

# A Review of Van Hiele's Model

Edward Yalley | eyalle1@lsu.edu | Advisor: David Kirshner, Ph.D. LSU.



## A. Introduction

According to both Van Hiele (1986) and French (2014) students' ability in mathematics has an influence on their level of geometrical conceptual ability. Despite the concerns of Asemani, Aseidu-Addo and Oppong (2017) as well as other scholars about the teaching and learning of geometry, many mathematics teachers continue to employ the traditional chalk and talk method in the Geometry classroom. As a result, Oladosu (2014) explained that inability to analyze identified geometric properties, lack of understanding of formal geometric concepts among others as some difficulties that students face while learning geometry. The Van Hiele model is one of the widely used theories in the teaching and learning of geometry. It has influenced classroom practices, curriculum designs and to a large extent mathematical education research. The theory is about learning levels. For instance, Vojkuvkova (2012) indicated that the Soviets researched the theory and integrated their findings in their educational curriculum; the Americans followed the trend in the 1970's. However, earlier studies like De Villiers and Njisane (1987) seem to suggest otherwise. They asserted that there is some confusion within the writings about the Van Hiele theory. Hence, this study sought to review the Van Hiele model.

## B. Research Questions

Based on the objectives of the study, the following research questions were developed:

1. What foundational theory/paradigm does the Van Hiele model hinges on?
2. What is the strengths and weaknesses of the Van Hiele Model?
3. How relevant is the Van Hiele model to teaching and learning of geometry today?
4. Why has interest in the Van Hiele model waned?
5. What possibilities exist with the Van Hiele model?

