What Types of Previous Knowledge Do Students Use When Learning New Geometry Skills?

by Amy Guda

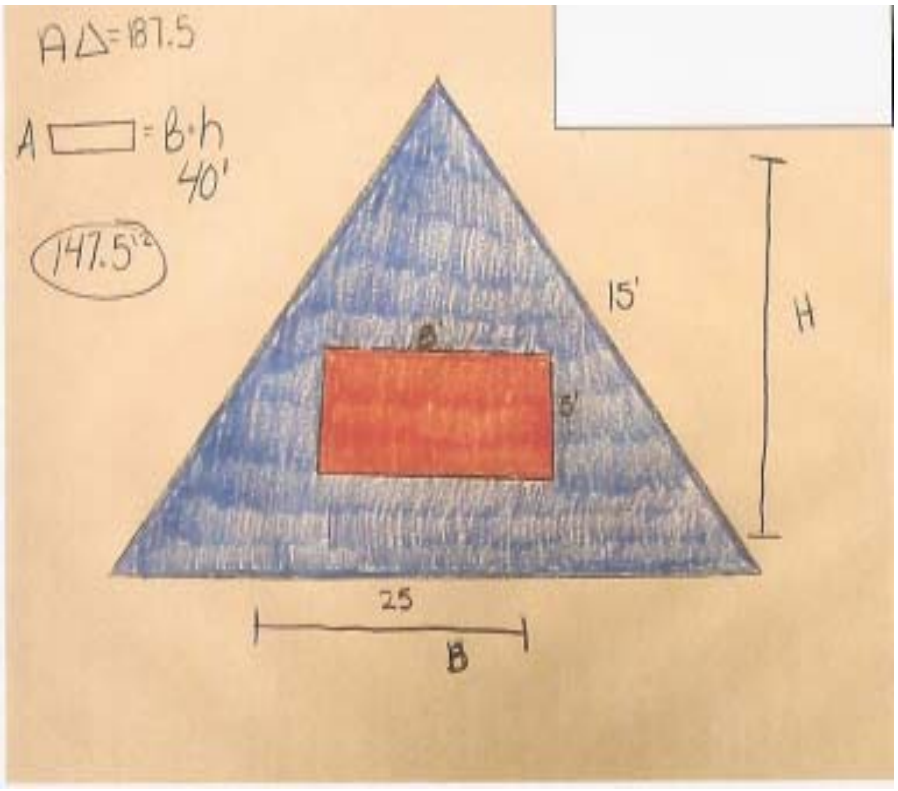
Amy Guda, who works at the Adult Basic Literacy Program at the Hocking County Job Service Center/ Lancaster-Fairfield Community Action Agency in Ohio, received an Adult Numeracy Network Practitioners' Research Project grant in 2008. For her project, she chose to explore the question: "What types of previous knowledge do students use when learning new geometry skills?"

While working on the Adult Numeracy Network Research Project, I had the opportunity to experience surprises, successes, and challenges as the research project developed. Our ABLE (Adult Basic Literacy Education) classroom has, as do many adult literacy programs, open enrollment. Each class consists of an average of three to six students representing a full range of educational functioning levels. I wanted to develop activities that would cover geometry benchmarks in all of the educational functioning levels. I collected enough data (from groups of nine to eleven students) to classify and look for patterns and trends. With the geometry assignments in the project, the group was able to cover the Ohio Department of Education educational benchmarks in levels one, two, three, five, and six (mastery of all levels was not achieved by all of the students participating). [Go to http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?Page=3&TopicRelationID=966&Content=56626 to check out the Ohio adult education math benchmarks.] The students participating in the project comprised of approximately 55% math educational functional level three students and approximately 45% math educational functional level four students.

During the course of the project, I investigated two ANN Teaching and Learning Principles. First, *"In an adult learning environment, mathematics instruction should: build on what students already know, valuing the various informal and alternative strategies students use to solve problems with geometry concepts at all levels."* In questioning students in class to gather information on alternative strategies, I asked informally, "How would you know how much wallpaper border trim to use in a room?" The students weren't familiar with the term perimeter but were able to say they would measure the length of each wall to know how much trim to use. They had a strategy to use and were able to transfer that knowledge when the term perimeter was introduced.

The second ANN Teaching and Learning Principle I investigated was, *"Feature worthwhile tasks, such as activities that are drawn from real life experience."* As the project proceeded, the students were involved in several activities/assignments. We started with perimeter. Each student came up with ideas of shapes, then assigned measurements and calculated perimeter.

