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# Science Teaching Practices and Learner Engagement in Upper Secondary Classrooms: A Qualitative Study at Der An Integrated School, Philippines

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**Abstract**

Learner engagement is a critical determinant of meaningful learning in science education, particularly at the upper secondary level where abstract concepts and disciplinary thinking intensify. While learner-centered and inquiry-based approaches are widely advocated, their enactment in real classroom contexts especially in integrated public schools remains uneven. This qualitative study explored science teaching practices and their influence on learner engagement in upper secondary classrooms at Der An Integrated School in the Philippines. Using a qualitative case study design, data were collected through semi-structured teacher interviews, classroom observations, and document analysis. Thematic analysis revealed four major themes: structured yet flexible science instruction, active and inquiry-oriented learning experiences, teacher–learner interaction as a driver of engagement, and contextual challenges shaping engagement practices. Findings indicate that learner engagement is strongest when teachers combine clear instructional structure with opportunities for inquiry, discussion, and real-world application. However, curriculum demands, time constraints, and resource limitations continue to shape instructional choices. The study highlights the need for sustained professional development, contextualized science pedagogy, and institutional support to strengthen learner engagement in upper secondary science classrooms.

**Keywords**: science education, learner engagement, teaching practices, qualitative study, upper secondary education, Philippines

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## 1. Introduction

Science education plays a pivotal role in preparing learners to participate meaningfully in a rapidly changing, knowledge-driven society. At the upper secondary level, science instruction is expected to move beyond factual recall toward conceptual understanding, scientific reasoning, and application of knowledge to real-world contexts. Learner engagement encompassing behavioral, cognitive, and emotional dimensions is widely recognized as a key factor influencing achievement, persistence, and interest in science-related fields.

In the Philippine education system, upper secondary science teachers face increasing expectations to implement learner-centered and inquiry-based pedagogies aligned with curriculum reforms. However, translating these pedagogical ideals into classroom practice remains challenging, particularly in integrated schools that serve diverse learners and operate under constraints related to time, resources, and curriculum coverage. While policy documents emphasize active learning and engagement, teachers often navigate tensions between covering required content and fostering deep learner participation.

Existing research has established that teaching practices significantly influence learner engagement in science classrooms. Strategies such as inquiry-based learning, collaborative activities, and contextualized instruction have been associated with higher levels of engagement and conceptual understanding. Yet, much of the literature relies on quantitative measures of engagement, offering limited insight into how engagement is experienced and cultivated in everyday classroom interactions.

This study addresses this gap by exploring science teaching practices and learner engagement from a qualitative perspective. By examining teachers' experiences and classroom practices at Der An Integrated School, the study aims to provide a nuanced understanding of how engagement is fostered, constrained, and negotiated in upper secondary science classrooms.

## 2. Review of Related Literature

### 2.1 Learner Engagement in Science Education

Learner engagement is commonly conceptualized as a multidimensional construct involving behavioral participation, cognitive investment, and emotional involvement in learning tasks. Research indicates that engaged learners are more likely to demonstrate deeper understanding, persistence, and positive attitudes toward science (Fredricks et al., 2004). In science education, engagement is particularly important due to the abstract and conceptually demanding nature of the subject.

### 2.2 Science Teaching Practices and Engagement

Studies have shown that learner-centered teaching practices, including inquiry-based learning, hands-on activities, and collaborative problem-solving, enhance engagement by actively involving learners in knowledge construction (Hmelo-Silver et al., 2007). Clear instructional structure combined with

opportunities for exploration and discussion has been found to support both understanding and motivation (Kirschner et al., 2006).

### 2.3 Teacher–Learner Interaction and Classroom Climate

Positive teacher–learner interactions contribute significantly to learner engagement. Teachers who create supportive classroom environments, encourage questioning, and provide timely feedback foster learners' sense of belonging and confidence (Skinner & Belmont, 1993). In secondary classrooms, where learners may experience increased academic pressure, relational aspects of teaching play a crucial role in sustaining engagement.

### 2.4 Gaps in the Literature

Despite growing interest in engagement, limited qualitative research has examined how science teachers in Philippine upper secondary schools enact engagement-oriented practices within real classroom constraints. This study contributes to the literature by providing in-depth, context-sensitive insights into science teaching and learner engagement.

## 3. Methods of the Study

### Research Design

The study employed a qualitative case study design, suitable for examining instructional practices and learner engagement within a bounded school context. This approach allowed for an in-depth exploration of teaching practices as they naturally occurred in upper secondary science classrooms.

### Research Site and Participants

The research was conducted at Der An Integrated School. Participants included upper secondary science teachers selected through purposive sampling based on their direct involvement in teaching science subjects. Classroom observations focused on intact science classes to capture authentic instructional interactions.

### Data Collection Methods

Data were gathered using multiple qualitative methods to ensure depth and triangulation. Semi-structured interviews explored teachers' instructional practices, beliefs about learner engagement, and challenges encountered in science teaching. Classroom observations focused on instructional strategies, learner participation, questioning patterns, and interaction dynamics. Document analysis included lesson plans, instructional guides, and assessment tasks related to observed lessons.

