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## Effective Questioning Techniques in the Mathematics Classroom

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# Effective Questioning Techniques in the Mathematics Classroom

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## Research Questions

- How can I ask questions during and after a lesson in order to initiate students' thoughtfulness and better understanding?
- What types of questions elicit more qualitative responses from students?
- How can I engage students to participate in classroom discussion?

## Literature

- "Teachers pose a variety of questions to their students every day. As teachers, we recognize that some questions promote deeper mathematical thinking than others" (Herbal-Eisenmann & Breyfogle, 2005).
- "Students retain 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see AND hear, 70% of what they say and 90% of what they say AND do" (Ezrailson, Kamon, Loving, and McIntyre, 2006, p. 278)
- The funneling interaction pattern limits students' and reflects teacher's thinking processes. The focusing pattern allowed the teacher to guide students through their own thought processes (Herbal-Eisenmann & Breyfogle, 2005).
- Communication theory shows how we create and understand verbal messages, which affects the way teachers give feedback (Forrest, 2008).
- Using discussion and responding to questions for assessment can motivate students to participate in class (Crockett, Chen, Namikawa, and Zilimu, 2009).
- The research pointed to a lack of communication in mathematics classrooms and the need for change.
- Discussion for qualitative responses is not typical in a mathematics classroom, and it is difficult to initiate, facilitate, and establish as a classroom norm

## Methods

- High school standard Geometry class of 30 students
- Taught 5 lessons: exploratory group activity, interactive lecture, internet activity, and investigative discussion
- Analyzed audio recordings, student work, exit slips, and post-teaching reflections

## Results

### A. Lessons/Activities

1. Euler's Formula (exploratory group activity with nets and polyhedrons)
  - Answered questions in groups then contributed to whole-class discussion
2. Vectors (interactive lecture)
  - Guided questions throughout lecture
3. Vector Addition (interactive internet activity)
  - Worked on a worksheet with probing questions
4. Law of Sines (exploratory pair activity to derive the formula)
  - Discussion questions as a class as well as in pairs
5. Law of Cosines (exploratory pair activity to derive the formula)
  - Worked through a worksheet as a class

### B. Types of Questions

1. *Can you see a relationship between the faces, vertices, and edges? Try to derive an equation that works for each of the rows.*
  - One student found the pattern and explained Euler's Formula to the rest of the class.
2. *How would we find the coordinates for this vector?*
  - I needed to walk the students through examples as it was a new topic.
3. *Find a picture of an example of a vector in real life, such as an airplane or flock of birds, and explain why you chose this picture.*
  - Most students chose something similar to the examples with good explanations. Some didn't explain at all, and a few gave very creative answers.
4. *How might you determine the measures of the missing angle and sides (of the non-right triangle on the board)?*
  - Most students knew how to find the angle. One had an idea of how to find the sides, but the purpose of the lesson was to find a method for this.
5. *Can you use the Law of Sines to solve these triangles? If not, why?*
  - "No because we don't have angles or enough information."

## Conclusions

- I found that if I asked thought-provoking questions in presenting new topics, students get frustrated and typically did not respond. In order to engage the students, I asked questions that students felt more comfortable in answering.
- Due to classroom norms, participation was not usually voluntary. By asking guiding questions, students were more likely to volunteer and participate.
- Discussion needs to be established as a classroom norm, and students need to feel comfortable with giving qualitative responses in order to elicit them.