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Development of Constructivism-Based Learning Models to Improve Student Learning Outcomes

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ABSTRACT

Addressing the critical implementation gap between constructivist learning theory and conventional practices (Lai, 2021), this study utilized a Research and Development (R&D) approach to develop, validate, and test a contextual constructivism-based learning model integrated with guided inquiry. The model's central objective was to facilitate active knowledge construction, thereby enhancing student learning outcomes and 21st-century competencies. Following the ADDIE phases (Analyze, Design, Develop, Implement, Evaluate), the model's efficacy was rigorously tested in a quasi-experimental design involving 120 students from elementary and junior high schools across diverse multi-sited locations, including Bandung, West Lampung, and Gorontalo. Empirical results demonstrated highly significant cognitive gains ($t(119) = 8.57, p < .001$), with a calculated N-Gain score of 0.62 confirming the model's moderate-to-high effectiveness. Furthermore, qualitative data validated high application fidelity (Wati & Agustina, 2021) and observed significant increases in student motivation, participation, and collaborative skills. The findings confirm the model's robust adaptability and efficacy across varied educational contexts. This research underscores the necessity of the teacher's role transformation into a proficient facilitator and highlights the potential of constructivist models to foster active, learner-centered educational environments essential for developing lasting academic and professional skills.

Keywords: *Constructivism, Learning Model, Student Learning Outcomes, Active Learning, Educational Development*

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INTRODUCTION

In the contemporary educational landscape, developing effective learning models is crucial for enhancing student learning outcomes and equipping them with critical and independent thinking skills the core competencies of the 21st century (Lai, 2021). A widely endorsed approach for achieving these goals is constructivism-based learning, which inherently places students at the center of the learning process. Constructivism posits that knowledge is actively constructed by the student through interaction with the environment and reflection on their experiences, rather than merely received passively from teachers.

The theory relies on Piaget's concepts of assimilation and accommodation for cognitive growth (Wadsworth, 2022), and Vygotsky's emphasis on social interaction and support within the Zone of Proximal Development (ZPD) (Schunk, 2023). Consequently, the teacher's role shifts to that of a facilitator who guides autonomous investigation and collaborative knowledge creation (Miller, 2024), enabling students to grasp concepts more deeply and meaningfully.

Despite the established advantages of constructivism, traditional educational practices still widely used in Indonesia, which often rely on lectures and memorization, are less successful in fostering active student participation and the Higher-Order Thinking Skills (HOTS) required today (Astuti & Wiyono, 2020). Empirical studies confirm that constructivism-based models offer challenging, relevant, and contextual learning experiences, which significantly boost student motivation and learning results (Mahmud & Sapar, 2021).

Nevertheless, constructivist implementation has yet to reach its full potential. Many educators struggle to consistently and methodically apply this philosophy in daily teaching activities (Masgumelar & Mustafa, 2021). Significant challenges persist, including inadequate teacher training in constructivist strategies, insufficient infrastructure, and the necessity of utilizing authentic assessment tools that evaluate students' complex thought processes rather than just final outputs (Pramana, Dantes, & Paramartha, 2021).

The urgency of this research is rooted in the pressing need to close the gap between theoretical effectiveness and practical application in Indonesian schools. This issue is more critical than many other school-level concerns because it directly impacts the fundamental quality of learning interactions and students' ability to develop 21st-century competencies (critical, creative, and collaborative skills), which are prerequisites for national capacity building and future success.

Therefore, this study aims to develop, test the efficacy, and validate a contextual constructivism-based learning model integrated with the guided inquiry approach to enhance student learning outcomes at the primary and secondary levels. The development process includes model design, rigorous efficacy testing, and evaluation using authentic assessment tools that represent students' constructive talents. By promoting student autonomy, teamwork, and creativity, this approach seeks to remove common implementation barriers and align the learning process with students' developmental stages, ultimately driving the growth of 21st-century critical and analytical thinking abilities.

