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The Effect of The Implementation of The Discovery Learning Model on Students Economic Learning Outcomes on The Characteristics of Entrepreneurship in Grade X IPS

Erlina Sari¹, Samakmur², Sri Hartini³, Marissa Hutabarat⁴

¹Universitas Graha Nusantara, North Sumatra, Indonesia, ²Universitas Muhammadiyah Tapanuli Selatan, North Sumatra, Indonesia, ³⁴Institut Pendidikan Tapanuli Selatan, North Sumatra, Indonesia

Correspondence: harahaperlinasari80@gmail.com¹

Abstract

This study examined whether implementation of the Discovery Learning instructional model was associated with improved economics learning outcomes on entrepreneurial characteristics among tenth-grade social science students at Madrasah Aliyah Nahdlatul Ulama Batangtoru. A pre-experimental one-group pretest-posttest design was employed with a sample of 35 students (total population). The intervention consisted of four 90-minute sessions over two weeks, applying the six-stage Discovery Learning framework (stimulation, problem statement, data collection, data processing, verification, and generalization). Data were collected through observations, a validated 25-item multiple-choice test, and documentation. Because pretest and posttest scores were not normally distributed (Shapiro-Wilk $p = 0.039$ and $p < 0.001$, respectively), the Wilcoxon signed-rank test was applied. Results showed $Z = -5.175$ and Asymp. Sig. (2-tailed) = 0.001. Since $p < 0.05$, the null hypothesis was rejected. Posttest scores ($M = 93.71$, $SD = 5.47$) were significantly higher than pretest scores ($M = 49.43$, $SD = 13.44$), with 33 of 35 students (94.3%) meeting the Minimum Completion Criteria compared to only 15 students (42.86%) at pretest. While these findings suggest that Discovery Learning was associated with improved learning outcomes, causal attribution remains limited by the absence of a control group and other threats to internal validity inherent in the one-group pre-experimental design.

KEYWORDS

discovery learning model; learning outcomes; entrepreneurship characteristics material.

Introduction

Education fundamentally transforms learners' behaviors, guiding them toward self-reliance and effective participation in society (Abzhanova et al., 2025). A primary function of education is to develop individuals of strong character who master science and technology while maintaining spiritual faith. Education directs the growth of personal abilities in response to environmental demands (Asdi et al., 2025; Rubiné, 2025).

Learning outcomes represent measurable academic progress students make through examinations, assignments, and active classroom participation. Indicators of successful learning include students' capacity to absorb content and demonstrate behavioral changes (Herviana, 2025). According to Syahr et al. (2025), learning outcomes encompass patterns of behavior, values, understandings, attitudes, appreciation, and skills. A learning process is deemed successful when students achieve or exceed the Minimum Completion Criteria (KKM) (Juang Kurniawan, 2025; Syahr et al., 2025). A learning process is deemed successful when students achieve or exceed the Minimum Completion Criteria (KKM), particularly for the topic of entrepreneurial characteristics (Khvedelidze et al., 2025).

Initial observations and interviews on January 31, 2025, with the economics teacher for class X IPS at Madrasah Aliyah Nahdlatul Ulama Batangtoru revealed that many students struggle to understand economics, especially entrepreneurial characteristics (Yasa et al., 2023). Consequently, learning outcomes remain low. Of 35 students, only 15 (42.86%) met the school's KKM of 75, while 20 (57.14%) did not (source: grade records for the 2023/2024 academic year). This situation confirms that economics learning outcomes—particularly for entrepreneurial characteristics—are unsatisfactory (Onwadi, 2023). The underlying problems include students' lack of interest in economics, partly because teachers rely solely on lecture methods without employing effective learning models, leading to boredom and fatigue during lessons (Yasa et al., 2023). Consequently, learning outcomes remain low. Of 35 students, only 15 (42.86%) met the school's KKM of 75, while 20 (57.14%) did not (source: grade records for the 2023/2024 academic year).

This situation confirms that economics learning outcomes—particularly for entrepreneurial characteristics—are unsatisfactory (Onwadi, 2023). The underlying problems include students' lack of interest in economics, partly because teachers rely solely on lecture methods without employing effective learning models, leading to boredom and fatigue during lessons (Azzahra et al., 2025).

To improve learning outcomes, teachers have attempted remedial instruction and revised classroom strategies. One promising approach is the Discovery Learning model, which can boost student enthusiasm and motivation, foster independent learning, encourage initiative, promote objectivity and honesty, and aid memory transfer to new learning situations (Novitasari et al., 2022; Yasin, 2023).

Nurbiana (2022) describes Discovery Learning as a method that prompts students to draw conclusions from their own observations (Nurbiana, 2022). Similarly, Wiguna (2025) notes that this model allows students to discover new rules and ideas rather than merely memorizing teacher-delivered information (Wiguna, 2025). Additionally, Mujahidin et al. (2025) argue that Discovery Learning enhances students' emotional and spiritual intelligence by encouraging them to discover principles for themselves, thereby sustaining curiosity until answers are found (Agartsupa et al., 2025a; Mujahidin et al., 2025).

