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Literature Review on the Development and Validation of a Chemistry Inquiry-Based Module for Grade 9

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Abstract: This study addresses the limitations of traditional teacher-centered instruction in science education by promoting inquiry-based learning (IBL) as a student-centered approach. The research focuses on designing and validating a Chemistry module for Grade 9 learners, aligned with curriculum standards and inquiry principles. Literature consistently supports that inquiry-based strategies enhance conceptual understanding, critical thinking, and scientific literacy. Validation processes ensure instructional quality, usability, and effectiveness. The review highlights global and local studies that justify the development of learner-centered modules, emphasizing their role in advancing 21st-century skills and improving science education outcomes in the Philippine context.

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I. INTRODUCTION

Traditional Chemistry instruction often relies on rote memorization and teacher-centered delivery, limiting opportunities for learners to explore, question, and construct knowledge independently. Inquiry-based learning (IBL) shifts this paradigm by encouraging active participation through questioning, experimentation, and problem-solving. Globally, IBL has been shown to improve conceptual understanding, motivation, and engagement (Jegstad, 2023; Purwandari et al., 2022). In the Philippines, the need for validated instructional materials that integrate inquiry-based strategies is pressing, particularly for Grade 9 learners who are developing foundational scientific skills. This study aims to develop and validate a Chemistry inquiry-based module that enhances comprehension, participation, and scientific inquiry abilities.

II. LITERATURE REVIEW

➢ *Inquiry-Based Learning in Chemistry Education*

IBL engages learners in scientific investigation, fostering knowledge construction through exploration and critical thinking. Studies confirm its effectiveness in improving conceptual understanding and affective outcomes (Jegstad, 2023; Purwandari et al., 2022). Guided inquiry, a structured form of IBL, strengthens reasoning skills and learner independence (Adauyah & Aznam, 2024; Almira et al., 2023). In the Philippine context, Duran and Duran (2021) and Balagtas et al. (2022) reported improved engagement and critical thinking among students exposed to inquiry-based instruction.

➢ *Development of Chemistry Instructional Modules*

Instructional modules provide structured, self-paced learning opportunities. Yuliani et al. (2021) emphasized that well-designed modules improve achievement, while Branch (2021) highlighted the ADDIE framework for effective instructional design. In the Philippines, self-learning modules (SLMs) have been widely adopted (DepEd, 2021), with studies showing enhanced independent learning and comprehension (Malaluan, 2021). Contextualized modules further improve engagement and understanding (Sarmiento & Orale, 2022). Integrating inquiry-based strategies into modules strengthens outcomes, as demonstrated by Asmi et al. (2024) and Wulandari et al. (2024).

➢ *Effectiveness of Inquiry-Based Instructional Materials*

Inquiry-based instructional materials enhance analytical and investigative skills (Varadarajan, 2024; Hmelo-Silver,

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2021). In the Philippines, Alonzo (2021) and Torres (2022) found that inquiry-based modules significantly improved performance and engagement. Garcia and Reyes (2023) highlighted gains in science process skills and problem-solving abilities. These findings confirm the potential of inquiry-based modules to transform Chemistry instruction.

- *Validation of Instructional Materials*

Validation ensures instructional quality, accuracy, and usability. Plomp (2021) and Tessmer (2021) emphasized iterative development and formative evaluation, including expert validation and pilot testing. In the Philippine context, Ramos (2021) and De Castro & Eguia (2022) confirmed that validated materials enhance teaching effectiveness and learner outcomes. Valdez (2023) stressed the importance of revisions based on pilot testing to produce learner-centered modules.

- *Inquiry-Based Learning and 21st-Century Skills*

IBL supports the development of critical thinking, collaboration, and problem-solving—skills essential for modern learners (OECD, 2021). Trinidad (2022) and Santos & Bautista (2023) found that inquiry-based approaches enhance these competencies among Filipino students. In Chemistry education, these skills are vital for analyzing data, solving problems, and applying scientific concepts.

III. METHODOLOGY

The study employs a Research and Development (R&D) design using developmental research. Participants include expert validators, Grade 9 students, and science teachers. Instruments consist of the developed module, validation checklists, and evaluation questionnaires. The module follows the 5E instructional model (engage, explore, explain, elaborate, evaluate) to promote inquiry-based learning. Validation involves expert review, pilot testing, and revisions to ensure instructional quality.

IV. FINDINGS/RESULTS

Anchored on literature, the developed module is expected to demonstrate high validity and usability. Studies consistently show that inquiry-based strategies improve conceptual understanding and performance (Jegstad, 2023; Purwandari et al., 2022). The integration of the 5E model aligns with findings that structured inquiry frameworks deepen learning. Local studies (Alonzo, 2021; Torres, 2022) confirm that inquiry-based modules enhance engagement and science process skills, supporting the module's effectiveness.

V. DISCUSSION

The findings reflect global and local literature on the effectiveness of inquiry-based learning. The module's design, grounded in constructivist and inquiry principles, aligns with best practices in science education. Validation processes ensure instructional quality and contextual relevance. In the Philippine context, the module addresses gaps in available learner-centered materials and supports the development of 21st-century skills. The study confirms that integrating inquiry pedagogy with systematic module development enhances instructional quality and learner outcomes.

VI. CONCLUSION

The literature strongly supports the development and validation of a Chemistry inquiry-based module for Grade 9. Inquiry-based strategies consistently improve conceptual understanding, critical thinking, and scientific inquiry skills. Validated instructional materials contribute to effective teaching and enhanced student outcomes. This study concludes that inquiry-based modules are essential tools for advancing science education in the Philippines, addressing gaps in instructional resources, and fostering 21st-century competencies among learners. Future research should empirically test the module's impact and expand its application across grade levels and subject areas.

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