Interval: Indonesian Journal of Mathematical Education
Vol. 4, No.2, August 2026, pp. 55~62
ISSN: 3021-7857, DOI: 10.37251/ijome.v4i2.3447

Cultivating Mathematics Learning Autonomy through Resource-Based Learning: Insights from Classroom Action Research

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Article Info

Article history:

Received May 13, 2026
Revised Jun 20, 2026
Accepted Jul 15, 2026
Online First Aug 29, 2026

Keywords:

Classroom Action Research
Mathematics Learning Autonomy
Mathematics Learning Outcomes
Resource-Based Learning

ABSTRACT

Purpose of the study: This study aimed to examine the effectiveness of Resource-Based Learning in cultivating mathematics learning autonomy among junior high school students and to identify its contribution to improving students' mathematics learning outcomes through classroom action research.

Methodology: This study employed Classroom Action Research based on the Kemmis and McTaggart model involving planning, acting, observing, and reflecting stages. Participants were 18 seventh-grade students. Data were collected using observation sheets, interview guides, documentation, mathematics achievement tests, and a mathematics learning autonomy questionnaire validated through content validity and Cronbach's Alpha reliability. Descriptive quantitative and qualitative analyses were applied.

Main Findings: The implementation of Resource-Based Learning increased students' mathematics learning autonomy in terms of initiative, self-confidence, and responsibility. Students' mathematics achievement also improved across cycles. Learning activities became more active through the utilization of worksheets, peer tutors, manipulative media, and library resources. Limited learning resources were identified as a factor affecting instructional effectiveness.

Novelty/Originality of this study: This study presents a comprehensive integration of Resource-Based Learning with multiple learning resources, including peer tutors, worksheets, manipulative media, and library utilization, to foster mathematics learning autonomy. The findings provide empirical evidence regarding the role of diverse learning resources in developing autonomous learning habits and enhancing mathematics achievement in classroom action research settings.

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1. INTRODUCTION

Learning autonomy has become one of the essential competencies that should be developed in mathematics education to prepare students for lifelong learning. Autonomous learners are characterized by their ability to initiate learning activities, regulate their own progress, and take responsibility for achieving learning goals [1]. In mathematics learning, autonomy enables students to construct knowledge independently and develop confidence in solving mathematical problems. The development of learning autonomy is also consistent with educational objectives that emphasize the formation of responsible and self-directed individuals [2], [3]. Therefore, promoting mathematics learning autonomy has become an important concern in improving the quality of mathematics education.

Despite its importance, many students still demonstrate low levels of learning autonomy in mathematics classrooms. Students tend to rely heavily on teachers' instructions, show limited initiative in accessing learning resources, and frequently postpone completing assignments [4], [5]. Several students also experience difficulties in managing their learning responsibilities and lack confidence in solving mathematical problems independently. Such conditions may negatively affect students' engagement and academic achievement in mathematics [6]. Consequently, efforts to cultivate learning autonomy among students require innovative learning strategies that encourage active participation and independent learning habits.

Previous studies have reported that learning autonomy contributes positively to students' academic performance and learning motivation. Research on constructivist approaches has also shown that providing opportunities for students to explore knowledge independently can foster meaningful learning experiences [7], [8]. In addition, Resource-Based Learning has been recognized as an instructional strategy that utilizes various learning resources to support active learning. Existing studies generally emphasize the effectiveness of Resource-Based Learning in improving academic achievement and learning engagement [9], [10]. However, limited attention has been given to its role in strengthening students' mathematics learning autonomy through cyclical classroom interventions.

Although numerous studies have examined Resource-Based Learning, most investigations have focused on cognitive outcomes rather than affective and self-regulatory dimensions. Furthermore, empirical evidence concerning the implementation of Resource-Based Learning in mathematics classrooms through classroom action research remains relatively scarce [11], [12]. Studies that specifically investigate how multiple learning resources, peer tutoring, and learning worksheets contribute to students' autonomy are still limited. This situation indicates a research gap regarding the practical mechanisms through which Resource-Based Learning can cultivate mathematics learning autonomy [13]. Therefore, further investigation is needed to provide empirical evidence concerning the contribution of Resource-Based Learning to fostering autonomous learning behaviors among students.

Investigating mathematics learning autonomy is important because independent learners are more likely to adapt to changing educational demands and continuously develop their competencies. Learning autonomy encourages students to become responsible for their own learning process and reduces excessive dependence on teachers [14], [15]. Moreover, mathematics learning requires persistence, confidence, and self-regulation, which are closely associated with autonomous learning characteristics. The implementation of Resource-Based Learning provides opportunities for students to interact with diverse learning resources and construct understanding actively [16], [17]. Hence, examining the effectiveness of Resource-Based Learning in cultivating mathematics learning autonomy is expected to contribute to the improvement of mathematics teaching practices.