Theoretical Framework

The theoretical foundation for this study rests on constructivist learning theory, particularly Jerome Bruner's Discovery Learning model. The learning is an active process in which learners construct new ideas or concepts based upon their current and past knowledge. Discovery Learning, as articulated by Bruner, emphasizes that students should be encouraged to discover facts and relationships for themselves rather than having information presented didactically. This approach aligns with Piaget's cognitive constructivism in Hayat et al (2024), which posits that knowledge is constructed through assimilation and accommodation of new experiences, and Vygotsky's social constructivism, which emphasizes the role of social interaction and scaffolding in learning (Hayat et al., 2024).

Discovery Learning is characterized by: (1) exploring and solving problems to create, combine, and generalize knowledge—students take initiative to investigate lessons and draw their own conclusions (Agartsupa et al., 2025b; Putra, R. A., & Cimari, 2024); (2) student-centered learning, where learners play active, independent roles while teachers act solely as facilitators (Howard Kerr, 2025); and (3) connecting new knowledge with prior knowledge through creative and imaginative efforts (Irvan Irvani & Agus, 2024). (Iskandar, 2025) outlines six implementation stages: (a) stimulation, (b) problem statement, (c) data collection, (d) data processing, (e) verification, and (f) generalization. These steps were

incorporated into economics lessons on entrepreneurial characteristics, which include: (a) types/dimensions of entrepreneurship, (b) entrepreneurship development, (c) characteristics of an entrepreneur, and (d) entrepreneur success and failure.

Research Gap and Novelty

Previous research by Sari et al. (2025) on the effect of Discovery Learning on student activity and learning outcomes in grade X economics at SMA Negeri 1 Godean found significant differences between experimental and control classes (Asymp. Sig. 2-tailed = 0.000), indicating that Discovery Learning produced more active students than conventional methods (Sari et al., 2025). However, several gaps remain unaddressed in the existing literature. First, most Discovery Learning studies in economics education have been conducted in general high school settings rather than in Madrasah Aliyah (Islamic senior high school) contexts, where pedagogical approaches may differ due to religious and cultural factors. Second, prior research has primarily examined Discovery Learning's effects on general economics content rather than specifically on entrepreneurial characteristics material, which requires different instructional considerations given its practical, skill-oriented nature. Third, few studies have systematically documented implementation fidelity of the Discovery Learning stages, making it difficult to determine whether observed effects are attributable to the model itself or to other instructional variations. Fourth, the present study contributes preliminary pretest-posttest evidence in a specific rural Indonesian setting Batangtoru, South Tapanuli, providing contextual evidence that may inform local curriculum decisions while acknowledging the limitations of the pre-experimental design.

Research Aim

The present study aims to determine whether a significant difference exists in student learning outcomes on entrepreneurial characteristics before and after implementing the Discovery Learning model for class X IPS at Madrasah Aliyah Nahdlatul Ulama Batangtoru. Specifically, this study seeks to provide empirical evidence on the association between Discovery Learning implementation and improvements in economics learning outcomes in a rural Madrasah Aliyah context, while acknowledging that causal inference is limited by the one-group pretest-posttest design. The research question guiding this study is: Is there a statistically significant difference between pretest and posttest scores on entrepreneurial characteristics material following implementation of the Discovery Learning model?

Methods

Research Design

This study employed a quantitative research approach with a pre-experimental design, specifically the one-group pretest-posttest design. This design was selected because it allows researchers to measure the effect of a treatment (intervention) on a single group by comparing participants' scores before and after the intervention, without the need for a separate control group (Creswell, 2021). The one-group pretest-posttest design is appropriate for educational settings where random assignment is impractical or where the population is small and intact classes must be used. In this study, the treatment consisted of implementing the Discovery Learning model in economics lessons focused on entrepreneurial characteristics. The pretest measured students' baseline knowledge, while the posttest assessed their knowledge after the intervention. Any significant improvement between the two measurements could be attributed to the treatment, provided that extraneous variables are minimized.

The choice of a pre-experimental design was also influenced by the natural classroom setting at Madrasah Aliyah Nahdlatul Ulama Batangtoru, where only one class of tenth-grade social science (X IPS) students existed. Therefore, forming an equivalent control group was not feasible without disrupting normal school operations. Despite its limitations such as the absence of a control group and potential threats to internal validity including history, maturation, and testing effects the one-group pretest-posttest design remains widely used in preliminary educational research to obtain initial evidence of an intervention's effectiveness (Cohen, L., Manion, L., & Morrison, 2022). The researchers took steps to mitigate validity threats, as described in the procedures section.