### Data Analysis

Data were analyzed using thematic analysis. Transcripts and observation notes were coded inductively, and recurring patterns were organized into themes. Credibility was enhanced through triangulation of data sources, member checking, and reflective memo writing.

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## 4. Results and Findings

Analysis of interview transcripts, classroom observations, and instructional documents revealed four major themes that describe science teaching practices and learner engagement in upper secondary classrooms. These themes reflect how teachers structure instruction, promote active learning, build classroom relationships, and negotiate contextual constraints while fostering learner engagement in science.

### Theme 1: Structured yet Flexible Science Instruction

Teachers consistently emphasized that effective science instruction requires a balance between clear structure and instructional flexibility. Participants described beginning lessons with explicit explanations, concept clarification, and demonstrations to establish a strong cognitive foundation before allowing learners to explore ideas through guided or independent activities. This structured approach was viewed as necessary for helping learners grasp abstract scientific concepts and procedures, particularly at the upper secondary level where content complexity increases.

One teacher explained, *"Kailangan malinaw muna ang concept bago sila mag-explore,"* highlighting the importance of conceptual clarity prior to inquiry. Another participant shared, *"Kapag walang structure, nalilito ang students, lalo na sa science,"* while a third added, *"After the discussion, doon ko sila hinahayaan magtanong at mag-try ng activities."* These responses suggest that structure provides cognitive scaffolding, while flexibility allows teachers to respond to learners' questions, misconceptions, and interests.

Interpretively, this theme aligns with research emphasizing the role of structured guidance in science learning. Kirschner, Sweller, and Clark (2006) argue that minimally guided instruction may overwhelm learners, particularly when dealing with complex content. At the same time, studies suggest that flexibility within structured lessons supports deeper understanding by allowing teachers to adjust pacing and address emergent learning needs (Hmelo-Silver et al., 2007). The findings indicate that teachers' ability to balance structure and flexibility is central to sustaining learner engagement in science classrooms.

### Theme 2: Active and Inquiry-Oriented Learning Experiences

Active and inquiry-oriented learning experiences emerged as a strong driver of learner engagement. Teachers reported higher levels of participation, attentiveness, and interest when lessons incorporated experiments, problem-based tasks, simulations, and hands-on activities. These strategies enabled learners to take an active role in constructing knowledge rather than passively receiving information.

One participant noted, *"Mas active ang students kapag sila mismo ang gumagawa,"* while another shared, *"Kapag experiment na, kahit tahimik dati, nagiging involved,"* indicating that inquiry activities

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encouraged broader participation. A third teacher explained, *"Mas naiintindihan nila ang lesson kapag nakikita at nararanasan nila,"* underscoring the value of experiential learning.

These findings support extensive literature on inquiry-based science education, which highlights that hands-on and problem-based approaches enhance engagement, motivation, and conceptual understanding (Hmelo-Silver et al., 2007; National Research Council, 2000). Inquiry-oriented instruction allows learners to ask questions, test ideas, and make sense of scientific phenomena, thereby fostering cognitive and emotional engagement. The study suggests that when teachers intentionally design inquiry experiences aligned with lesson objectives, learner engagement becomes more sustained and meaningful.

**Theme 3: Teacher-Learner Interaction as a Driver of Engagement**

Teacher-learner interaction emerged as a critical factor in shaping learner engagement. Participants emphasized that questioning techniques, timely feedback, and encouragement created a classroom environment where learners felt comfortable participating, asking questions, and expressing ideas. Teachers described engagement not only as a result of activities but also as a product of relational dynamics within the classroom.

One teacher shared, *"Kapag ramdam nilang open ka sa tanong, mas nagiging engaged sila,"* while another stated, *"Kailangan marunong kang makinig sa sagot nila kahit mali,"* highlighting the importance of psychological safety. A third participant added, *"Yung simpleng encouragement, malaking bagay sa confidence nila,"* suggesting that emotional support plays a role in sustaining engagement.

Interpretively, this theme reinforces research emphasizing the relational dimension of learner engagement. Skinner and Belmont (1993) found that supportive teacher behaviors, such as responsiveness and involvement, are strongly associated with students' behavioral and emotional engagement. In science classrooms, where learners may fear making mistakes, positive teacher–learner interactions are especially important in encouraging risk-taking and inquiry (Fredricks et al., 2004). The findings indicate that engagement is co-constructed through instructional strategies and interpersonal relationships.

**Theme 4: Contextual Challenges Shaping Engagement Practices**

Despite teachers' commitment to engagement-oriented instruction, contextual challenges significantly shaped classroom practices. Participants identified curriculum pacing requirements, limited instructional resources, large class sizes, and time constraints as barriers to sustained implementation of inquiry-based and interactive strategies. Teachers described having to balance ideal pedagogical approaches with practical realities.

One participant reflected, *"Gusto mo sana ng more activities, pero kulang sa oras at gamit,"* while another shared, *"Minsan lecture na lang kasi kailangan tapusin ang topic,"* illustrating compromises made due to curricular pressure. A third teacher noted, *"Mahirap mag-group work kapag siksikan at marami ang estudyante,"* highlighting how class size affected engagement strategies.