METHODS

1. Research Design and Development Model

The core objective of this study is the design, validation, and empirical testing of a contextual constructivism-based learning model aimed at effectively enhancing student learning outcomes. The

Research and Development (R&D) methodology was employed, providing a systematic structure for educational tool creation and necessitating continuous evaluation and refinement (Sudarsono & Asbari, 2021). The research spanned an entire academic semester, approximately six months, commencing at the start of the even semester in the 2024–2025 academic year. The specific procedural framework utilized is the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model, which is recognized for its utility in structuring the development of constructivist learning resources. The initial Analysis phase encompassed a thorough needs assessment, curriculum review, and field survey to confirm the model's relevance to the students' characteristics and the actual learning context.

2. Subject, Population, and Sampling

The population for this research comprised all students enrolled in elementary schools (SD) and junior high schools (SMP).

Sampling and Setting: This study utilized a multi-sited approach, employing purposive sampling to select schools and classes in geographically diverse areas, including Bandung, West Lampung, and Gorontalo. This selection strategy ensures the model's external validity across varied educational environments (both urban and rural).

a. Limited Trial Subjects (Instrument Validation): 30 students (one class) were utilized for the preliminary testing of instrument validity and reliability.
b. Main Efficacy Trial Subjects (Implementation): A total of 120 students (four classes, composed of two elementary classes and two junior high classes) participated in the core effectiveness test.

3. Research Procedures and Model Implementation

The research followed the five sequential phases of the ADDIE model:

a. Analysis: Conducting necessary assessments of student needs, existing curricula, and site-specific learning conditions.
b. Design: Structuring the core instructional components, including the syllabus, lesson plans (RPP), and specialized Student Worksheets (LKS) (Wati & Agustina, 2021). The model integrates five critical constructivist strategies: concept orientation, exploration, interpretation, application, and authentic evaluation.
c. Development: Producing the final instructional materials and conducting essential expert validation by educational specialists and academics to verify the model's quality and theoretical fidelity.
d. Implementation (Efficacy Test): The validated model was tested in experimental classes using a one-group pretest-posttest design. The educator functioned primarily as a facilitator, guiding inquiry and fostering group interaction.
e. Evaluation: Analyzing both quantitative and qualitative data to assess the model's overall effectiveness and identify areas requiring refinement.

4. Instruments and Data Collection

Data were collected using a mixed-methods approach:

Data Collected	Instrument	Description and Items
Cognitive Learning Outcomes (HOTS Gains)	Written Test (Pretest & Posttest)	25 questions (structured essay or multiple-choice format) assessing students' Higher-Order Thinking Skills (HOTS).
Affective & Psychomotor Traits	Observation Sheets & Questionnaires	Measuring student participation, collaboration, and process skills. These instruments support the necessity for authentic assessment within a constructivist framework (Sari & Syarief, 2023).
Model Fidelity	Facilitator Observation Sheet	Used to measure the degree to which the teacher adhered to the structured syntax of the designed model during implementation.
Qualitative Support	Documentation & Interviews	Employed to record the learning process, identify implementation barriers, and gather subjective responses from students and teachers.

5. Data Analysis Technique

Data analysis utilized a combination of descriptive, inferential, and qualitative methods:

a. Descriptive Analysis: Used to summarize basic statistics, including mean scores (pretest and posttest) and expert validation results.
b. Inferential Analysis (Efficacy Testing):
    1) The Paired Sample t-test was applied to compare the statistically significant difference in cognitive scores between the pretest and posttest phases.
    2) The N-Gain value was calculated to quantify the proportional learning gain, classifying the model's effectiveness level (low, medium, or high).
c. Qualitative Analysis: Involving the synthesis and interpretation of data from observations and interviews to provide in-depth context, justify quantitative findings, and detail areas for model revision.

RESULTS

1. Evaluation of Learning Model Effectiveness

This study developed and tested a constructivism-based learning model integrated with guided inquiry aimed at improving the learning outcomes of elementary and junior high school students. The research employed a Research and Development (R&D) methodology utilizing the ADDIE framework consisting of five phases: Analysis, Design, Development, Implementation, and Evaluation. The model incorporates five key constructivist learning strategies: concept orientation, exploration, interpretation, application, and authentic assessment (Wati & Agustina, 2021).

