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REVIEWER'S REPORT

Manuscript No.: IJAR-57870

Title: Meaningful Learning Through Scientific Experiments: Its Impact on Learning Skills and Information Processing Among Elementary School Students in Science Education.

Recommendation:

Accept as it is .....

Accept after minor revision.....

Accept after major revision .....

Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality		√		
Techn. Quality	√			
Clarity	√			
Significance	√			

Reviewer's ID: JPR- 212

Detailed Reviewer's Report

Summary Assessment

This manuscript investigates a timely and educationally relevant question: whether meaningful learning through inquiry-based scientific experiments improves learning skills and information processing among elementary school students. The study employs a quasi-experimental design with 61 fifth-grade students, comparing an inquiry-based experimental group (n=30) against a traditional instruction control group (n=31). Pre- and post-test achievement measures based on Bloom's Taxonomy, combined with qualitative classroom observations, provide convergent evidence that the inquiry approach significantly enhances academic performance, analytical thinking, and information-processing abilities.

The paper is **well written, theoretically grounded, and methodically presented**. The findings are practically significant for science educators, curriculum developers, and policymakers. Only a few minor issues require attention before publication.

Strengths of the Manuscript

1. **Clear Theoretical Framework** The manuscript appropriately anchors the study in Ausubel's meaningful learning theory, constructivist perspectives, Piaget's cognitive development theory, and Vygotsky's social constructivism. This multi-theoretical grounding strengthens the interpretative power of the findings.
2. **Appropriate Methodology** The quasi-experimental design is suitable for a natural educational setting. Pre-test equivalence between groups (Experimental: M=64.21, SD=6.34; Control: M=63.75, SD=6.11) is properly established before intervention.
3. **Valid and Reliable Instrument** The achievement test, consisting of 25 items distributed across five cognitive levels of Bloom's Taxonomy, was reviewed by five domain experts. Reliability coefficients are reported as acceptable.
4. **Clear Results** Post-test differences are substantial (Experimental: M=87.43, SD=5.28; Control: M=72.16, SD=6.02), and qualitative observations support the quantitative findings. Effect sizes (though not reported) are likely large based on mean differences.
5. **Practical Educational Implications** The implications section is specific, actionable, and appropriately directed at teachers, curriculum developers, policymakers, and teacher-training programs.
6. **Honest Limitations** The study acknowledges its key limitations: single school, small sample (N=61), single grade level (fifth grade), short intervention duration, and exclusive focus on science education.

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Minor Concerns (Required for Revision)

Issue	Location	Recommendation
Repetitive text	Lines 56–60 and 60–64 (page 2) contain nearly identical paragraphs.	Delete the duplicate paragraph.
Missing Table 1 caption & proper numbering	Page 9, Table 1 appears without an explicit caption. Pre-test table is labeled but not numbered.	Add "Table 1. Pre-Test Scores of the Experimental and Control Groups" above the table.
Missing Table 2 caption	Page 9, post-test table lacks a proper caption.	Add "Table 2. Post-Test Scores of the Experimental and Control Groups."
Effect sizes not reported	Section 4.2 (post-test results) reports means and SDs but no effect size (Cohen's d, η^2).	Add effect sizes with confidence intervals to allow readers to judge practical significance. Example: Cohen's d = 2.71 (95% CI: 2.02–3.40), indicating a very large effect.
Reliability coefficient not specified	Page 8, line 265 states "The obtained reliability coefficient indicated an acceptable level" but the actual value (e.g., Cronbach's α) is missing.	Report the exact reliability coefficient (e.g., α = 0.87).
Inconsistent numbering of research questions	Page 5, lines 166–172 list four research questions. Page 6, lines 179–183 list three hypotheses. Hypothesis H1 corresponds to question 1, H2 to question 2, but H3 to question 3 — no hypothesis is explicitly linked to question 4.	Either add a fourth hypothesis (H4) or align the numbering.
Minor typographical issues	Page 4, line 120: "critical- thinking" has an inconsistent hyphen. Page 13, reference formatting: some DOIs present, others missing.	Standardize hyphenation and ensure all DOIs are included where available (e.g., Duran & Dökme, 2016 includes DOI; others do not).

Suggested Improvements (Optional but Recommended)

1. **Add a CONSORT-style flow diagram** Although this is a quasi-experimental study, a simple participant flow diagram (enrollment, allocation, pre-test, intervention, post-test, analysis) would improve transparency.
2. **Report inferential statistics** In addition to means and SDs, include t-test or ANOVA results with exact p-values and degrees of freedom. Example: *t(59) = 10.84, p < .001, Cohen's d = 2.71*.
3. **Clarify the intervention duration** Page 7 states "an instructional unit consisting of five inquiry-based science lessons" but does not specify the total duration (e.g., 5 days, 5 weeks). Add this information.
4. **Expand the description of "traditional instruction"** Page 4, line 143: "traditional teacher-centered instruction" should be operationally defined (e.g., lecture, textbook reading, individual worksheets, no experiments).
5. **Consider a figure** A simple bar graph comparing pre-test and post-test means across groups would enhance visual impact (similar to the missing figure in the previous manuscript).

Specific Textual Corrections

Current Text	Correction
Page 2, lines 56–64 (duplicate paragraph)	Delete lines 60–64 entirely.
Page 4, line 120: "critical- thinking skills"	Change to "critical thinking skills" (consistent hyphenation).
Page 8, line 265: "The obtained reliability coefficient indicated an acceptable level"	Replace with "Cronbach's alpha for the achievement test was α = 0.86, indicating good internal consistency."
Page 9, Table 1 (no caption)	Add: "Table 1. Pre-Test Scores of the Experimental and Control Groups"
Page 9, Table 2 (no caption)	Add: "Table 2. Post-Test Scores of the Experimental and Control Groups"
Page 13, reference list: inconsistent DOI	Example: Duran & Dökme (2016) — keep DOI; others

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formatting	without DOI should note "no DOI" or leave blank consistently.

Overall Conclusion

This is a **methodologically sound, well-written, and educationally significant study**. The authors successfully demonstrate that inquiry-based scientific experiments, grounded in meaningful learning theory, substantially improve academic achievement, analytical skills, and information processing among elementary school students. The quasi-experimental design, pre-test equivalence, expert-validated instrument, and honest discussion of limitations reflect strong research practice.

Minor revisions primarily addressing repetitive text, missing table captions, unreported effect sizes, and unspecified reliability coefficients are sufficient to bring this manuscript to publication readiness. Once these corrections are made, the paper will make a valuable contribution to the literature on science education, inquiry-based learning, and cognitive development in elementary settings