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**Strengthening Higher-Order Thinking Skills in 3D Geometry:  
Problem Solving or Direct Instruction?**

Evidence shows students' higher-order thinking in solid (3D) geometry remains weak, partly because classes are dominated by lecture and routine exercises. Yet few studies have directly compared problem-solving instruction with traditional direct instruction on 3D-geometry HOTS, while controlling for prior ability. This gap limits clear guidance for classroom practice. In this quasi-experimental study, we compared a problem-solving approach versus traditional direct instruction for enhancing HOTS in high school solid geometry. Two intact eleventh-grade classes ( $n = 20$  each) in Indonesia were assigned to one of the two methods. Both groups took identical pre- and post-tests of challenging geometry problems (essay tasks on cube and pyramid sections, angles, and distances) and participated in brief post-unit interviews about their learning. Pre-post gains were analyzed via ANCOVA (controlling pretest scores) and effect sizes. The results showed that the problem-solving group achieved significantly higher gains in the HOTS indicators (argument clarity, multiple representations, cross-disciplinary connections) than the direct-instruction group (adjusted  $F(1, 37) = 55.18$ ,  $p < .001$ ,  $\eta^2 \approx 0.60$ ; Cohen's  $d \approx 0.82$ ). Qualitative feedback echoed this: students in the problem-solving class reported deeper engagement with spatial concepts, while many in the lecture-based class noted passive learning. These findings align with recent research: inquiry-based and active strategies strengthen mathematical thinking more than teacher-centered methods. This study is among the first to quantify the effect of a problem-solving curriculum on HOTS in 3D geometry, showing that replacing procedural lectures with rich problem tasks substantially strengthens students' geometric reasoning. The implications are clear: to prepare students for STEM fields, geometry teaching should shift toward student-centered, problem-based activities that explicitly target spatial visualization and critical analysis.

**Keywords:** Higher-order thinking skills (HOTS), solid geometry, problem-solving instruction, direct instruction, spatial visualization, quasi-experimental design.

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