These findings align with literature documenting how structural and contextual factors influence instructional practices. Studies have shown that curriculum overload and limited resources can constrain teachers' ability to implement learner-centered approaches, even when they value such practices (Darling-Hammond, 2017; OECD, 2019). The results suggest that learner engagement is not solely dependent on teacher competence or motivation but is also shaped by systemic conditions within the school environment.

**Summary of Findings**

Overall, the four themes illustrate that learner engagement in upper secondary science classrooms emerges from the interaction between structured pedagogy, inquiry-oriented learning experiences, supportive teacher–learner relationships, and contextual realities. Teachers demonstrated pedagogical adaptability and commitment to engaging learners, yet their practices were shaped and sometimes constrained by institutional and systemic factors. These findings highlight the need for instructional support, resource provision, and policy alignment to sustain engagement-oriented science teaching practices.

## 5. Discussion

The findings demonstrate that learner engagement in upper secondary science classrooms is shaped by a dynamic interaction between teaching practices, classroom relationships, and contextual constraints. Teachers' use of structured instruction played a crucial role in providing learners with cognitive clarity, particularly when introducing abstract scientific concepts and complex procedures. Clear explanations, demonstrations, and guided discussions helped learners build foundational understanding, reducing confusion and cognitive overload. This finding aligns with research suggesting that well-structured instruction supports learners' comprehension and prepares them to engage more meaningfully in higher-order tasks (Kirschner et al., 2006). Structure, therefore, functioned as a stabilizing element that enabled learners to participate more confidently in subsequent learning activities.

At the same time, inquiry-oriented and activity-based approaches emerged as powerful drivers of active learner engagement. When teachers incorporated experiments, problem-based tasks, and hands-on investigations, learners became more involved, attentive, and willing to participate. These practices encouraged learners to ask questions, test ideas, and collaboratively construct understanding, which are central goals of science education. Consistent with prior research, inquiry-based learning was shown to promote deeper cognitive engagement by situating learning within authentic scientific practices (Hmelo-Silver et al., 2007). The findings suggest that the most engaging science classrooms were those in which teachers successfully combined instructional structure with opportunities for exploration and inquiry, rather than relying exclusively on one approach.

Teacher–learner interaction also emerged as a critical factor influencing engagement, reinforcing literature that emphasizes the relational dimension of learning. Supportive questioning, constructive feedback, and encouragement created classroom environments where learners felt safe to express

ideas, make mistakes, and participate actively. Such interactions fostered learners' emotional and behavioral engagement, particularly in a subject where fear of incorrect answers can inhibit participation. This finding supports Skinner and Belmont's (1993) assertion that positive teacher behaviors such as responsiveness and involvement are closely linked to sustained learner engagement. In the context of upper secondary science, where academic demands are high, relational support appeared to play a key role in sustaining learners' motivation and persistence.

However, the study also revealed that systemic and contextual constraints limited the consistent implementation of engagement-focused strategies. Curriculum pacing requirements, large class sizes, limited instructional time, and insufficient resources often compelled teachers to prioritize content coverage over interactive and inquiry-based activities. Even when teachers valued learner-centered approaches, these constraints shaped their instructional decisions and reduced opportunities for sustained engagement. This finding highlights that learner engagement is not solely a product of teacher competence or willingness, but is also deeply influenced by institutional and structural conditions. As such, improving engagement in science classrooms requires support beyond the individual teacher level.

## 7. Implications

The findings suggest several important implications for practice and policy. First, there is a clear need for professional development programs focused on inquiry-based and engagement-oriented science teaching. Such programs should provide teachers with practical strategies for integrating inquiry within structured lessons, managing classroom interactions during active learning, and assessing learner engagement meaningfully. Ongoing coaching and collaborative learning opportunities may further support teachers in refining these practices.

Second, schools should support flexible pacing and instructional planning that allow teachers to balance curriculum coverage with meaningful learner engagement. Rigid pacing guides may need to be revisited to create space for inquiry, discussion, and reflection, which are essential for deep science learning. In addition, access to adequate instructional resources, including laboratory materials and learning technologies, can significantly enhance teachers' capacity to implement engagement-oriented strategies effectively.

Finally, recognizing and addressing contextual constraints is essential in designing realistic and sustainable approaches to learner engagement. Policymakers and school leaders should consider class size, workload, and resource availability when promoting learner-centered science instruction. By aligning institutional support with pedagogical goals, schools can create conditions that enable teachers to sustain engaging science teaching practices and foster meaningful learner participation in upper secondary classrooms.

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## 8. Conclusion

This qualitative study illustrates that effective science teaching practices play a crucial role in fostering learner engagement in upper secondary classrooms. While teachers demonstrate commitment and pedagogical adaptability, sustained engagement requires supportive structures, aligned curricula, and ongoing professional development. Strengthening these areas can enhance science learning experiences and outcomes in Philippine secondary education.

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