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Investigating Student Engagement in Elementary Science: An ICAP Perspective on NGSS Practice Implementation

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Abstract

This presentation examines an observational investigation into how Science and Engineering Practices (SEPs), as outlined by the Next Generation Science Standards (NGSS), are carried out within elementary science classrooms and how their implementation shapes students' cognitive engagement. The study analysed 12 recorded science lessons from public schools, enabling a close examination of real classroom interactions and instructional patterns. The analysis centred on four primary aims: identifying the extent to which NGSS practices were integrated into teaching; determining the levels of student engagement using the ICAP framework, which differentiates engagement into passive, active, constructive, and interactive categories; exploring possible gender-related differences in these engagement patterns; and identifying the specific SEPs that appeared to support deeper levels of thinking and participation. To guide the analysis, a validated observational rubric anchored in the eight NGSS practices was employed to code teacher behaviours, instructional decisions, and student responses. The findings revealed that although SEPs appeared consistently across the lessons, they were often enacted in a procedural or surface-level manner. This type of implementation tended to produce engagement that remained largely passive—such as listening or observing—or active, such as completing structured tasks without generating new ideas. Instances of constructive engagement, where students extended or transformed presented information, and interactive engagement, where students built knowledge collaboratively, were present but much less frequent. Across participating classrooms, female students demonstrated higher engagement scores and a greater tendency to participate in constructive, interactive forms of learning than their male counterparts. These gender-based differences were consistent across several SEPs and particularly noticeable in practices involving communication, information evaluation, and explanation building. Among the eight NGSS practices, those focused on obtaining and evaluating information and those requiring students to construct scientific explanations were the strongest catalysts for deeper cognitive involvement. Lessons that featured these practices more

prominently tended to provide richer opportunities for students to reason, justify, and communicate their ideas. The study's outcomes emphasize the need for more deliberate and well-supported instructional approaches if teachers are to move beyond procedural enactment of SEPs. Strengthening teacher preparation, offering targeted professional development, and ensuring that curricula allocate space for inquiry and reasoning are essential steps toward enhancing engagement. The results also highlight the importance of scaffolding, strategic questioning, and structured opportunities for student–student interaction, all of which can elevate engagement to constructive and interactive levels. By shedding light on how NGSS-oriented practices are interpreted and applied in a distinctive cultural context, this study contributes to international discussions on improving science instruction and fostering meaningful engagement in early-grade science classrooms. The insights generated provide valuable guidance for educators, curriculum developers, and policymakers seeking to deepen scientific literacy and promote higher-order thinking among young learners.

Keywords: NGSS, Science Education, Primary, Student Engagement, Video Analysis, Gender Differences, Inquiry-Based Learning