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As a secondary mathematics instructor, algebra is at the heart of all we do. For this very reason the article by Senk and Thompson titled, *Strategies Used by Second-Year Algebra Students to Solve Problems*, stood out to me. In my experience, when students are presented with a challenging problem where a strategy is not obvious to them, often times they write "IDK" (I don't know) or leave the item blank in lieu of trying a different strategy. This article proved interesting because the study conducted in it addressed this very issue.

The main focus of the study in the article was to see the influence that a type of curriculum has on the different strategies used by students to solve problems and the success rate for those strategies. The study used 16 total classrooms that included 306 second-year algebra students. Four schools in four states each had two classrooms using a more progressive second-year algebra curriculum from the University of Chicago School mathematics Project's (UCSMP) *Advanced Algebra Curriculum*. The other two classrooms in each school used a more traditional second-year algebra curriculum. It is worth noting that before the study began, a pre-test was given to pick the schools and the classrooms to be used in order to start on a level playing field.

Each teacher in the study completed an Opportunity to Learn (OTL) where the teachers indicated what topics the students in their classrooms were exposed to. This was something that I would not have considered doing before reading this article. I felt it was a crucial part to the validity of the study. The data collected from the OTL was used to interpret the results of a test that all students completed. The test administered to students

during the study was *Problem Solving and Understanding* (PSU). The PSU test consisted of four constructed-response questions within the second-year algebra curriculum with topics being Quadratic Comparison, Quadratic Application, Power Function Inequalities, and Logarithm Properties.

Student work was scored by a rubric on a scale of 0 to 4 with each answer being categorized by the strategy used. Those categories were symbolic, graphical, numerical, and other. A score of 3 to 4 was deemed successful. It was interesting to see that problems students left blank were coded differently, in other words not just given a 0. This was another crucial element to this study. As a teacher, I would rather have a student attack a problem in some manner rather than just leave it blank. If a student can start with a thought then I have something to build upon with them. Leaving a question blank gives nothing to go on. The study found that the schools that were using the UCSMP curriculum had only 4% of the questions left blank overall while the non-UCSMP schools left 13% blank overall (Senk and Thompson, p 122).

On one particular problem of the PSU test, the Quadratic Comparison, only 7% of students using the UCSMP curriculum left it blank compared to 32% of non-UCSMP curriculum students. This is huge considering it was a procedural task that can be done using a symbolic method. In fact, 60% of students using both types of curricula used a symbolic method to answer this question (Senk and Thompson, p 124).

The UCSMP curriculum uses multiple strategies for solving problems throughout the curriculum. The non-UCSMP curriculum strategies were dominated by symbolic strategies. Looking at the data and considering this big difference in curricula, I believe

this is why UCSMP students left so few blank on the PSU test. UCSMP students were given far more tools and ways to think about a problem than the non-UCSMP students.

Another interesting observation is that students from both types of curricula made the same common errors. For instance, on the Power Function Inequality question, a common error was to give only integer answers for the solution instead of realizing that the answer could be any real number within the range.

Overall, the UCSMP students were more successful than the comparison school students. It definitely wasn't a homerun by comparison as many of the numbers were close. However, bottom line is, that multiple solution approaches presented gave students a better idea of how to start a problem lowering the amount of "IDK" and blank answers.

Reading this article left me with several unanswered questions and curious thoughts. It would be interesting to know exactly what curriculum the non-UCSMP students were using. Was this a new curriculum for all the teachers? Were the non-UCSMP or the UCSMP teachers using curriculum they had been using and had experience with? If not, was training provided for each type of curricula? When the teachers filled out the OTL did they only have topics to check off or types of problems to look at? The problems asked on the PSU test were not always what I would have expected based on the category. Filling out the OTL, I may have felt a certain topic was covered. However, it may not have been covered to the depth that the questions on the PSU asked. This could provide inaccurate information for the OTL data.

Reflecting on my own practices and pedagogy, I find it to be critical that no matter what type of curriculum is being used, students must have opportunities to try

multiple ways to solve problems. Multiple representations also allow students to see connections to mathematics that are already present just waiting to be discovered. For instance, finding the roots of a quadratic can be done in many different ways. Any one of which helps students understand why the other methods work. Factoring and setting the factors equal to zero then graphing and looking at the x-intercepts would help students see how the two are connected.

Another conclusion that warrants further investigation for me is that writing alone is not the only or even best way to communicate mathematics. Students from both schools were asked to communicate but students using the non-USCMP curriculum communicated more with individual writing, while the USCMP students communicated more by reading and discussions. It has always been my belief that we need to allow opportunities for students to communicate. I allow several opportunities for communication in writing. However, students do not always get the opportunity to share these thoughts. The result of this study reminded me of how important this sharing opportunity is for students. I believe I need to shift the focus in my classroom to more collaborative communication being written, verbal, or both.

In my experience, teachers that feel strongly about a more traditional curriculum argue that students lose fundamental skills when using a more progressive curriculum. The data from this study shows that students using both curricula were successful when using a more traditional means to solve the problems. However, when using other methods, students using the UCSMP curriculum were more successful. This needs further investigation but could be an argument against the thought that fundamentals are compromised when using a more progressive curriculum.

Reading this brief and dissecting it was a powerful experience for me. It allowed me to think of what I will need to do for my own research as well as see the depth and detail that accompany such a process.

Bibliography

Senk, S. L., Thompson, D. R., (2006). A BRIEF REPORT: Strategies Used by Second-Year Algebra Students to Solve Problems. *Journal for Research in Mathematics Education,* 37(2), 116-128.