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PROJECT R.A.I.D. (READ, ANALYZE, AND INTERPRET DATA): A PATHWAY IN FOSTERING CRITICAL THINKING IN SCIENCE AMONG STUDENTS

Author's Name: Mona Sheila R. Alejandro[1], Vanessa L. Palisoc[2]

Affiliation:

1. Sergia Soriano Esteban Integrated School – SPED Center, Philippines.
2. Sergia Soriano Esteban Integrated School – SPED Center, Philippines.

Corresponding Author Name & Email Id: Mona Sheila R. Alejandro,
mona.alejandro@deped.gov.ph

ABSTRACT

Critical thinking is a vital 21st-century competency that enables learners to solve problems, evaluate evidence, and make reasoned decisions. This study assessed the effectiveness of Project R.A.I.D. (Read, Analyze, and Interpret Data), a project-based learning (PBL) intervention, in enhancing the critical thinking skills of Grade 10 students at Sergia Soriano Esteban Integrated School SPED Center. A total of 86 students participated in a pre-test/post-test design, that measured four domains of critical thinking: interpretation, analysis, inference, and conclusion. Findings revealed significant improvements across domains, with interpretation advancing from "Proficient" to "Advanced" and analysis improving from "Beginning" to "Developing." Inference scores also increased, while drawing conclusions remained "Proficient." Overall, the results confirmed that the intervention effectively enhanced students' critical thinking skills, with no significant differences observed by sex and age. The study concludes that Project R.A.I.D. is a promising strategy for fostering higher-order thinking among junior high school learners and recommends its integration into science instruction.

Keywords: Project R.A.I.D., Project-Based Learning, Critical Thinking, Science Education, Secondary Learners

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INTRODUCTION

The development of critical thinking is a central goal of contemporary education, particularly in science, where students are expected to evaluate data, interpret findings, and draw valid conclusions. Globally, concerns have been raised about students' ability to engage in higher-order thinking. The World Economic Forum (2020) identified critical thinking, problem-solving, and creativity as among the most essential skills for the future workforce, yet international assessments continue to reveal gaps. For instance, the 2022 Programme for International Student Assessment (PISA) revealed that more than 77% of Filipino students scored below proficiency in science, ranking the Philippines among the lowest-performing countries (OECD, 2023). This mirrors challenges reported in other developing nations, where limited resources, reliance on rote learning, and insufficient teacher training hinder the cultivation of higher-order thinking (Schleicher, 2019).

Beyond PISA, the Trends in International Mathematics and Science Study (TIMSS, 2019) also revealed persistent global disparities, with students from many Asian and African countries performing significantly below the international average in science and problem-solving tasks. UNESCO (2021) has likewise emphasized that global learning crises are deepened by inequities in access to quality education and pedagogies that fail to foster critical and creative thinking. These findings emphasize the urgent need for effective teaching strategies that can bridge both local and global learning gaps.

Project-Based Learning (PBL) has emerged as a promising approach to enhancing higher-order skills. By engaging learners in real-world, inquiry-based tasks, PBL allows students to apply classroom concepts, collaborate with peers, and cultivate independent reasoning (Balemen & Keskin, 2018; Chua & Lee, 2023). In line with this framework, Project R.A.I.D. (Read, Analyze, and Interpret Data) was conceptualized to help Grade 10 students strengthen their capacity to process information, analyze patterns, and make logical inferences through structured activities embedded in science learning.

The significance of this study is multi-level. For students, it develops lifelong competencies in interpretation and reasoning, enabling them to meet both national and global standards in scientific literacy. For teachers, it provides a practical, adaptable model of project-based learning that can enhance classroom practice. For school leaders and administrators, the findings can inform instructional reforms and professional development. Finally, for policymakers, the study offers evidence that may guide broader curriculum innovations and support the integration of critical thinking initiatives to address systemic educational challenges highlighted in global assessments.

This study specifically aimed to describe the profile of students in terms of age and sex, determine their critical thinking skills before and after the intervention across four domains—interpretation, analysis,

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inference, and drawing conclusions, examine differences in post-test performance by sex, and assess the overall improvement in critical thinking skills before and after Project R.A.I.D.

