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The Impact of Banathy Instructional Design Model and Motivation on Science Learning Outcomes in Fourth-Grade Students

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Abstract: This study addresses the problem of low science learning outcomes among elementary students by examining whether the Banathy Instructional Design Model can improve performance across different motivation levels. The objective was to compare the effects of the Banathy model and conventional instruction on fourth-grade students' science learning outcomes while also analyzing the interaction between instructional model and student motivation. A quasi-experimental design with a nonequivalent control group was employed, involving one experimental group taught using the Banathy model and one control group receiving conventional instruction. Data on learning outcomes were collected through a standardized posttest and analyzed using comparative statistical techniques. The results show that students in the experimental group achieved significantly higher science learning outcomes than those taught conventionally. Further analysis indicates that the Banathy model benefits both high- and low-motivation students, although highly motivated students demonstrate the greatest improvement. Notably, even students with lower motivation exhibited better performance when taught using the Banathy model. These findings suggest that the Banathy Instructional Design Model is effective for heterogeneous classrooms and can enhance science learning outcomes regardless of students' initial motivation levels.

Keywords: Banathy model; Elementary education; Instructional design; Learning motivation; Science outcomes

Introduction

Education is a fundamental pillar of constructing a knowledgeable and quality generation (Siswopranoto, 2022). One of the critical issues affecting success in education is the instructional design underpinning learning. The Banathy Instructional Design Model offers a system-based design whereby educators are urged to take into account the relationships between various components in the learning processes, such as objectives, content, methods, and evaluation (Branch, 2016). This approach integrates and holistically considers learning, ultimately enhancing the learning outcome of students, especially in Natural Science at the elementary level (Ilfah et al., 2025).

Motivation is the key that helps to sustain learning success. Meisahro et al. (2022) showed that motivation from parents can influence students' learning outcomes in natural science subjects at the elementary level. This is also parallel to findings by Chai et al. (2021), who asserts that intrinsic motivation is vital to enhancing academic accomplishment in subjects that are particularly difficult and require deep understanding, such as natural science (Leenknecht et al., 2020; Rinjani et al., 2022). Motivation stemming from personal value and internal goals is particularly important for

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persistence and the use of complex learning strategies (Ai, 2025; Howard et al., 2021).

In the broader theoretical landscape, effective instructional design is strongly grounded in systems theory, which posits that learning outcomes are shaped by the dynamic interaction among instructional components (Reigeluth & Carr-Chellman, 2009). This perspective aligns with Banathy's view that education functions as an interconnected system in which modifying one element, such as content structure, learning activities, or assessment procedures, affects the overall learning process. In addition, motivation theory, particularly Self-Determination Theory, emphasizes that students' competence, autonomy, and relatedness significantly influence their engagement and academic performance (Ryan & Deci, 2020). When instructional design is structured systematically and supports students' psychological needs, it not only facilitates deeper understanding but also strengthens intrinsic motivation, thereby maximizing the potential for improved academic achievement (Thakur et al., 2021). These theoretical perspectives jointly support the integration of instructional design and motivation as complementary factors in enhancing science learning outcomes (Hala & Xhomara, 2024).

In their studies, however, the achievement level in learning outcomes of the fourth graders of Gugus IV, Banuhampu District was observed to be low. From the Mid-Semester Assessment administered by the educators, most of the students scored below the mastery score set at the minimum passing grade of 70. The majority of the students scored an average of only 62 to 65, which suggests a gap between the desired learning objectives and the actual learning outcome shown in Table 1. Therefore, more effort is required for improving the quality of learning in natural science from the perspective of both instructional design and motivation of the learner (Ntuli et al., 2022).

Table 1. Mid-Semester Assessment for Natural Science Learning in Grade IV of SDN Gugus IV Banuhampu District

School Name	Grade	Number of Students	Average Score	Completed	Not Completed
SDN 03 Cingkariang	IV	18	65.51	8	10
SDN 18 Ladang Laweh	IV	21	62.24	12	9
SDN 13 Cingkariang	IV	20	63.06	8	12
SDN 01 Gobah	IV	16	64.26	7	8
SDN 14 Parik Lintang	IV	14	62.46	8	7

Source: Head of Gugus IV Kubang Putiah, Banuhampu District, Agam Regency

Based on this data, it can be seen that the majority of students do not meet the established Mastery Learning Criteria. This indicates an improvement needed in the approach of teaching towards the use of learning design model which optimistically motivates and engages students more in their natural science learning process (Park et al., 2022). Shifting from conventional to more interactive, student-centered learning design models can substantially enhance mastery and motivation in natural science learning (Cardenas et al., 2022; Muhlisin, 2019). The quality learning outcomes can be enhanced through the Banathy Instructional Design Model as such a model supports an integrated system where each of the elements in the learning process will contribute towards achieving a broader goal (Liana & Silitonga, 2021). According to Saçak et al. (2022), a good instructional design will ensure that learning does not solely rely on content but also considers how students engage in the learning process.

