THE VAN HIELE LEVELS OF GEOMETRIC UNDERSTANDING

There are five levels which are developmental and the order is important, namely:

Level 1 (Visualisation): Learners recognise figures by appearance alone, often by comparing them to a known prototype. The properties of figure are not perceived. At this level students make decisions based on perception, not reasoning.

Level 2 (Analysis): Learners see figures as the collection of properties. They can recognise and name properties of geometric figures but they do not see relationship between these properties. When describing an object, a student operating at this level may list all properties the student knows but not discern which properties are necessary and which are sufficient to describe an object.

Level 3 (Abstraction): Learners perceive relationships between properties and between figures. At this level, learners can create meaningful definitions and give informal arguments to justify their reasoning. Logical implications and class conclusions, such as square being a type of a rectangle are being understood. The role and significance of formal deduction is, however, not understood.

Level 4 (Deduction): Learners can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. At this level students should be able to construct proofs such as those typically found in a high school geometry class.

Level 5 (Rigor): Learners at this level understand the formal aspects of deduction, such as establishing and comparing mathematical systems. Learners at this level understand the use of indirect proof and proof by contrapositive, and can understand non-Euclidean proofs. This is a post high school kind of reasoning.

BELOW ARE FREQUENTLY ASKED QUESTIONS (Q) AND RELEVANT ANSWERS (A):

Q. Can a student skip levels?

A. According to the van Hieles'model, a student cannot achieve one level of understanding without having mastered all the previous levels. Research in the United States and other countries supports this view with one exception. Some mathematically talented students appear to skip levels, perhaps because they develop logical reasoning skills in ways other than through geometry.

Q. What if the teacher is thinking at a different van Hiele level than the students?

A. This situation is common. Most high school geometry teachers think at the fourth or fifth van Hiele level. Research indicates that most students starting a high school geometry course think at the first or second level. The teacher needs to remember that although the teacher and the student may both use the same word, they may interpret it quite differently. For example, if a student is at the first level, the word "square" brings to mind a shape that looks like a square, but little else. At the second level, the student thinks in terms of the properties of a square, but may not know which ones are necessary or sufficient to determine a square. The student may feel that in order to prove that a figure is a square, all the properties must be proved. The teacher, who is thinking at a higher level, knows not only the properties of a square, but also which ones can be used to prove that a figure is a square. In fact, the teacher may think of several different ways to show that figure is a square, since the teacher knows the relationships between the various properties and can determine which properties are implied by others. The teacher must evaluate how the student is interpreting a topic in order to communicate effectively.

Q. What happens if a teacher tries to teach at a level of thought that is above a student's level?

A. Generally, the student will not understand the content that is being taught. Usually, the student will try to memorize the material and may appear to have mastered it, but the student will not actually understand the material. Students may easily forget material that has been memorized, or be unable to apply it, especially in an unfamiliar situation.