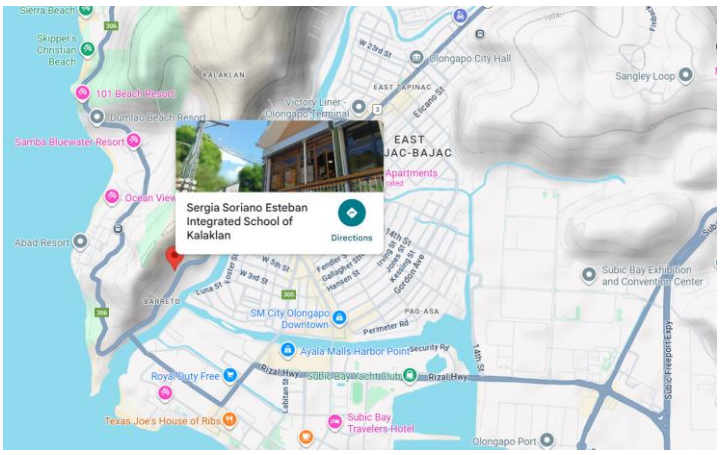
METHODOLOGY

Research Design

The study employed an action research design with a pre-test/post-test approach to determine the effectiveness of Project R.A.I.D. in enhancing the critical thinking skills of Grade 10 students. Action research was deemed appropriate since it focused on improving classroom instruction through the direct implementation of a project-based learning intervention.

Participants and Location

The respondents of the study were 86 Grade 10 students from Sergia Soriano Esteban Integrated School – SPED Center, Division of Olongapo City. A total population sampling was used to ensure complete representation of learners in the class section where the intervention was introduced. The participants reflected the typical age range of junior high school students and were almost evenly distributed by sex.



Instrument

A researcher-made test was utilized to measure students' critical thinking skills. The instrument covered four domains - interpretation, analysis, inference, and conclusion - and test items were aligned with science competencies in the K to 12 curriculum. To ensure quality, the test underwent both validity and reliability testing. It was validated by subject specialists in science education to establish content and construct validity, and it was pilot-tested with a comparable group of learners. The results of the reliability test yielded a Cronbach's alpha coefficient of 0.86, indicating high internal consistency. With these measures, the instrument was deemed valid and reliable for assessing respondents' critical thinking skills. Scores were interpreted based on proficiency descriptors (Beginning, Developing, Proficient, and Advanced) consistent with DepEd standards.

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Data Collection

The study was conducted during the third quarter of the school year. Prior to data collection, approval was obtained from the school head, and proper coordination was established with the class advisers to ensure the smooth implementation of the intervention. Informed consent was also obtained from the student participants and their parents, ensuring ethical considerations were observed. A pre-test was administered prior to the implementation of Project R.A.I.D. to determine baseline critical thinking skills. Project R.A.I.D. was then introduced through contextualized activities that required students to read scientific texts, analyze data, and interpret results. After completing the intervention, a post-test was administered to measure changes in performance.

Data Analysis

The responses were organized, tabulated, and analyzed using frequency counts, percentages, means, and t-tests. Profile variables such as sex and age were compared to identify differences, and paired t-tests were used to assess the significance of changes before and after the intervention. Statistical significance was set at the 0.05 level.

RESULTS AND DISCUSSION

Table 1. Profile of Respondents in Terms of Age and Sex (N = 86)

Profile	Category	Frequency	Percentage
Age	14 and below	12	13.95%
	15–16	70	81.40%
	17 and above	4	4.65%
Total		**86**	**100%**
Sex	Male	44	51.16%
	Female	42	48.84%
Total		**86**	**100%**

As shown in Table 1, the majority of the respondents (81.40%) were aged 15–16, which is the typical age range for Grade 10 learners. A smaller proportion (13.95%) were 14 years old or younger, while only 4.65% were 17 years old or older. This indicates that the respondents were generally within the expected age bracket for their grade level, aligning with the developmental competencies expected in science education. According to Piaget's theory of cognitive development, learners in this age group (the formal operational stage) begin to demonstrate higher-order thinking, such as logical reasoning and problem-solving (Inhelder & Piaget, 1958), making them more receptive to interventions designed to enhance critical thinking.