The novelty of this study lies in the integration of Resource-Based Learning with multiple learning resources, including peer tutoring, student worksheets, instructional media, and library utilization, to foster mathematics learning autonomy. Unlike previous studies that mainly concentrated on learning outcomes, this study places learning autonomy as the primary focus of investigation [18]. In addition, this study employs a classroom action research design that enables continuous reflection and improvement throughout the learning process. The findings are expected to provide practical insights into how Resource-Based Learning can be implemented to develop autonomous learning behaviors in mathematics classrooms. Therefore, this study contributes to expanding existing knowledge regarding the promotion of mathematics learning autonomy through learner-centered instructional practices.

2. RESEARCH METHOD

2.1 Research Design

This study employed Classroom Action Research (CAR) using the Kemmis and McTaggart model to improve students' mathematics learning autonomy through Resource-Based Learning. The research was conducted through iterative cycles consisting of planning, action, observation, and reflection. Each cycle was designed to identify weaknesses in the learning process and formulate improvements for subsequent actions. The study was terminated when the predetermined indicators of success had been achieved. This design enabled continuous refinement of instructional practices and promoted meaningful learning experiences for students.

Figure 1. Classroom Action Research Cycle

2.2 Participants and Research Setting

The study was conducted in the 2009/2010 academic year at SMP Dahlia and involved 18 students of class VII-B as research participants. The participants represented diverse academic abilities and learning characteristics. The researcher acted as the practitioner implementing the intervention, while a colleague served as an observer during the learning process. Collaborative work between the researcher and observer facilitated data collection and reflective evaluation in each cycle [19]. The research setting provided a natural classroom environment for examining the implementation of Resource-Based Learning [20].

2.3 Research Procedure

The research began with a preliminary observation to identify students' learning autonomy problems in mathematics. Two action cycles were then implemented, each consisting of planning, acting, observing, and reflecting stages [21]. Resource-Based Learning was carried out by utilizing various learning resources, including worksheets, mathematics textbooks, peer tutors, and manipulative materials. Observations, interviews, documentation, and reflective discussions were conducted throughout the intervention process. The findings from each cycle became the basis for improving instructional practices in the following cycle.

2.4 Instruments and Data Collection

The study employed both quantitative and qualitative instruments to obtain comprehensive data. Quantitative data were collected through mathematics achievement tests and a mathematics learning autonomy questionnaire consisting of 42 items. Qualitative data were obtained through classroom observations, interviews, field notes, and documentation of learning activities. The questionnaire measured three dimensions of learning autonomy, namely initiative, self-confidence, and responsibility [22]. Instrument validity was established through expert judgment and item analysis, while reliability testing indicated a high level of consistency.

Table 1. Dimensions of Mathematics Learning Autonomy

Dimension	Indicators
Initiative	Courage to act and awareness of learning needs
Self-confidence	Confidence in abilities, problem-solving, and independence from others
Responsibility	Timely task completion and seriousness in learning

2.5 Data Analysis and Trustworthiness

Quantitative data were analyzed using descriptive statistics, including percentages and mean scores, to determine changes in students' mathematics learning autonomy and achievement. Qualitative data were analyzed through coding procedures involving data reduction, categorization, interpretation, and conclusion drawing. Data visualization was presented using tables and graphs to facilitate interpretation. To ensure trustworthiness, triangulation was conducted by comparing findings obtained from observations, interviews, and researchers' field notes. The combination of quantitative and qualitative analyses provided a comprehensive understanding of the effectiveness of Resource-Based Learning in cultivating mathematics learning autonomy.

3. RESULTS AND DISCUSSION

3. Improvement of Mathematics Learning Autonomy through Resource-Based Learning

The implementation of Resource-Based Learning contributed positively to the development of students' mathematics learning autonomy. The combination of multiple learning resources, including worksheets, textbooks, peer tutoring, and manipulative materials, encouraged students to learn more independently. Improvements were observed in the dimensions of initiative, self-confidence, and responsibility throughout the two action cycles. Findings from questionnaires, classroom observations, and interviews consistently indicated better learning autonomy among students. These results suggest that Resource-Based Learning facilitated students' active involvement and strengthened their capacity for self-directed learning.

Table 2. Improvement of Mathematics Learning Autonomy

Cycle	Mean Percentage (%)	Category
Pre-action	71.0	Moderate
Cycle I	78.4	Good
Cycle II	86.7	Very Good

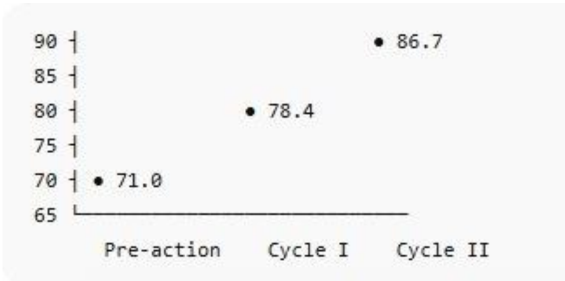

Figure 2. Improvement of Mathematics Learning Autonomy

3.2 Enhancement of Mathematics Learning Achievement

Students' mathematics achievement also improved following the implementation of Resource-Based Learning. The mean score increased progressively from the first cycle to the second cycle, indicating better mastery of mathematical concepts. At the end of Cycle II, 72.5% of students obtained scores equal to or above the class average, exceeding the predetermined success criteria. The highest score reached 95, whereas the lowest score was 40. These findings demonstrate that the enhancement of learning autonomy was accompanied by improved academic performance.