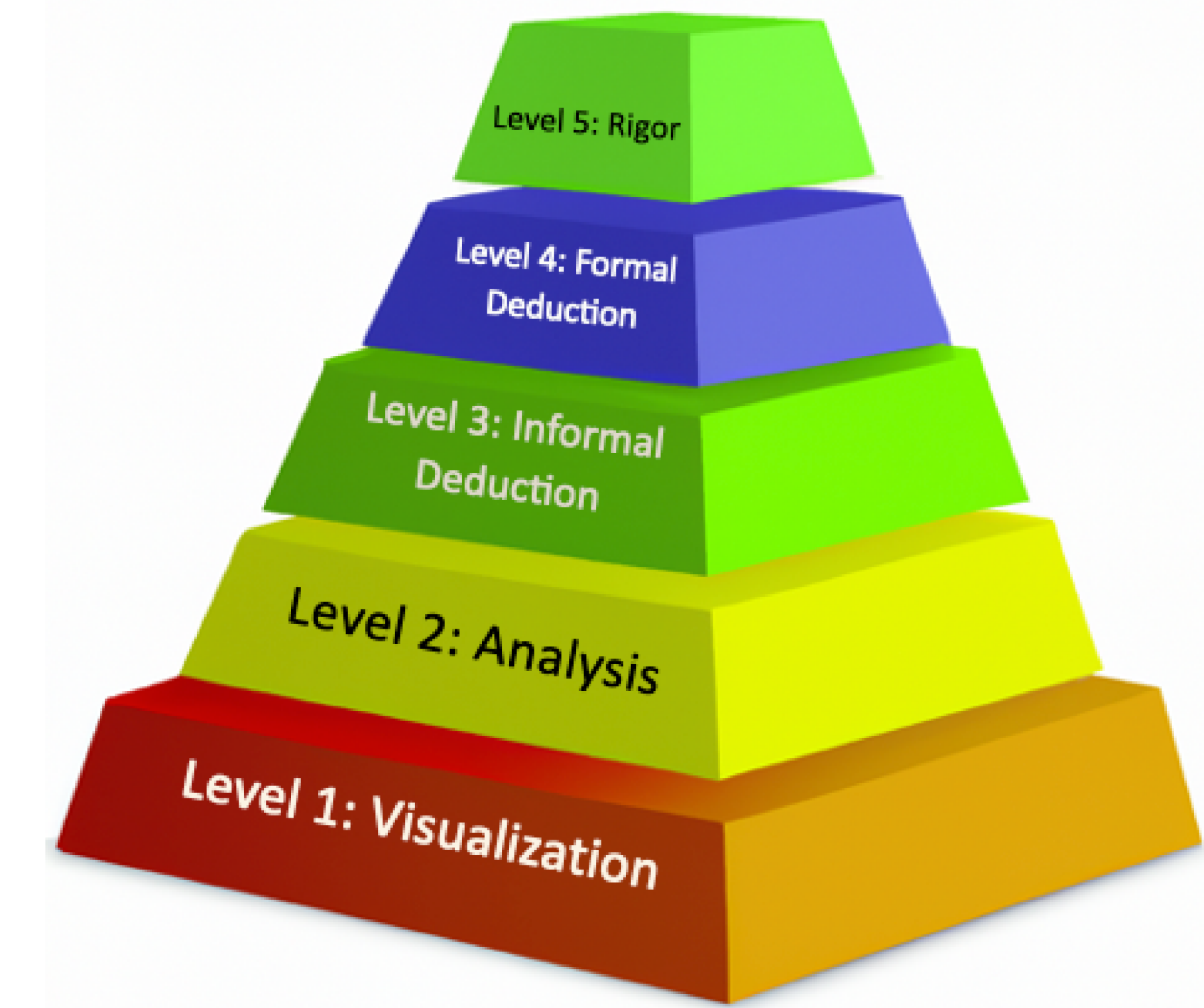
## C. Methodology

The approach used in this study sought to review the relevant literature focused on the Van Hiele model was employed in the study. In the review, I sought to research, read, analyze, evaluate and summarize the scholarly books, articles and other works focused on the Van Hiele theory. Moreover, other related literature and concepts which seems to form the foundation for the model was reviewed.

## F. Conclusions

1. The van Hiele model can be traced from ideas from Gestalt Psychology and Piaget's theory. Moreover, the design of the theory supports ideas of constructivism. Kilkeny (2015), explained that, just as Vygotsky (1978), van Hiele saw interaction with cultural environment necessary for learning. Thus, the first two phases of the theory involve exploration and interaction through guided learning processes.
2. The strength of the theory lies in its simplicity, reliability and compatibility with other teaching-learning ideas; designing of geometric tests and integration with technology. However, it is limited in application due to unaddressed realities that exists in the classroom. These realities include the existence of sub-levels, the diverse ways of modern mathematical proof and the role of the teacher. The van Hiele theory in collaboration with the Piagetian stage theory can help instructional designers with insights into what students can and cannot do within the various levels of instruction and learning of a course. "Perhaps this knowledge could guide the instructional design process in the development of eLearning courses for geometry" (Kilkenny, 2015)
3. For a theory that can assist both the teacher and the learner in developing geometric thinking, "no model is convincing than Van Hiele's geometric thinking model" (Naufal et al. 2021). Hence, researchers like Yalley et. al (2021) continue to explore and try to improve some aspects of the van Hiele theory.
4. Interest in the van Hiele theory has not waned. Rather, there are other theoretical frameworks that compares well with the van Hiele theory and hence researchers of today have more options than four decades ago. Across the globe, researchers continue to employ the model as a unit theoretical framework or with technology integration in geometry teaching and learning.
5. Although most researchers in geometry teaching and learning employed the theory, there are few research works that focused on using the theory to investigating teaching strategies. Also, the use of van Hiele model and the application of metacognition to improving geometric thinking is under researched. Finally, the hierarchical nature of the theory needs to be addressed.

## D. Analysis



Brodie (2004) is among the rare research works that center on relationship between Van Hiele and Vygotsky. However, many (Cole and Wertsch 1996; Nicholl, 2002; Brodie 2004) worked on the relationship between Piaget's and Vygotsky's. As for relationship between Piaget's theory and Van Hiele's it is no secret. One important relationship between Van Hiele's theory and that of Vygotsky is the language. Although Piaget, Vygotsky and Van Hiele are all adherents of constructivism, Van Hiele and Piaget stressed on the need for a learner's improvement through teaching while Vygotsky did not. In the figure below, the levels within Van Hiele's theory are explained and analyzed to answer the research questions.

## G. Recommendations

I recommend that researchers explore more on the integration or investigation of teaching strategies with the van Hiele theory. Thus, teacher education institutions should design activities in mathematics education that integrates the theory for the training of pre-service teachers. Secondly, a comparative research analysis of the van Hiele model and other theories in the developing of geometric thinking and metacognition should be explored by researchers. Moreover, researchers should explore a review of the levels as to where mathematical arguments or logical proofs like proof by construction can be learnt or taught. Finally, research in determining existence of hierarchical thinking before van Hiele's levels 1 and 2 can be explored.

## H. References

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## E. Results