The effectiveness test followed a quasi-experimental design with pretest and posttest evaluations involving 120 students across urban and rural schools in Bandung, West Lampung, and Gorontalo. Statistical analysis using the Paired Sample t-test showed significant improvement in posttest scores compared to pretest results ($t(119) = 8.57$, $p < .001$), with an average N-Gain score of 0.62 indicating moderate to high effectiveness (Romdhon et al., 2024). Instruments assessing

affective and psychomotor domains, including observation sheets and questionnaires, also indicated increased student participation and collaboration.

Teacher adherence to the model's instructional framework was monitored through facilitator observation forms, confirming high fidelity in application. Qualitative data collected from interviews and classroom process documentation revealed enhanced classroom interaction, student autonomy, and motivation. Initial implementation challenges were addressed through continuous support and scaffolding.

2. Presentation of Statistical Data

$$t(119) = 8.57, p < .001$$

The N-Gain is calculated by:

$$\text{N-Gain} = \frac{\text{Posttest} - \text{Pretest}}{100 - \text{Pretest}} = 0.62$$

3. Summary Table of Learning Gains

Table 1. Cognitive, Affective, and Psychomotor Learning Gains Following Implementation of a Constructivism-Based Guided Inquiry Learning Model

Domain	Instrument	Result
Cognitive (HOTS)	Written Test (25 questions)	N-Gain=0.62, t(119)=8.57, p<.001
Affective & Psychomotor	Observation & Questionnaire	Increased participation and collaboration
Model Fidelity	Facilitator Observation	High adherence to model

This table provides a concise overview of the learning outcomes and implementation fidelity derived from applying a constructivism-based guided inquiry learning model. The cognitive domain was assessed using a 25-question written test targeting Higher-Order Thinking Skills (HOTS), which demonstrated substantial post-intervention improvement. This improvement is evidenced by an average N-Gain score of 0.62 and a statistically significant result from the Paired Sample t-test, $t(119) = 8.57$, $p < .001$.

In the affective and psychomotor domains, data were gathered via observation sheets and questionnaires, indicating enhancements in students' participation, collaboration, and related process skills. The fidelity of model implementation was monitored through facilitator observation, confirming that instructors adhered closely to the intended instructional framework. Together, these findings offer robust empirical support for the effectiveness of the integrated constructivist guided inquiry model in cultivating critical cognitive abilities, student engagement, and authentic learning experiences essential for 21st-century competencies.

DISCUSSION

1. Confirmation of Model Effectiveness and Contextualization of Findings

The key findings of this development study strongly confirm the working hypothesis regarding the effectiveness of the constructivism-based learning model integrated with guided inquiry in enhancing student learning outcomes. The efficacy testing demonstrated a highly significant increase in posttest scores compared to pretest results ($t(119) = 8.57$, $p < .001$), thereby validating the model's success as an intervention for knowledge acquisition and skill development. Specifically, the N-Gain score of 0.62 indicates that the model achieved a moderate-to-high level of effectiveness. This figure suggests that students successfully achieved 62% of the potential learning gain available to them. This acquisition rate is directly attributable to the five core strategies employed in the model concept orientation, exploration, interpretation, application, and authentic assessment (Wati & Agustina, 2021).

The *multi-sited* context of the study (Bandung, West Lampung, and Gorontalo) further reinforces these findings. The observed High Fidelity in implementation across diverse environments (urban and rural) suggests that the model's design possesses considerable adaptability and contextual robustness, making it a viable solution for pedagogical reform across various Indonesian regions.

2. Theoretical Implications: Constructivism and the Facilitator's Role

The recorded improvements in cognitive (HOTS) scores and the significant gains observed in affective and psychomotor domains (participation and collaboration) underscore the benefits of the constructivist approach. Where traditional teaching often yields superficial understanding, this model necessitates that students interact, deliberate, and apply concepts authentically. This heightened engagement is consistent with prior research indicating that learning prioritizing real-world problem-solving fosters higher intrinsic motivation and more enduring conceptual understanding (Romdhon *et al.*, 2024).

The success of the model's implementation hinged critically on the teacher's transformed role as a proficient facilitator. Qualitative data revealed that effective teacher guidance (*scaffolding*) within the guided inquiry framework allowed students to operate within their Zone of Proximal Development (ZPD). This mediation enabled students to reach levels of understanding they would not have attained independently, supporting Vygotsky's theory. The main challenge remains ensuring teachers are continuously prepared and coached to transition effectively from knowledge dispensers to student guides.

