

# GeoGebra

## A Tool to Create Favorable Learning Situations with Emphasize on Logical Reasoning and Communication

*M. Brunström, M. Fahlgren  
Karlstad University, Sweden*

### Frameworks Concerning Mathematical Competencies

During the last decades there has been lots of work done to point out specific competencies needed to master mathematics. Instead of focusing on the content the aim has been to specify competencies which are important in all areas of mathematics. Two examples from the U.S. where this is formulated are *Principles and Standards for School Mathematics* (NCTM, 2000) and *Adding It Up: Helping Children Learn Mathematics* (Kilpatrick, Swafford, & Findell, 2001). One example of a corresponding Nordic framework is the Danish *KOM project* (Competencies and the Learning of Mathematics) (Niss & Jensen (ed.), 2002) where eight competencies are described. These competencies also form the mathematical framework for the international *PISA study*. One example of a corresponding framework in South East Asia is Singapore's framework, which largely correspond to the framework in *Adding It Up*. In *TIMSS* (Trends in International Mathematics and Science Study) the evaluation of test data in mathematics is divided into two dimensions, one concerning content and one concerning cognitive skills. The cognitive dimension is in turn divided into three so-called domains; knowing, applying and reasoning.

In Sweden a framework consisting of six competencies has been developed by a research group in Umeå (Palm et al, 2004). This framework has been done in an attempt to describe the general curriculum goals in mathematics at Upper Secondary School in Sweden.

One of the general goals in the Swedish curriculum for mathematics at Upper Secondary School is: "The school in its teaching of mathematics should aim to ensure that pupils --- develop their ability to follow and reason mathematically, as well as present their thoughts orally and in writing" (National agency for education, 2000, s.60). These abilities are in some way expressed in all of the frameworks mentioned above.

### GeoGebra

For students to have a possibility to develop the different competencies it is important to create favorable learning situations. Therefore, an important task for researchers and teachers in mathematics is to find and describe these situations. We think that one of the major advantages of GeoGebra, is that the program provides great opportunities to create such learning situations, especially when it comes to competencies concerning reasoning

in mathematics and to communicate mathematics. This is something we would like to discuss and investigate further. We have chosen to concentrate on the part of GeoGebra concerning geometry, even though our main interest is the competencies and not the geometry involved.

Some potential issues are

1. To what extent and in what ways do students use logic reasoning when they work in pairs and use GeoGebra to investigate certain geometrical statements? (See Connor et al (2007) for a similar study)
2. To what extent and in what ways do students communicate and how do they use the terminology of mathematics when they work in pairs and use GeoGebra to investigate certain geometrical statements?
3. What kind of geometrical questions are most appropriate and how should these questions be formulated in order to tempt students to use logic reasoning and to communicate mathematically when they work in pairs with GeoGebra?
4. To what extent and in what ways do students develop other mathematical competencies when they use GeoGebra to investigate certain geometrical statements?

As we need to analyze different aspects of how the students act and communicate, it might be a good method to videotape their work. We also think that it would be appropriate to have a videotaped interview directly after their work to clarify any confusion about their reasoning. Even if they didn't express their thoughts verbally, they may well have reasoned logically in their mind.

Our plan is to concentrate on some of the questions above and to do a minor investigation in the first stage. After that we hope to be ready to specify a research question for a major investigation, possibly as part of a PhD thesis. We hope that the conference will give us further inspiration and ideas to our research projects with Geogebra.

## References

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