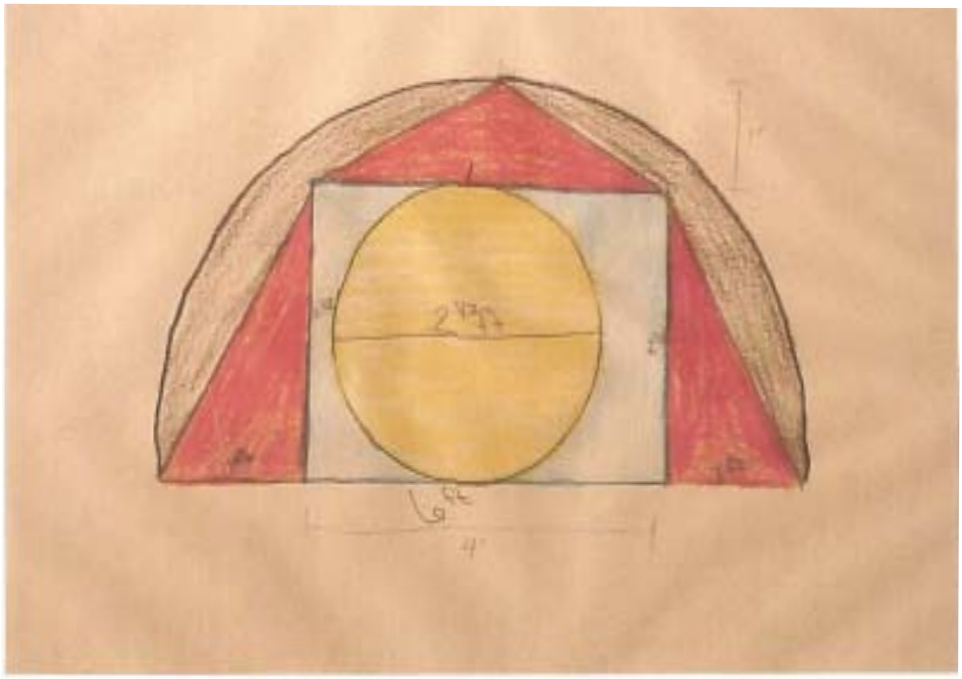
Students moved from working on perimeters to calculating area. At this point in the research project, the use of color was modeled and then utilized by students for color-coding and illustration. The final activity was



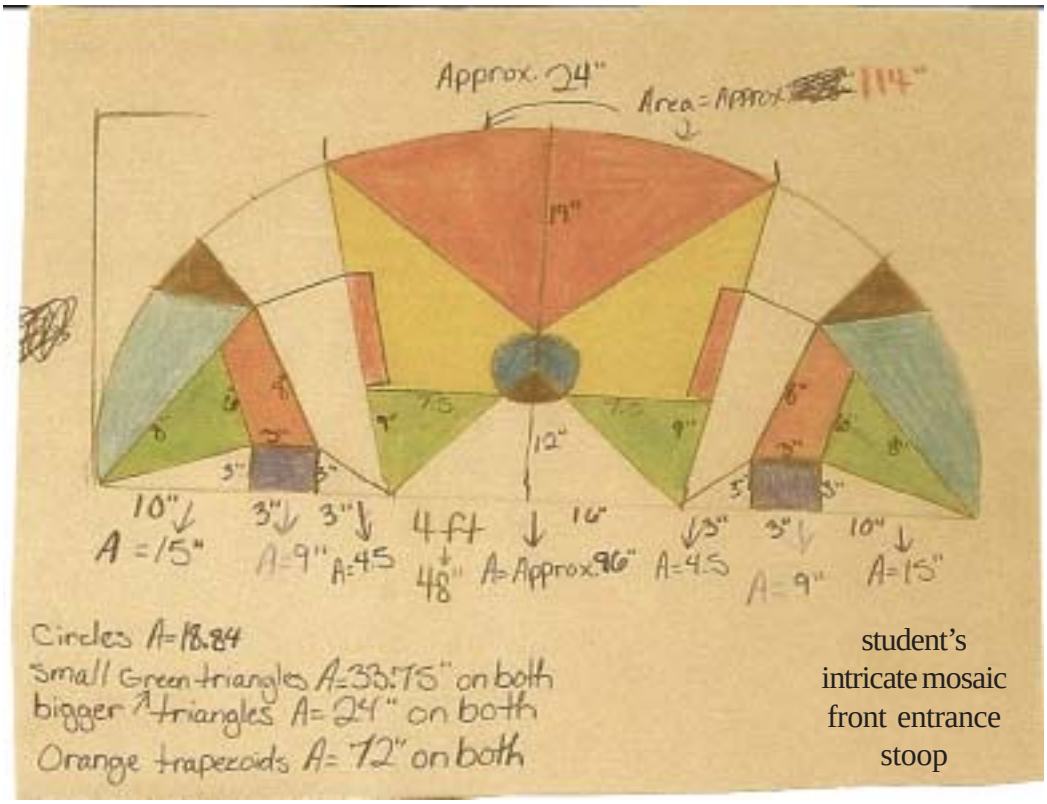
calculating area of shapes (student generated idea) in a mosaic table top [page 4], sound stage [student example at left], or front entrance stoop [as in the student example below and on page 3].

In the data collection portion of the project, I collected both quantitative and qualitative data. I collected student work samples and made use of pre- and post-knowledge questionnaires that included questions about vocabulary, concepts, and use of geometry in real-life. In addition, I used the TABE assessment to evaluate changes in academic functioning (geometry relevant questions only). The students were also tested with the full math survey of the TABE assessment. There were changes in the students' math educational functioning levels.