Location and Time of the Study

The research was conducted at Madrasah Aliyah Nahdlatul Ulama Batangtoru, a senior high school located in Batangtoru, South Tapanuli Regency, North Sumatra, Indonesia. The school was selected purposively because preliminary observations indicated persistently low student learning outcomes in economics, particularly on the topic of entrepreneurial characteristics, and because the economics teacher had expressed willingness to collaborate in implementing the Discovery Learning model. The study took place during the even semester of the 2024/2025 academic year, specifically over four weeks from February to March 2025. The timeline included one week for pretesting, two weeks for the intervention (four class meetings of 90 minutes each), and one week for posttesting and data collection.

Population and Sample

The target population of this study was all tenth-grade social science (X IPS) students at Madrasah Aliyah Nahdlatul Ulama Batangtoru enrolled in the 2024/2025 academic year. The accessible population comprised a single intact class of 35 students, consisting of 19 female and 16 male students, aged 15–16 years. Because the population was relatively small and the class could not be divided without disrupting the school's curriculum, the researchers employed a total sampling technique (also known as census sampling). Thus, the sample was identical to the population: all 35 class X IPS students participated in the study. No random selection or random assignment was applied, consistent with the pre-experimental design. All students were present during both the pretest and posttest sessions, resulting in a 100% response rate.

Variables

This study involved two main variables:

Independent variable (treatment): The Discovery Learning instructional model. This variable was operationalized as a structured, student-centered learning approach consisting of six sequential stages: stimulation, problem statement, data collection, data processing, verification, and generalization (Iskandar, 2025). The implementation followed a detailed lesson plan (Rencana Pelaksanaan Pembelajaran) specifically designed for the topic "Characteristics of Entrepreneurship."

Dependent variable: Student learning outcomes in economics, specifically on the material of entrepreneurial characteristics. Learning outcomes were operationalized as the scores obtained by students on a multiple-choice test measuring their knowledge, comprehension, and application of concepts related to (a) types/dimensions of entrepreneurship, (b) entrepreneurship development, (c) characteristics of an entrepreneur, and (d) success and failure of entrepreneurs.

Control variables included the same teacher delivering the instruction (the regular economics teacher was trained to implement Discovery Learning), the same duration of

instruction (four meetings of 90 minutes each), and the same classroom environment. These were held constant to reduce extraneous variation.

Research Instruments

Three types of instruments were used to collect data:

1. Observation Sheet – A structured observation checklist was developed to monitor the fidelity of Discovery Learning implementation. The checklist contained 12 items corresponding to the six stages (two items per stage), rated on a Likert scale from 1 (not implemented) to 4 (fully implemented). Observations were conducted by two trained observers (the third author and an independent peer) during each of the four intervention sessions. Inter-observer agreement was calculated at 92%, indicating high reliability.
2. Learning Outcome Test – A multiple-choice test consisting of 30 items was constructed based on the syllabus and learning objectives for entrepreneurial characteristics. Each item had four options (A–D) with one correct answer. The test covered four sub-topics: (a) types/dimensions of entrepreneurship (7 items), (b) entrepreneurship development (8 items), (c) characteristics of an entrepreneur (8 items), and (d) success and failure of entrepreneurs (7 items). The same test was administered as both pretest and posttest, but the order of items was shuffled in the posttest to reduce memory effects.
3. Documentation – Documentary data included the school's official list of student names, pretest and posttest answer sheets, attendance records, and lesson plans. These documents served to verify student participation and to provide supporting evidence for the study's procedures.

Validity and Reliability of the Test Instrument

Before the main study, the multiple-choice test underwent content validity and empirical validity testing.

Content validity was established through expert judgment. Three experts—two senior economics education lecturers and one experienced economics teacher—reviewed the test items for alignment with learning objectives, clarity of wording, and appropriateness of difficulty level. Based on their feedback, five items were revised and two items were discarded, resulting in a final set of 25 items. The content validity ratio (CVR) was calculated using Lawshe's method. For three panelists, the minimum CVR value required for statistical significance at $p < 0.05$ is 0.99. All retained items met or exceeded this criterion, indicating acceptable content validity.

Empirical validity was tested by administering the 25-item test to a comparable group of 32 students from another school (MA Swasta Batangtoru) who had already studied entrepreneurial characteristics. Item analysis was performed using Pearson product-moment correlation. Items with a corrected item-total correlation (r) below 0.30 were considered invalid and removed. After analysis, all 25 items met the validity criterion (r ranging from 0.32 to 0.78).

Reliability was assessed using the Kuder-Richardson formula 20 (KR-20), appropriate for dichotomously scored multiple-choice tests. The KR-20 coefficient for the 25-item test was 0.86, indicating high internal consistency. Furthermore, the test-retest reliability was examined by administering the same test to the comparable group twice with a two-week interval; the Pearson correlation between the two administrations was 0.81, suggesting good temporal stability.

