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Grade Level/Subject: Geometry

Topic: Teaching Logical Reasoning as a Beginning Step to Proofs

Objectives (P.A.S.S.): Geometry 1.3 Use logical reasoning skills (inductive and deductive) to make and test conjectures, formulate counter examples, follow logical arguments, judge the validity of arguments and construct simple valid arguments.

Introduction: This is a game I had played at a spring NCTM conference and tried with a Geometry class well into the school year when I came back. They thought it might help with understanding proofs when they are first introduced. This was my first year to teach geometry since then, so I decided to pull it out and actually try it in the beginning of the year. It is still a little early to see if it is having any effects, but I am hoping for the best.

Instructional process: You might first ask students if they are familiar with a game called "Master Mind". (I am not.) This is supposedly a math variation of that game. It will be played in groups of two after a short demonstration game or two with the whole class. Explain that one person will pick a number and the other player will try to guess that number. Digits cannot be repeated and you probably want to allow numbers to start with zero to keep the chances of all digits the same. Before starting, a decision should be made about whether the number will be 2 or 3 digit. Once that is decided, the designated player will write down a number and keep it hidden from the other player. As guesses are made the player who wrote down the number will respond by telling the other player how many of the digits in his guess are correct digits and how many of those digits are in the proper place. Each "guesser" should prepare a piece of paper to record his guesses, the response and what he knows after each response. You may want to use the chalkboard or an overhead to demonstrate the proper form. (This is an important part of getting the "proof connection".) He should have 4 columns headed "guess", "digits", "places", "conclusions", with the fourth being the widest. Start your demonstration with a two-digit example such as "I've written a two-digit number on this piece of paper. Let's see how many guesses it takes you to discover what it is." Let's say your number is "57". Call on a student to guess. If they were to say "25", your response would be "1 digit, no places" and your form should read: 25 in the 1st column, 1 in the 2nd, 0 in the 3rd, and either in words or symbols, "the number contains a 5 or 7 but not in its current location" (_5 or 7_). Guessing will continue until someone discovers the number. After each guess discuss what you know and why and record it. (A guess of 53 would get the response of 1 digit, 1 place. A guess of 36 would get a 0 digits, 0 places.) You may also want to discuss strategy or you may leave that to student discovery. After that number is discovered you should at least start a demonstration on a 3 digit number to show that it goes through the same process. You may even want to encourage some kind of scoring system to recognize the person who has used the least guesses to find the most numbers in the time allotted for this activity. If turning it into a contest you would need to specify the number of digits to use. Possibly two for the first 5 minutes or so and then switch to three.

Closure: To help see the connection, as the game comes to a close, discuss with students what information they were using each time they wrote their conclusion. Was it only based on the current guess or did it involve the information that had come from the start? Help them to see that information continued to build and be used until they reached the desired endpoint, which in this case was the correct number. This is the same type of analysis we are trying to build in them as they work from “Given” to “Prove” when they are working on a proof.

Assessment: This is basically a matter of observation during the activity. The best assessment will probably be seeing if this introduction actually helped them catch on to proofs better than classes where this was not part of the early process.

Modifications/Accommodations: This should not be a major problem for limited language speakers since numbers are usually among their first words understood, but if it should be a problem, they could write their guesses down and still should understand the two number answers (digit & place) to their guess. For low ability levels, they might be grouped together and stick with two digit numbers if that is a problem, but some of those learners may actually excel at this game and raise confidence by beating the class “brains”. So use your own judgment in grouping.

Reflection: I pulled this out early this year before students really even knew what a proof was, but only have done it as a whole class activity for the most part. Now that they are beginning to supply reasons on proofs and will soon need to start writing short proofs, this may actually be a better time to spend a little time playing one-on-one. I hope I have not ruined the effect by trying it too soon. I believe the toughest part of incorporating this into the geometry class is deciding on the proper timing for it. Too early and they don't get the connection even as you refer back to the game, too late and they've already caught on and it's just a fun little game that wasted class time.