As the project developed, I kept notes on student comments and strategies. One strategy that stood out during the project was the ability of the students to discuss their assignments, each adding what they knew. I feel this interchange facilitated the actual solving and completion of the problems and assignments. In our final assignment of calculating area in multi-step geometric problems, I was impressed with the students' willingness to take on more than the original assignment. The assignment was to draw a circle within a triangle or



half circle and calculate all areas. Students came up with the idea to design a mosaic tabletop and this developed into a door stoop, entrance and sound stage. The students were willing and enthusiastic to take on complex geometric shapes as noted in the example on the right.



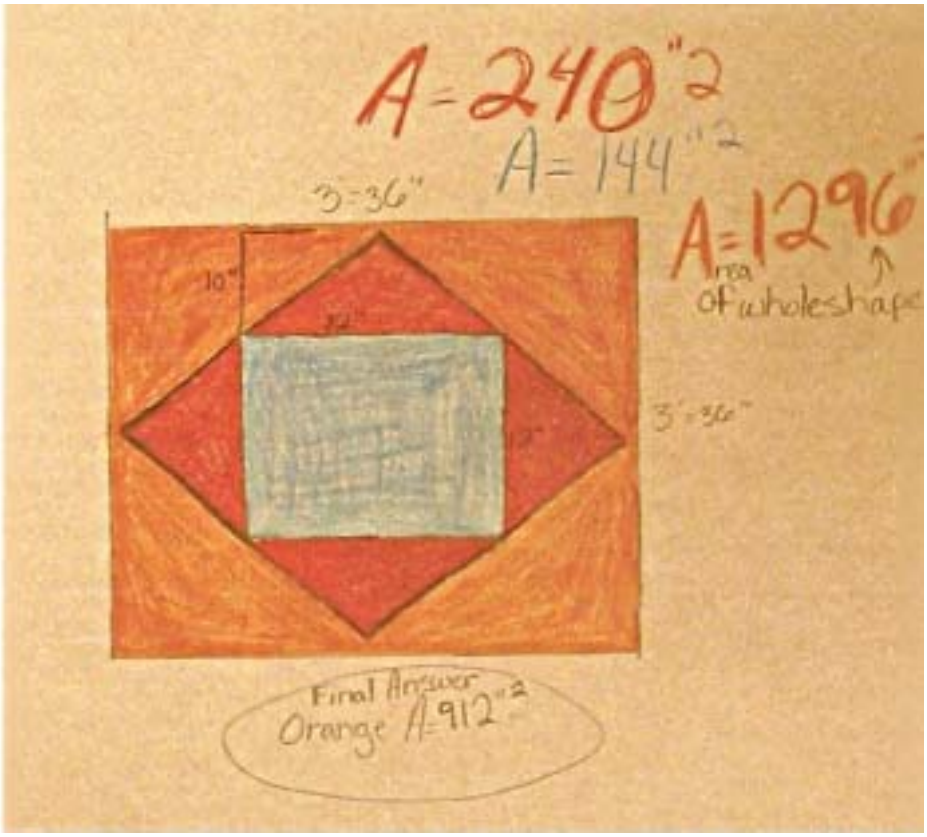
student's intricate mosaic front entrance stoop

During the final project, one student who designed a sound stage, was helping another student in understanding the assignment. I asked her if she would be willing to show the class. She went in front of the class and demonstrated her project on the classroom easel. I was impressed with her understanding at math level three and she did an excellent job illustrating and explaining how to solve the area of the shapes. She used various colors to illustrate her example.

In analyzing and interpreting data from the project, I collected previous student knowledge on a questionnaire. [For sample items from the questionnaire, see page 4.] I gathered information on what geometry skills/knowledge students held at the onset of the project. Of the students questioned initially in the project, three out of nine answered yes to having previous geometry experience at home and one out of nine answered yes to having previous geometry experience at work. Eight out of nine students did respond initially to doing an activity that does involve geometry (they didn't know it was geometry and alternative strategies may have been used to solve the problem, for example, estimation and/or guess and check to accomplish the task such as landscape bed edging).

Upon collecting data from the students, I had to modify the classifying prior knowledge portion from three types (work, school, home-originally proposed) to classifying by work and home only. There were no students who had known previous school experience with geometry.

The patterns and trends that I saw in the data were that most students had participated in a life activity that depended on geometry skills to accomplish even though they didn't know it was geometry. At the onset of the project 50% of the students could find basic geometric shapes in the classroom or think of one at home.



In looking at the research question, *What types of previous knowledge do students use when learning new geometry skills?* I feel it is evident a majority of the students came to classwith an understanding of some geometric concepts without necessarily knowing it was geometry. They had alternative strategies to solve real-life geometry-based tasks. I feel using this previous knowledge benefited the students in making connections when vocabulary terms and formulas were introduced.

Geometry Pre-Test Sample Items

What geometric shapes can you find in the classroom? Home?

How many degrees does a circle have?

How have you used geometry at work?

How have you used geometry at home?

How have you used geometry at school?

Have you ever installed paper border trim in a room in your house (wallpaper)?

Have you ever installed wood baseboard trim in your house?

Have you ever installed plastic edging around a landscaping bed?