In addition to the above, the Banathy Instructional Design Model also plays an important role in the quality assurance of teaching and learning through a well-designed framework for the educators (Maming et al., 2020). A systematic approach toward instructional design is captured under the Banathy model where each of the components of the learning process such as goals, content, methods, and evaluation works together to create a cohesive learning experience (Kusnadi & Bilhaq, 2025). The model is grounded under the concept of viewing education in interconnected systems, which enables holistic and integrated learning experiences (Yuliana, 2021). From here, by focusing on the relations between these elements, Banathy's model would encourage the creation of a more interactive and engaging learning environment, improving student motivation and facilitating much deeper learning where learning is more worth doing (Dormann et al., 2017).

In learning sciences, motivation plays an increasingly important role. Afiqah et al. (2022) said that high intrinsic motivation could bring improvement in students' learning outcomes in the aspects of understanding and application of scientific concepts. Henceforward, designing effective instruction should take motivational factors into consideration, thus keeping students interested and active in the process of learning (Urhahne & Wijnia, 2023). The systematic approach in designing instruction is what Banathy proposed, ensuring that all components of the learning process are well coordinated and working to achieve optimal learning outcomes. Integrative between different methods of learning such as problem-based learning, which encourages students to think critically and solve problems in real-world contexts (Rifai et al., 2023), is part of this model.

Hence, the study intends to know how Banathy's instructional design model and motivation combined would influence the learning results of fourth graders in natural science. It is hoped that this research would provide a deeper understanding of the effective means of improving natural science learning outcomes through a formal structured approach on instructional design and strong student motivation.

Method

Time and Location of the Research

This study was conducted during the 2024/2025 academic year in SD Negeri Gugus IV Banuhampu, Agam Regency, Indonesia. The experimental class was located at SDN 18 Ladang Laweh, while the control class was located at SDN 14 Parik Lintang.

Population and Sample

The population consisted of all fourth-grade students in SD Negeri Gugus IV Banuhampu. The sample was selected purposively based on class characteristics relevant to the study. The experimental group comprised 14 students from SDN 18 Ladang Laweh, who were taught using the Banathy Instructional Design Model. The control group included 17 students from SDN 14 Parik Lintang, who received conventional instruction. Both groups were taught by educators of similar qualifications and followed the same curriculum.

Type of Research

This research employed a quantitative quasi-experimental design, where the researchers did not have full control over extraneous variables (Auliya et al., 2020). The study used the Nonequivalent Posttest-Only Control Group Design to examine differences in learning outcomes between two non-randomized groups.

Research Design

The experimental group implemented the Banathy Instructional Design Model, while the control group used a conventional learning model. The design structure is shown in Table 2.

Table 2. Research Design

Class	Treatment	Posttest
Experimental	X	O
Control	-	O

Notes:
X : Banathy Instructional Design Model
- : Conventional learning model
O : Final learning outcomes test

To further explore interactions among variables, a 2 × 2 factorial design was applied, combining the instructional model (A) with learning motivation (B). The factorial matrix is presented in Table 3.

Table 3. The Factorial Design

Motivation (B)	Banathy Instructional Design Model (A_1)	Conventional (A_2)
High (B_1)	A_1B_1	A_2B_1
Low (B_2)	A_1B_2	A_2B_2

Notes:
A_1B_1: Learning outcomes of students using the Banathy Instructional Design Model with high motivation
A_1B_2: Learning outcomes of students using the Banathy Instructional Design Model with low motivation
A_2B_1: Learning outcomes of students using the conventional model with high motivation
A_2B_2: Learning outcomes of students using the conventional model with low motivation

In this design, the independent variable is the Banathy Instructional Design Model, the moderator variable is learning motivation, and the dependent variable is learning outcomes.