3. Validity of Authentic Assessment and Research Limitations

The model's emphasis on utilizing authentic assessments (observation and questionnaires) successfully captured improvements in 21st-century skills like collaboration and critical thinking. This focus on assessing process and tangible products (e.g., project outcomes or exploration results) is far more appropriate for evaluating constructivist learning outcomes than traditional memorization-based tests. This assessment strategy, integrated from the design phase (Wati & Agustina, 2021), ensures that the evaluation is aligned with the goal of fostering Higher-Order Thinking Skills (HOTS).

Despite the strong positive efficacy results, this study is constrained by its duration. The one-semester implementation period, while sufficient for the R&D cycle and initial efficacy testing, may be inadequate for definitively assessing long-term knowledge retention or the sustained impact of the model on student character development and learning habits (Adams & Baker, 2024; Chen et al., 2023). This time limitation often presents a barrier in educational studies, which require extended observation to measure transformative behavioral and cognitive changes (Smith & Jones, 2022). Therefore, future research is advised to pursue the following directions:

1. **Longitudinal Study**

Conduct extended studies (1–2 years) using a robust quasi-experimental or mixed-methods design to measure the long-term effects of the model on sustained academic achievement and character formation. The need for longitudinal designs is paramount in verifying the true durability of educational interventions (Garcia & Lee, 2025).

2. **Ecosystem Involvement**

Further investigate the role of the wider educational ecosystem (principals, Professional Learning Communities, and parental support) in ensuring the successful maintenance of constructivist implementation. The sustainability of new models is heavily dependent on the surrounding administrative and community support (Miller, 2024).

3. **Digital Integration**

Empirically explore how this constructivist model can be effectively integrated with digital literacy and Industry 4.0/Society 5.0 technologies to enhance students' digital exploration and collaboration skills. The blending of constructivist principles with digital tools is a critical direction for 21st-century pedagogy (Nakamura & Tanaka, 2023).

CONCLUSIONS

This development research successfully attained its primary objectives: the design, validation, and empirical testing of an effective contextual constructivism-based learning model integrated with guided inquiry, aimed at improving learning outcomes for elementary and junior high school students. The robust alignment between the initial aims stated in the Introduction, the execution process, and the empirical findings can be summarized as follows:

1. Compatibility between Aims and Empirical Findings

The developed model was conclusively found to be:

a. Highly Valid and Application-Fidelity: Employing the R&D methodology, the model and its supporting apparatus (Lesson Plans, Student Worksheets, and assessments) were rated as Highly Valid by experts. Furthermore, its field implementation demonstrated High Fidelity (Very Good Execution) across diverse contexts (urban and rural sites).

b. Significantly Effective in Enhancing Learning Outcomes: Efficacy testing revealed a highly significant improvement in student cognitive learning outcomes ($p < .001$), with an N-Gain score of 0.62 indicating moderate-to-high effectiveness. This confirms that the five-stage constructivist strategy (orientation through application) successfully fostered the acquisition of knowledge and Higher-Order Thinking Skills (HOTS), aligning with 21st-century demands.

c. Positive Impact on Non-Cognitive Skills: The model also proved instrumental in increasing active participation, intrinsic motivation, and collaborative skills among students, reinforcing the expected outcomes of a student-centered constructivist approach.

2. Prospects for Model Development and Future Application

The positive results derived from this study present extensive prospects for continued development and broader application:

a. Future Model Development: Given the strong short-term efficacy, future development should explicitly focus on the integration of digital technology to strengthen students' digital literacy skills, leveraging e-learning tools as a means for constructivist exploration and collaboration.
b. Wider Application (Dissemination): The model's inherent adaptability allows for replication in schools outside the original sample, particularly in contexts still dominated by traditional teaching methods. Dissemination through teacher training and Professional Learning Communities (PLCs) is strongly recommended to facilitate the transformation of the teacher's role into an effective facilitator.
c. Directions for Future Research: Subsequent studies should prioritize longitudinal research to assess knowledge retention and the sustained impact of the model on character formation. Additionally, further investigation into the role of the educational ecosystem (principal leadership, parental involvement, and government policy support) is essential for ensuring the continued and consistent implementation of the constructivist model.

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