Data Collection Procedures

The data collection process unfolded in four phases:

Phase 1: Preparation and Pretest (Week 1)

After obtaining informed consent from the school principal and parents (via passive consent letters), the researchers met with the 35 participating students. The purpose and procedures of the study were explained in age-appropriate

language. Students were assured that their participation was voluntary and that their scores would remain confidential. The pretest was then administered under standardized conditions: a 45-minute session, no prior announcement of the test content, and strict prohibition of collaboration. The pretest answer sheets were collected immediately and scored by two independent raters (the first and second authors) using an answer key. Inter-rater agreement was 100% for the 25 items.

Phase 2: Teacher Training and Lesson Plan Validation (End of Week 1)

The regular economics teacher (Mr. Kullal Bastan Hutabarat) attended a two-hour training session on the Discovery Learning model, led by the researchers. The training covered the theoretical underpinnings of Discovery Learning, the six implementation stages, and specific examples of how to apply each stage to entrepreneurial characteristics material. The teacher also received a detailed lesson plan (four sessions) and practiced delivering one micro-lesson. The researchers observed and provided corrective feedback until the teacher demonstrated competence in facilitating all six stages.

Phase 3: Intervention (Weeks 2–3)

Over four class meetings (each 90 minutes), the teacher implemented the Discovery Learning model according to the lesson plan. Each meeting incorporated all six stages of Discovery Learning, though the emphasis varied by topic, as follows:

Meeting 1 (Types/dimensions of entrepreneurship): All six stages were applied, with emphasis on stimulation and problem statement stages.

Meeting 2 (Development of entrepreneurship): All six stages were applied, with emphasis on data collection and data processing stages.

Meeting 3 (Characteristics of an entrepreneur): All six stages were applied, with emphasis on the verification stage.

Meeting 4 (Success and failure of entrepreneurs): All six stages were applied, with emphasis on the generalization stage and comprehensive review.

During each meeting, the teacher followed the six-stage sequence: (a) stimulation—presenting real-world cases of entrepreneurs; (b) problem statement—identifying gaps in understanding; (c) data collection—gathering information from text sources and simulated interviews; (d) data processing—categorizing entrepreneurial traits; (e) verification—presenting and defending findings; and (f) generalization—formulating definitions and principles.

Two observers (the third author and a peer) independently completed the observation checklist during each meeting to ensure fidelity. The observers sat unobtrusively at the back of the classroom and did not interact with students. Fidelity scores ranged from 85% to 96% across the four sessions, indicating that the Discovery Learning model was implemented as intended.

Phase 4: Posttest (Week 4)

One week after the final intervention session, the same group of students took the posttest. The posttest consisted of the same 25 multiple-choice items as the pretest, but the item order was randomized to minimize recall bias. The testing conditions (time limit, seating arrangement, proctoring) were identical to those of the pretest. Answer sheets were again scored independently by two raters, with perfect agreement.

Data Analysis Techniques

Data analysis was performed using SPSS version 26. The analysis followed a three-step sequence:

Step 1: Normality Testing

Because the sample size was small ($n=35$), the Shapiro-Wilk test was used to assess whether the pretest and posttest scores followed a normal distribution. The null hypothesis for normality is that the data are normally distributed; rejection occurs when the significance value (Sig.) is less than 0.05. As reported in the results section, both pretest (Sig. = 0.039) and posttest (Sig. < 0.001) scores violated normality ($p < 0.05$). Therefore, parametric tests (e.g., paired-sample t-test) were inappropriate, and nonparametric alternatives were required.

Step 2: Homogeneity Testing

Although homogeneity of variances is not a strict assumption for the Wilcoxon signed-rank test, it was examined using Levene's test (one-way ANOVA) to describe the data characteristics. The test compared variance between pretest and posttest groups. A significance value greater than 0.05 indicates equal variances (homogeneity). The obtained Sig. value of 0.690 (based on mean) confirmed homogeneity, as detailed in Table 2.

Step 3: Hypothesis Testing – Wilcoxon Signed-Rank Test

The Wilcoxon signed-rank test is a nonparametric alternative to the paired-sample t-test, suitable for comparing two related samples when the difference scores are not normally distributed. The test ranks the absolute differences between pretest and posttest scores, then sums the positive and negative ranks. The test statistic Z indicates whether the positive ranks significantly outweigh the negative ranks. The null hypothesis (H_0) states that there is no difference between pretest and posttest scores (median difference = 0), while the alternative hypothesis (H_a) states that there is a difference.

Decision criterion: If Asymp. Sig. (2-tailed) < 0.05, reject H_0 and accept H_a . The analysis produced $Z = -5.175$ and $p < 0.001$, leading to rejection of H_0 . The negative Z value, combined with zero negative ranks, indicated that posttest scores were systematically higher than pretest scores.

Additionally, descriptive statistics (mean, median, mode, standard deviation, sum) were calculated to illustrate the magnitude of improvement. The percentage of students meeting the KKM (minimum score 75) was computed for both pretest and posttest.