Research Stages

The procedures of this study followed several sequential stages. The preparation stage involved reviewing curriculum content, developing the research instruments, and determining the experimental and control classes. This was followed by the implementation stage, in which the Banathy Instructional Design Model was applied in the experimental class, while the control class continued with the conventional instructional model. During the data collection stage, learning outcomes tests and learning motivation questionnaires were administered to both groups. The data verification stage included checking the validity and reliability of the instruments and ensuring the completeness of the collected data. Finally, in the data analysis stage, test scores and questionnaire results were processed using statistical procedures appropriate to each hypothesis.

Research Instruments

The instruments consisted of learning outcomes tests and learning motivation questionnaires. The test measured students' cognitive abilities and was developed based on a blueprint aligned with the science curriculum. The questionnaire assessed students' motivation levels related to the learning process.

Data Analysis

The data consisted of test scores and motivation questionnaire scores. To analyze the first three hypotheses, t-tests were used for comparing means between two groups. When the data met assumptions of normality and homogeneity, a standard t-test was conducted. For non-homogeneous data, a t'-test was applied. If the data were not normally distributed, the Mann-Whitney U test was used. The fourth hypothesis examined the interaction between the Banathy Instructional Design Model and learning motivation on learning outcomes; therefore, ANOVA was performed. All analyses were conducted using Minitab, following checks for normality and homogeneity.

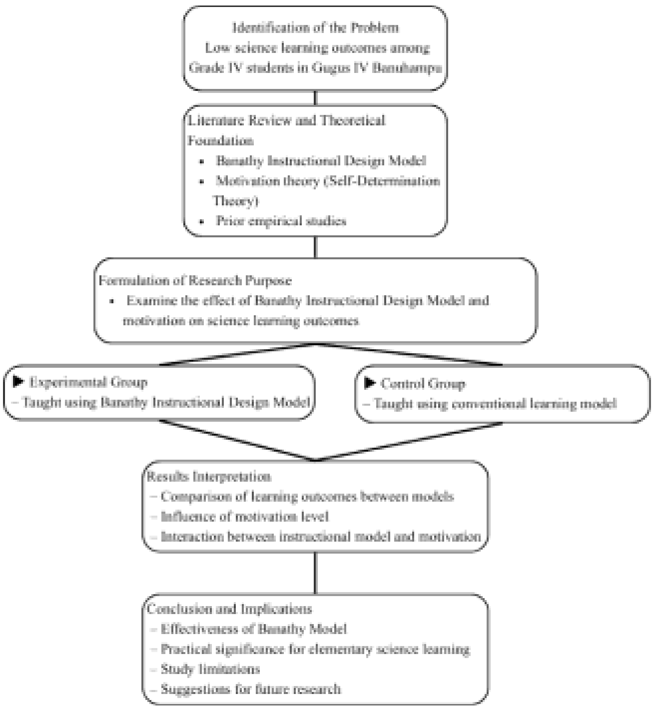

Figure 1. Flowchart of the research procedure

Result and Discussion

The research results focus on the final test scores of science learning from both the experimental and control groups, differentiated by students' learning motivation. Below is the description of the data from the study.

Description of Research Data

Science Learning Outcomes in the Experimental and Control Classes

The learning outcomes of students in the experimental and control classes were analyzed in terms of average, median, mode, standard deviation, variance, minimum, and maximum values. The summary of the results is shown in Table 4.

Table 4. Descriptive Statistics of Students' Learning Outcomes in the Experimental and Control Classes

Statistic	Experimental Class	Control Class
Average	84.05	73.53
Median	86.67	73.33
Mode	86.67	70
SD	9.08	14.21
Variance	82.36	202.04
Minimum	70	50
Maximum	100	100

Based on the descriptive analysis of the data in Table 4, there is a noticeable difference in the learning outcomes between the experimental and control groups. The experimental class, taught using the Banathy Instructional Design Model, achieved a higher average score (84.05) compared to the control class (73.53). The median score in the experimental class was 86.67, while the control class had a median of 73.33, indicating more consistent high scores in the experimental group. Furthermore, the standard deviation in the experimental class (9.08) was lower, showing more uniform results compared to the control class, which had a higher standard deviation (14.21), reflecting more varied performance. Despite the differences, both classes had the same maximum score of 100, indicating that students from both groups achieved the highest possible score.

Science Learning Outcomes Based on High Learning Motivation

The analysis of students' learning outcomes based on high motivation is shown in Table 5.

