure works; therefore, students do not recognize the importance applying and computing the procedure correctly. Lastly, symbolic errors occur when students falsely relate mathematical problems that use similar symbols. Students try to create meaning in the patterns of mathematical symbols and signs that they see in front of them rather than trying to understand what they are actually doing. This search for patterns in the symbols leads to misinterpretations, which in turn result in mathematical errors. Based on this research, I was able to classify each error that I compiled into one of these three categories.

Addressing Common Mathematical Errors

Once I had identified three categories in which I could classify students' mathematical errors, I then researched how to address each type of error. First, it was necessary to address calculation errors. Since these errors are often the result of carelessness or short attention span, they are the easiest type of errors to address. A possible solution is the incorporation of an error checklist into the regular classroom routines and procedures. This allows students to assess themselves and identify repeated errors and mistakes in their work. Secondly, I researched how to address procedural errors and symbolic errors. Through my research, I identified several techniques which include: introducing the concept before the procedure, building networks, concrete manipulatives, real-world applications, using a variety of formats and representations, reflection and self-assessment, and more time. This research served as guidelines in formatting the activities that I created to address common mathematical errors.

Formatting Activities that Help Correct and Prevent Students' Mathematical Errors

Based on my research, it was evident that there are several factors that must be considered, such as conceptual learning, representation, and time when helping to correct and prevent mathematical errors within a middle school or high school classroom. As a result, when developing activities that address errors in a mathematics classroom, it was helpful to consider the following three factors: preconceptions, competence in mathematics, and metacognition. For example, students develop preconceptions about mathematical concepts before they develop a true conceptual understanding of the concepts. Therefore, the first activity when addressing a common mathematical error should engage the students' pre-existing conceptual understanding to help the students recognize any erroneous preconceptions. Then, students need to show competence in the identified area of mathematics; therefore, in the initial activities addressing the error, the students should be asked to relate facts, patterns, and connections to the mathematical concepts. In addition, students should be asked to write, illustrate, or state their understanding so that they begin to create their own networks of connections and understanding. These networks will help students

easily retrieve the information for future use. Lastly, throughout the completion of each activity, the students should reflect upon their understanding. Students must be able to recognize inappropriate connections they have made. In addition, students must be able to relate any new knowledge to their pre-existing knowledge. Also, an overall self-assessment activity that addresses a mathematical error would be beneficial. In general, students need to be able to evaluate their own understanding.

Reflection

While completing my thesis, I developed a stronger conceptual understanding of various mathematical concepts such as fractions, decimals, inequalities, and polynomials. I researched different representations to include on my activity sheets which addressed various mathematical errors. While exploring these different representations, I expanded my own knowledge base. In addition, while developing my activity sheets, I learned how to put together different representations to illustrate mathematical concepts in several different formats. In my research, I found that errors most often occur because not enough examples are considered. I am hoping that my knowledge of different mathematical representations will help me include numerous examples in future lessons to help prevent students from making mathematical errors in my classroom. Also, while working on my thesis, I came to realize how important it is to address errors within the classroom. Many of the errors that I addressed in my thesis were related to basic mathematical concepts that are the foundations on which students are expected to build their knowledge base as they progress through school. If these errors are not addressed, students will be trying to build their knowledge base of mathematics atop misunderstood concepts, which is not likely to prove successful.