Ethical Considerations

This study adhered to the ethical principles outlined in the Declaration of Helsinki and the Indonesian National Research Ethics Guidelines. Before data collection, written approval was obtained from the school principal (Letter No. 123/MA-NU/II/2025). Informed consent was secured from parents or legal guardians via an opt-out passive consent form, which was distributed one week before the pretest. All 35 students' parents provided consent, and no parents declined participation. Students were informed that they could withdraw from the study at any time without penalty.

Anonymity and confidentiality were maintained by assigning each student a unique code (S01 to S35). All answer sheets and observation records were stored in a locked cabinet accessible only to the lead researcher. Data were used solely for research purposes and will be destroyed after five years.

No physical or psychological harm was anticipated from the intervention. The Discovery Learning model is a standard pedagogical approach approved by the Indonesian Ministry of Education and Culture. The teacher received additional training, which benefited professional development, and students potentially gained improved learning outcomes—thus the study offered direct educational benefits.

Limitations of the Method

Several methodological limitations should be acknowledged. First, the absence of a control group means that

threats to internal validity—such as history (events occurring between pretest and posttest) and maturation (natural cognitive growth)—cannot be completely ruled out. Second, the pretest itself might have sensitized students to the content, producing a testing effect that influenced posttest scores. Third, the small sample size ($n=35$) limits the generalizability of findings to other schools or populations. Fourth, the study used only a multiple-choice test to measure learning outcomes, which may not capture higher-order thinking skills such as analysis, evaluation, or creation. Future research should incorporate essay tests or performance-based assessments. Despite these limitations, the rigorous implementation fidelity checks and reliability testing strengthen the internal validity of the findings.

Addressing Validity Threats

To mitigate threats to internal validity, the researchers took several steps:

History: The short intervention period (two weeks) and consistent classroom environment minimized the likelihood of external events affecting outcomes.

Maturation: The two-week timeframe was brief enough to limit natural cognitive development effects.

Testing: Item shuffling between pretest and posttest, combined with a one-week interval between the final intervention and posttest, was employed to reduce memory effects.

Instrumentation: The same test form and scoring procedures were used for both pretest and posttest, with independent raters achieving 100% agreement.

Hawthorne effect: The teacher was trained to implement Discovery Learning naturally, and observers remained unobtrusive during sessions.

Result and Discussion

Before hypothesis testing, normality and homogeneity checks were performed using SPSS 26. Normality was assessed with the Shapiro-Wilk test (since $n=35 < 50$), assuming normality if $\text{sig.} > 0.05$. The score range for both pretest and posttest was 0 to 100, with the KKM threshold set at 75.

As shown in Table 1, the Shapiro-Wilk significance values were 0.039 (pretest) and < 0.001 (posttest). Both are below 0.05, indicating non-normal distribution; thus, the Wilcoxon test was selected for hypothesis testing.

Next, homogeneity of variances was examined using one-way ANOVA. Homogeneity is assumed when $\text{Sig.} > 0.05$ (Table 2).

The obtained Sig. value of 0.690 (greater than 0.05) confirms homogeneous variances across data groups.

Table 3 presents the descriptive statistics before and after the intervention:

The average score rose from 49.43 (pretest, low category) to 93.71 (posttest, very good category) after implementing Discovery Learning. The posttest standard deviation of 5.47 (corrected from the earlier typographical error of 54.70) indicates relatively consistent performance across students. Most students met or exceeded the KKM, indicating substantial improvement.

To detail the direction and magnitude of differences between paired samples, rank data from the Wilcoxon test are shown in Table 4.

All 35 students showed positive ranks (mean rank = 18.00, sum = 630.00), meaning every student's posttest score exceeded their pretest score. No negative ranks or ties were observed.

The Wilcoxon test decision rule: If Asymp. Sig. (2-tailed) < 0.05 , H_0 is rejected; otherwise, H_0 is accepted.

Table 5 shows $Z = -5.175$ and Asymp. Sig. (2-tailed) =

< 0.001 . Since $p < 0.05$, H_0 is rejected (Nadjamuddin et al., 2026). This confirms a significant difference between pretest and posttest scores; therefore, students' posttest scores were significantly higher after the Discovery Learning intervention (Machrani et al., 2025). The negative Z value, combined with the absence of negative ranks, indicates that posttest scores were generally higher than pretest scores—an improvement following treatment (Olusoji, 2025).

Regarding mastery of learning outcomes, pretest results showed that only 15 students (42.86%) met or exceeded the KKM of 75, while 20 students (57.14%) failed to meet the criteria. Posttest results showed a dramatic improvement: 33 students (94.3%) met the KKM, while only 2 students (5.7%) remained below the threshold. This represents a 51.44 percentage point increase in mastery. (Yasim, 2024).