Table 5. Descriptive Statistics of Science Learning Outcomes Based on High Motivation

Statistic	Experimental Class	Control Class
Average	93.33	84
Median	93.33	83.33
Mode	93.33	80
SD	5.44	5.48
Variance	29.61	30
Minimum	86.67	80
Maximum	100	93.33

As seen in Table 5, students with high motivation in the experimental class showed better learning outcomes compared to those in the control class. The experimental class had a higher average score (93.33) compared to the control class (84.00). The mode and median values for the experimental class were both 93.33, reflecting a more concentrated distribution of high scores. Although the standard deviations and variances were similar, the experimental group maintained a higher minimum score (86.67) and a perfect maximum score of 100, unlike the control class.

Science Learning Outcomes Based on Low Learning Motivation

The descriptive statistics for students with low motivation are presented in Table 6.

Table 6. Descriptive Statistics of Science Learning Outcomes Based on Low Motivation

Statistic	Experimental Class	Control Class
Average	74.67	60
Median	73.33	58.33
Mode	70	70
SD	5.58	8.94
Variance	31.11	80
Minimum	70	50
Maximum	83.33	70

In Table 6, the results for students with low motivation indicate that the experimental class outperformed the control class, with an average score of 74.67, compared to 60.00 in the control class. The variance and standard deviation in the experimental class were lower, suggesting more consistent academic performance. Despite having a similar mode (70.00), the control class had a wider spread of scores, with a higher standard deviation (8.94) and variance (80.00). The experimental group achieved a higher minimum score (70.00) and a higher maximum score (83.33) compared to the control class, where the maximum score was only 70.00.

Data Analysis Prerequisites Testing

Before analyzing the data using t-tests, normality and homogeneity tests were performed. Normality was tested using the Anderson-Darling test, while homogeneity was tested using the F-test at a 5% significance level. The results for both tests are presented in the following tables.

Normality Test

The Anderson-Darling test was used to assess whether the data followed a normal distribution. The results, summarized in Table 7, show that the data for both groups are normally distributed, as all P-values exceed 0.05.

Table 7. Results of the Normality Test for Learning Outcomes

Class	Motivation	P-value	Description
Experimental	High	0.41	Normal
	Low	0.331	Normal
	Overall	0.485	Normal
Control	High	0.057	Normal
	Low	0.166	Normal
	Overall	0.85	Normal

Homogeneity Test

The homogeneity test using the F-test indicated that there is no significant difference in variance between the experimental and control classes, as shown in Table 8. All P-values are greater than 0.05, confirming that the data in both groups are homogeneous.

Table 8. Results of the Homogeneity Test for Learning Outcomes

Creativity	P-value	Description
Learning Outcome (Overall)	0.945	Homogeneous
High Motivation	0.483	Homogeneous
Low Motivation	0.809	Homogeneous

Hypothesis Testing

Based on the normality and homogeneity test results, the data were eligible for analysis using parametric t-test procedures. The first hypothesis inquired whether there is a difference in the way both experimental groups (Banathy Instructional Design Model) and control groups (conventional learning model) would produce learning outcomes. A t-test was performed, which revealed the t-value of 2.39 and p-value of 0.012, which indicates that the null hypothesis was rejected; therefore, the experimental group performed significantly better in generating learning achievements compared to the control group. These research findings have shown that students taught under the Banathy instructional design model had better science learning outcomes than those under conventional learning. This indicates that Banathy's systemic view is valid; that is, objectives, evaluation, and learning activities start as an interlinked cycle. The design allows a lot of structure into what would otherwise have been poorly defined learning so that formative evaluation permitted ongoing revision of students' understandings throughout the learning process.

The previous research offers compelling evidence of technology-assisted learning providing substantial improvement in students' learning outcomes (Bentri et al., 2022). Involving students actively through discussions, observations, and reflections, Banathy's instructional design encourages the deeper understanding of content and fosters critical thinking and collaboration skills (Ilfah et al., 2025). A high efficacy of Banathy's instructional design comes from providing clear parameters for systematically developing pedagogical needs from the formulation of learning objectives, through goal-based assessment tools, to an instructional system that meets students' needs (Setyawan & El Hakim, 2023).

The second would test whether there is a difference between experimental and control learning outcomes of high-motivated students. Using the information derived, t value achieved was 2.55 while p-level was at 0.019, which rejected the null hypothesis. Hence, it was inferred that the Banathy Instructional Design Model is significantly better in increasing learning achievements among high-motivated students than the conventional model. Students exhibiting a high motivation for learning who had engaged in learning through the Banathy instructional design model gained a better achievement in science learning than those following conventional learning.

