PhD Research Proposal

Enhancing Senior High School Students' Geometric Thinking through Technology-Supported Van Hiele Instruction: A Mixed-Methods Quasi-Experimental Study in Ghana

Abstract

This proposal extends the applicant's previous study on Van Hiele geometric thinking levels by investigating whether a technology-supported instructional intervention can significantly improve students' geometric reasoning, proof construction and mathematics achievement among Senior High School students in Ghana.

Background

Previous work established that most Year Three Senior High School students attained the Analysis level of the Van Hiele model. The proposed doctoral study moves beyond describing students' thinking levels to testing an instructional intervention designed to promote progression to higher levels of geometric reasoning.

Problem Statement

Although descriptive evidence exists on students' geometric thinking, limited intervention studies have examined how technology-supported instruction can improve geometric reasoning in Ghanaian secondary schools.

Aim

To determine the effectiveness of technology-supported Van Hiele instruction in improving students' geometric thinking, proof skills and mathematics achievement.

Objectives

1. Determine baseline Van Hiele levels. 2. Develop and implement a technology-supported instructional programme. 3. Evaluate its effect on geometric thinking. 4. Examine proof construction skills. 5. Investigate gender differences. 6. Explore teachers' and students' experiences.

Research Questions

1. What are students' initial Van Hiele levels? 2. Does the intervention improve geometric thinking? 3. Does it improve proof construction? 4. Are there gender differences? 5. How do participants perceive the intervention?

Hypotheses

H01: No significant difference exists between pre-test and post-test geometric thinking scores. H02: No significant difference exists between experimental and control groups. H03: Gender has no significant effect after the intervention.

Methodology

A mixed-methods quasi-experimental design will be adopted. Participants will be selected from Senior High Schools in Ghana. Data will be collected using the Van Hiele Geometry Test, achievement tests, classroom observations and interviews. Quantitative data will be analysed using descriptive statistics, ANCOVA, t-tests and regression, while qualitative data will undergo thematic analysis.

Expected Contributions

The study will provide evidence on effective instructional approaches for improving geometric thinking, inform curriculum development, and contribute to mathematics education research in Ghana and internationally.

References (sample)

Piaget (1970); Usiskin (1982); Van Hiele (1986); Vygotsky (1978). A complete APA 7th reference list should be developed in the final proposal.