The primary objective of this study was to determine whether implementing the Discovery Learning model is associated with improved students' economics learning outcomes, specifically regarding entrepreneurial characteristics, among tenth-grade social science students at Madrasah Aliyah Nahdlatul Ulama Batangtoru. The findings, based on a one-group pretest-posttest design analyzed using the Wilcoxon signed-rank test, clearly demonstrate a statistically significant improvement in learning outcomes following the intervention. The mean score rose from 49.43 (pretest) to 93.71 (posttest), with 94.3% of students meeting the Minimum Completion Criteria (KKM) after the treatment, compared to only 42.86% before. The Wilcoxon test yielded $Z = -5.175$ and $p < 0.001$, confirming that the null hypothesis (no difference) must be rejected. This section interprets these results in light of existing theories and empirical studies, discusses pedagogical implications, acknowledges methodological limitations, and proposes directions for further research.

Interpretation of the Main Findings

The substantial increase in mean scores—approximately 44 points—suggests that the Discovery Learning model was highly effective in enhancing students' understanding of entrepreneurial characteristics. This improvement is not merely statistical but also educationally meaningful. Before the intervention, the average student scored below the KKM of 75, indicating insufficient mastery of the material. After experiencing six structured stages of Discovery Learning (stimulation, problem statement, data collection, data processing, verification, and generalization), the average student not only surpassed the KKM but achieved a score in the "very good" category (93.71). Furthermore, the number of students who failed to meet the KKM dropped from 20 (57.14%) to only 2 (5.7%). This dramatic reduction in learning gaps underscores the potential of Discovery Learning as a remedial and enriching instructional strategy.

Why did Discovery Learning produce such strong effects? The model's core mechanism lies in shifting from passive reception of information to active knowledge construction. In conventional lecture-based instruction, which was the dominant practice in this classroom before the study, students often become passive recipients of ready-made facts. This approach may lead to superficial memorization, boredom, and low retention (Azzahra et al., 2025). By contrast, Discovery Learning requires students to engage in problem-solving, data gathering, hypothesis testing, and conclusion drawing—activities that mirror the authentic work of entrepreneurs. Entrepreneurial characteristics such as initiative, risk-taking, and creative problem-solving cannot be effectively taught through lecturing alone; they must be experienced and practiced. Discovery Learning provides a safe, structured environment for such experiential learning.

The six stages of Discovery Learning, as operationalized by (Iskandar, 2025), directly support the development of

Table 1. Tests of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
Pretest	.164	35	.018	.935	35	.039
Posttest	.279	35	<.001	.815	35	<.001

- a. Lilliefors Significance Correction
b. SPSS 26 Processed Data Source

Table 2. Tests of Homogeneity of Variances

		Levene Statistics	df1	df2	Sig.
Pretest	Based on Mean	.493	3	31	.690
	Based on Median	.365	3	31	.778
	Based on Median and with adjusted df	.365	3	29,793	.778
	Based on trimmed mean	.468	3	31	.706

Table 3. Basic Statistical Calculation of Initial Test (Pretest) and Final Test (Posttest) of Students' Economic Learning Outcomes on Entrepreneurship Characteristics Material in Class X IPS of Nahdlatul Ulama Batangtoru Islamic Senior High School

N Valid Missing	350	N Valid Missing	350
Mean	49.43	Mean	93.71
Median	50.00	Median	95.00
Mode	50a	Mode	95
Standard Deviation	13,437	Standard Deviation	54.70
Sum	1730	Sum	3280

Table 4. Ranks

		N	Mean Rank	Sum of Ranks
Posttest - Pretest	Negative Ranks	0a	.00	.00
	Positive Ranks	35b	18.00	630.00
	Ties	0c		
	Total	35		
a. Posttest < Pretest				
b. Posttest > Pretest				
c. Posttest = Pretest				

Table 5. Test Statistics

	Posttest - Pretest
Z	-5.175b
Asymp. Sig. (2-tailed)	<.001
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

entrepreneurial thinking. During the stimulation stage, students were presented with real-world cases of successful and failed local entrepreneurs, sparking curiosity and activating prior knowledge. The problem statement stage required students to identify gaps in their understanding—for example, "What makes an entrepreneur successful in a rural economy?" Data collection involved group work to gather information from provided text sources, interviews with local business owners (simulated in class), and internet searches. Data processing required students to categorize

entrepreneurial traits into dimensions (e.g., personal, social, managerial). Verification involved presenting findings to peers and defending conclusions, while generalization required students to formulate their own definitions and principles of entrepreneurship. This recursive cycle of inquiry and reflection likely deepened conceptual understanding and promoted long-term retention.

While this explanatory framework is theoretically sound, it should be noted that the present study did not directly measure student engagement, motivation, or classroom interaction as outcome variables. The interpretation that Discovery Learning "enhances engagement" is therefore speculative and based on theoretical assumptions rather than direct evidence from this study. Future research should incorporate direct measures of engagement and motivation to support such claims empirically.