Banathy's instructional design is very responsive to student characteristics, such as the motivation to learn, thus promoting actualization of their critical and reflective thinking potential (Salfia & Afandi, 2025). This study shows how motivation-sensitive learning can lead to deeper and more meaningful learning experiences (Aminah, 2023; Mufidah & Sartika, 2025). The Banathy model that is responsive to learning motivation not only enhances students' potentials but also enrich the learning journey with constructive reflections and feedbacks (Gunada, 2021). It is this design that optimally learns high-motivated students through pertinent and adaptive learning experiences.

The third hypothesis poses the difference in learning outcomes for students with the Banathy Instructional Design Model and for students who study using the traditional learning model. Analysis yielded a t-value of 3.17 and a p-value of 0.006, indicating rejection of the null hypothesis. This suggests that students who are lowly motivated gain significantly high learning outcomes from the Banathy Instructional Design Model than from conventional learning models.

The study also revealed that students with poor motivation learned more through the Banathy instructional design model than through conventional learning in which all students were enrolled in Science subjects. The systematic approach of the Banathy model also keeps students with low motivation in the learning process by clearly structuring learning, encouraging them to focus on learning and motivate them toward their learning goals (Hasnah et al., 2021). Problem-based learning and activities associated with one's day-to-day life tend to help in lowering the barriers that come in place due to motivation and getting students involved in learning (Maulidia et al., 2019). The Banathy model does well in really making learning more fun and less burdensome even for the highly disinterested students because of its very flexible learning structure (Damayanti, 2022). Education is very much effective when the right strategies of learning are used, such that they help students understand or apply information better. Therefore, such strategies should be identified along with learning objectives and student needs at the beginning of learning (Sabila & Rahmalia, 2024).

The fourth hypothesis investigated the interaction of the Banathy Instructional Design Model with motivation on students' learning outcomes. The two-way ANOVA results show no significant interaction, with an F-value of 0.53, which is lower than the F-table value of 3.39, further confirming that the Banathy Instructional Design Model is as effective for high and low-motivated students. Where the results of two-way ANOVA stress the absence of significant interaction between the application of the Banathy Instructional Design Model and learning motivation on science learning outcome, such result implies that the effect of Banathy instructional design on learning outcome is steady irrespective of students' motivation per se-whether high or low. It witnessed a flexible yet adaptive implementation such that under no circumstances would this model be detrimental to the learning outcomes, rather such outcomes would be enhanced irrespective of variable student motivation (Giasiranis & Sofos, 2020; Wang et al., 2024). Furthermore, the absence of interaction suggests that there need not exist a motivation barrier against implementing the Banathy instructional design. All in all, this model can be applied in a uniform manner in heterogeneous classrooms without compromising its effectiveness in improving learning outcomes (Andini et al., 2020; Pratiwi & Maftujianah, 2023). The applicability of this study also reinforces that the Banathy model promotes inclusive and adaptive learning environments and is strategically focused on improving science learning outcomes in elementary schools. The absence of interaction strengthens the argument that the Banathy model can be applied across different motivation levels without diminishing its effectiveness (Suparti & Netriwati, 2021).

Conclusion

This study concludes that the Banathy Instructional Design Model effectively enhances science learning outcomes for fourth-grade students, as evidenced by significantly higher achievement among those taught with the model compared to conventional instruction, with both highly motivated and low-motivated students benefiting from its structured, systematic, and needs-based approach. Although no significant interaction was found between learning motivation and the model, the findings suggest that the Banathy model can be applied effectively in heterogeneous classrooms regardless of motivational differences, supporting broader instructional inclusivity. These results imply that systematic instructional design has strong potential to strengthen cognitive development in elementary science learning, yet the study remains limited by its quasi-experimental design, small sample size, and focus on a single school cluster, which may constrain generalizability. Future research should expand to larger and more varied populations, explore applications across different subjects and educational levels, and investigate how specific components of the Banathy model contribute to deeper conceptual understanding. Overall, this study reinforces the value of the Banathy Instructional Design Model as a promising and adaptable framework for improving learning outcomes while highlighting the need for continued examination of its long-term and cross-context impacts.

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Author Contributions
Susi was responsible for the conceptualization and design of the study, including data analysis and interpretation. Darmansyah, Alwen Bentri, and Zuwirna contributed valuable feedback during the methodology development and results interpretation, ensuring the robustness and quality of the research.

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The authors declare no conflict of interest.

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