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In terms of sex distribution, the respondents were almost evenly divided, with 51.16% male and 48.84% female. The nearly balanced representation suggests that the study's findings are not heavily skewed toward one gender, providing an equitable basis for comparing results across sexes. Prior studies have noted that gender differences in academic performance are often minimal when learners are exposed to inquiry-based and project-based learning strategies (Manzano-León et al., 2021), supporting the observation that both male and female students may equally benefit from Project R.A.I.D.

Table 2. Mean Scores of Critical Thinking Skills Before Project R.A.I.D.

Domain	Mean	Description
Interpretation	7.8	Proficient
Analysis	4.3	Beginning
Inference	3.48	Beginning
Drawing Conclusions	7.01	Proficient
Overall Mean	5.65	Developing

As shown in Table 2, before Project R.A.I.D., students were Proficient in interpretation and conclusion, but only at the Beginning level in analysis and inference. These results indicate that learners could understand and summarize information but struggled with deeper reasoning tasks. Pratiwi and Widodo (2022) found that students often struggle with analytical reasoning without guided practice.

Table 3. Mean Scores of Critical Thinking Skills After Project R.A.I.D.

Domain	Mean	Description
Interpretation	8.73	Advanced
Analysis	6.43	Developing
Inference	4.74	Beginning
Drawing Conclusions	7.05	Proficient

As shown in Table 3, the implementation of Project R.A.I.D. improved scores across all domains. Interpretation advanced to Advanced, analysis improved from Beginning to Developing, and inference increased, though it remained at the Beginning category. Concluding showed a slight improvement while staying Proficient. These results align with studies by Huda et al. (2024) and Putri et al. (2021).

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Table 4. Differences in Post-Test Critical Thinking Skills by Sex

Domain	Male (M)	Female (F)	p-value	Interpretation
Interpretation	8.9	8.71	0.686	Not Significant
Analysis	7.95	8.99	0.394	Not Significant
Inference	8.84	8.76	0.964	Not Significant
Conclusions	7.81	9.21	0.054	Not Significant

Table 4 indicates that there were no significant differences by sex across all domains. Although females scored slightly higher in drawing conclusions, the difference was not statistically significant. This result is consistent with Manzano-León et al. (2021), who noted that PBL fosters equitable learning outcomes across gender groups.

Table 5. Paired t-test of Critical Thinking Skills Before and After Project R.A.I.D.

Variable	Pre-test Mean	Post-test Mean	Mean Difference	t(df)	p-value	Interpretation
Overall Critical Thinking	22.41	26.95	-4.55	-8.33 (85)	< 0.0001	Significant Improvement

Table 5 confirms that students' overall critical thinking skills significantly improved after the intervention. The mean score increased by 4.55 points, validating Project R.A.I.D.'s effectiveness in fostering cognitive development. This supports the findings of Phungsuk et al. (2020), who emphasized that PBL environments strengthen reasoning, interpretation, and decision-making abilities.

CONCLUSION AND RECOMMENDATIONS

The study's findings demonstrated that Project R.A.I.D. is an effective intervention for enhancing the critical thinking skills of junior high school learners. Prior to its implementation, students showed proficiency in interpretation and drawing conclusions but performed poorly in analysis and inference. After the intervention, their performance improved significantly, with interpretation advancing to the "Advanced" level and analysis moving to the "Developing" level. Inference also showed growth, though it remained the least developed domain. Overall, students' mean scores increased by 4.55 points, and the paired t-test confirmed that this improvement was statistically significant. Importantly, there were no

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significant differences in critical thinking performance across sex and age groups, suggesting that the intervention benefited all students equitably.

These findings affirm that Project R.A.I.D., as a project-based learning approach, effectively fosters higher-order thinking and provides a meaningful pathway for building essential 21st-century competencies. The results are consistent with earlier studies highlighting the value of PBL in engaging students in real-world problem solving and collaborative learning.

In light of these results, the study recommends the following: teachers may integrate Project R.A.I.D. strategies into their science instruction to enhance interpretation, analysis, and inference skills; school leaders and administrators should support its adoption by providing professional development and instructional resources; and policymakers may consider scaling up similar initiatives to address the learning gaps in science education revealed by national and international assessments. Future research may explore its application across other subject areas and grade levels to strengthen the evidence base for PBL in Philippine education.

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