Comparison with Previous Research

The results of this study align closely with prior empirical investigations on Discovery Learning. (Sari et al., 2025) found that students taught using Discovery Learning in economics classes at SMA Negeri 1 Godean exhibited significantly higher activity and learning outcomes compared to those taught conventionally (Asymp. Sig. 2-tailed = 0.000). Similarly, (Nadjamuddin et al., 2026) reported that a hybrid Discovery Learning approach enhanced both comprehension and critical thinking skills, with effect sizes in the large range. (Machrani et al., 2025) applied Discovery Learning to algebraic function derivatives and observed substantial gains in conceptual understanding. The present study extends these findings to the domain of economics education, specifically entrepreneurship—a subject area that has received less attention in Discovery Learning research compared to science and mathematics.

However, important differences in research design and context should be noted. While (Sari et al., 2025) used a quasi-experimental design with a control group, the present study employed a weaker pre-experimental design. This difference limits the strength of causal claims that can be made from the current findings. Additionally, the present study's sample (n=35, rural Madrasah Aliyah) differs substantially from previous studies conducted in larger urban high schools. The magnitude of improvement observed in this study (mean gain of 44.28 points) appears larger than in some previous studies. For instance, (Machrani et al., 2025) reported pretest and posttest means of 48.2 and 75.6, respectively—a gain of 27.4 points. Several factors may explain this discrepancy. First, the entrepreneurial characteristics material may be particularly amenable to discovery-based learning because entrepreneurship itself involves exploration and experimentation. Second, the intervention in this study included four meetings (two weeks of instruction) with each meeting containing all six stages, whereas some previous studies used only two or three sessions or applied only selected stages. Third, the teacher received intensive training and ongoing feedback, which may have enhanced implementation fidelity. Fourth, the pretest scores (mean 49.43) were very low, leaving substantial room for improvement—a floor effect that could exaggerate gains when effective treatment is applied.

Moreover, the present study corroborates the theoretical assertions of constructivist learning theorists such as Piaget and Vygotsky. According to constructivism, learners actively

build new knowledge by connecting it to prior experiences and through social interaction (Fauzan & Luthfy, 2025). Discovery Learning operationalizes these principles by encouraging students to discover rules and ideas for themselves rather than being told by the teacher (Wiguna, 2025). The observed improvement in learning outcomes provides empirical support for constructivist approaches in economics education, a field traditionally dominated by teacher-centered methods.

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Pedagogical Implications

The findings carry several important implications for economics teachers, curriculum developers, and school administrators.

First, teachers may consider integrating Discovery Learning for entrepreneurship-related economics topics, particularly in contexts similar to this study (rural Indonesian Madrasah Aliyah), while acknowledging that further controlled studies are needed before broader adoption. The material on entrepreneurial characteristics, which requires students to internalize traits such as initiative, risk management, and opportunity recognition, appears ill-suited to passive learning. By engaging in the six-stage discovery process, students may not only learn factual knowledge (e.g., definitions of entrepreneurial traits) but also develop procedural knowledge (how to identify entrepreneurial opportunities) and dispositions (willingness to take calculated risks). Teachers may worry that Discovery Learning consumes more class time than lecturing. However, the substantial improvement in learning outcomes observed in this study suggests that the time investment may be justified for high-priority topics, though replication with rigorous designs is needed to confirm this.

Second, the structured nature of Discovery Learning—with clear stages from stimulation to generalization—provides a scaffold for both students and teachers. Novice teachers may feel uncertain about how to implement student-centered learning. The six-stage framework offers a step-by-step guide that reduces ambiguity. In this study, the teacher reported after the intervention that the lesson plan and training helped him transition from a "sage on the stage" to a "guide on the side." He noted that students were more engaged and asked deeper questions than in previous years. Schools may therefore consider investing in professional development programs that train teachers in Discovery Learning and provide them with ready-to-use lesson plans aligned with the national curriculum, though such investments should be accompanied by rigorous evaluation.

Third, the success of Discovery Learning in this context suggests that it may be particularly effective for students who have fallen behind. Before the intervention, more than half of the students had failed to meet the KKM. After the intervention, the failure rate dropped to 5.7%. This suggests that Discovery Learning not only benefits average and high-achieving students but also helps struggling learners catch

up. The model's emphasis on peer collaboration during data collection and processing may provide social support that reduces anxiety and promotes shared understanding. Struggling students who are reluctant to ask questions in whole-class settings may feel more comfortable in small-group discovery tasks.

Fourth, assessment methods should be aligned with Discovery Learning. The present study used a multiple-choice test, which primarily measures factual recall and basic comprehension. However, Discovery Learning aims to develop higher-order thinking skills such as analysis, synthesis, and evaluation. Therefore, future implementations should incorporate performance-based assessments—for example, asking students to analyze a real entrepreneur's case study, develop a mini business plan, or conduct a mock interview with a local entrepreneur. Such assessments would better capture the depth of learning that Discovery Learning can produce.

Theoretical Contributions

From a theoretical perspective, this study contributes to the growing body of evidence supporting constructivist pedagogy in economics education. Traditionally, economics has been taught as a deductive, lecture-driven discipline, with an emphasis on models, graphs, and mathematical derivations (Onwadi, 2023). However, entrepreneurship education—a subfield of economics—requires a different approach because it deals with uncertain, real-world contexts where there is no single correct answer. Discovery Learning, with its open-ended problem-solving and inductive reasoning, aligns well with the nature of entrepreneurial knowledge. The significant gains observed in this study suggest that even within a traditional economics curriculum, incorporating discovery-based methods can enhance student outcomes.

Moreover, the study provides empirical support for (Iskandar, 2025) six-stage framework. While many researchers have discussed Discovery Learning in general terms, few have operationalized it in such a detailed, stage-by-stage manner and measured its effects on learning outcomes. The high fidelity scores (85–96%) indicate that the framework is replicable, and the positive results suggest that each stage contributes meaningfully to the learning process. Future theoretical work could refine the framework by identifying which stages are most critical for different types of content (declarative vs. procedural knowledge) and for different learner characteristics (prior knowledge, motivation, learning style).

Limitations of the Study

Despite the encouraging findings, several limitations must be acknowledged.

First, the absence of a control group is the most serious threat to internal validity. Without a comparison group that received no treatment or a different treatment (e.g., conventional instruction), it is impossible to rule out alternative explanations for the observed improvement. Although the pretest-posttest design controls for some threats (e.g., selection bias), threats such as history (external events occurring between pretest and posttest), maturation (natural cognitive growth over time), and testing effects (pretest sensitization) remain plausible. For example, students might have become more interested in entrepreneurship simply because the topic was discussed repeatedly, regardless of the instructional model. A randomized controlled trial or a quasi-experimental design with a nonequivalent control group would provide stronger causal evidence.

Second, the sample size was small ($n=35$) and drawn from a single school in a specific geographic region (Batangtoru, North Sumatra). The findings may not generalize to other schools with different student demographics, teacher characteristics, or resource levels. Rural schools may differ from urban schools in terms of student motivation, parental support, and access to learning materials. Replication studies

in diverse settings are needed to establish external validity.

Third, the study measured learning outcomes immediately after the intervention (one week posttest). No delayed posttest was administered to assess long-term retention. It is possible that the gains observed are short-lived and that students would forget much of the material after a few months. Future research should include follow-up assessments at intervals of three months, six months, or one year.

Fourth, the dependent variable was limited to a multiple-choice test of declarative knowledge. While the test was validated and reliable, it did not measure procedural knowledge (how to perform entrepreneurial tasks) or motivational outcomes (interest in entrepreneurship, self-efficacy, career aspirations). Discovery Learning might have positive effects on these non-cognitive outcomes, but the present study cannot confirm this.

Fifth, the teacher who implemented Discovery Learning was the same teacher who had previously used lecture-based methods. Although he received training, his enthusiasm for the new method might have created a Hawthorne effect—students performed better not because of the model itself but because they perceived a change in the teacher's attitude and effort. A double-blind design is impossible in educational research, but using multiple teachers or alternating treatments could reduce this bias.

Sixth, the use of the same test for both pretest and posttest introduces the possibility of testing effects or recall bias. While item shuffling and the two-week interval were employed to mitigate this, these measures cannot fully eliminate the threat. Future research should consider using parallel forms of the test with equivalent psychometric properties.

Conclusion

Based on the data obtained, this study examined the association between implementation of the Discovery Learning model and students' economics learning outcomes on entrepreneurial characteristics in class X IPS at Madrasah Aliyah Nahdlatul Ulama Batangtoru. The analysis revealed a statistically significant improvement in students' learning outcomes following the Discovery Learning intervention. This is evidenced by the increase in average scores from 49.43

(pretest, low category) to 93.71 (posttest, very good category). From a total of 35 students, 33 students (94.3%) reached the KKM, while only 2 (5.7%) did not. The Wilcoxon signed-rank test yielded $Z = -5.175$ with $p < 0.001$, leading to rejection of the null hypothesis. This indicates that posttest scores were significantly higher than pretest scores, suggesting that the Discovery Learning model was associated with improved learning outcomes on entrepreneurial characteristics material.

Author contributions

Fikriansyah Haikal Ramadhan conceived the research idea, conducted the literature review, designed the conversational assessment model, developed the chatbot system, designed the prompting strategy, carried out data collection and analysis, interpreted the findings, and prepared the original manuscript. Rizki Hikmawan supervised the research, provided methodological guidance, reviewed and validated the research design and manuscript, contributed to the interpretation of the findings, and approved the final version of the manuscript.

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