Table 3. Students' Mathematics Achievement

Indicator	Cycle I	Cycle II
Mean Score	69.3	78.6
Highest Score	90	95
Lowest Score	35	40
Students Achieving Criterion (%)	55.6	72.5

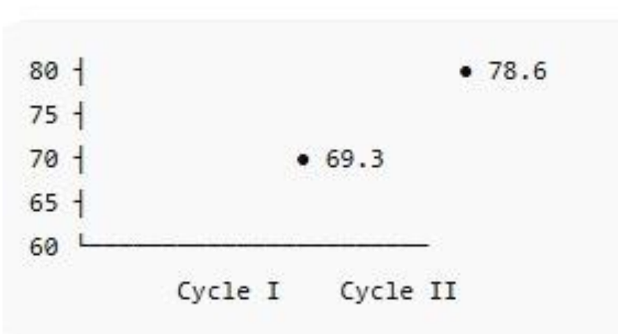

Figure 3. Mean Score Improvement across Cycles

3.3 Students' Responses toward Resource-Based Learning

Interview and observation data revealed that students responded positively to the implementation of Resource-Based Learning. Most students expressed greater confidence in solving mathematical problems and demonstrated increased responsibility in completing assignments. Peer tutoring and the use of diverse learning resources enabled students to seek information independently rather than relying solely on the teacher. Students also showed stronger engagement and initiative during classroom activities. These findings indicate that Resource-Based Learning created a more supportive environment for developing autonomous learning behaviors.

Table 4. Summary of Students' Responses

Aspect	Findings
Initiative	Students actively searched for learning resources
Self-confidence	Students became more confident in solving problems
Responsibility	Assignment completion improved
Peer Interaction	Collaboration through peer tutoring increased
Learning Engagement	Students participated more actively

3.4 Emerging Findings from Classroom Action Research

Several important findings emerged during the implementation of Resource-Based Learning. First, the availability of diverse learning resources significantly supported the development of students' learning autonomy and achievement. Second, peer tutoring played an essential role in encouraging collaboration and enhancing students' confidence during mathematics learning. Third, insufficient learning resources occasionally reduced the effectiveness of classroom activities because some students had to share materials with others. Therefore, adequate learning resources are necessary to maximize the effectiveness of Resource-Based Learning and ensure meaningful learning experiences for all students.

Table 5. Major Findings of the Study

Finding	Implication
Resource-Based Learning improved learning autonomy	Students became more independent learners
Mathematics achievement increased	Concept mastery improved
Peer tutoring supported learning	Collaboration and confidence increased
Limited learning resources affected effectiveness	Schools need to provide adequate learning materials

The findings of this study demonstrate that the implementation of Resource-Based Learning successfully improved students' mathematics learning autonomy. Improvements were evident in the dimensions of initiative, self-confidence, and responsibility, which showed progressive development from the pre-action stage to Cycle II. The use of multiple learning resources enabled students to actively construct knowledge and become less dependent on teacher-centered instruction. Questionnaire results, classroom observations, and interview findings consistently indicated positive changes in students' independent learning behaviors. These findings confirm that Resource-Based Learning provides opportunities for students to become active participants in the learning process.

In addition to enhancing learning autonomy, Resource-Based Learning also contributed to better mathematics achievement among students. The increase in average scores and the higher percentage of students achieving the predetermined success criteria indicate that the intervention improved conceptual understanding. Peer tutoring and the utilization of various learning resources created a supportive learning environment that facilitated problem-solving activities. Students became more confident in completing mathematical tasks and demonstrated greater responsibility in accomplishing assignments. Therefore, the development of learning autonomy was accompanied by improvements in academic performance.

The results of this study are consistent with previous studies emphasizing the importance of learner-centered approaches in mathematics education. Earlier studies generally reported that independent learning positively influences students' academic achievement and engagement [23], [24]. However, many previous studies focused mainly on the relationship between learning autonomy and achievement without examining how autonomy can be cultivated through diverse learning resources. In contrast, the present study highlights the role of Resource-Based Learning combined with peer tutoring and instructional materials in fostering autonomous learning behaviors [25]. Therefore, this study extends previous findings by providing empirical evidence from a classroom action research context.

This study offers novelty in the application of Resource-Based Learning as a strategy for cultivating mathematics learning autonomy through the integration of various learning resources. The novelty lies not only in the utilization of textbooks and worksheets but also in the optimization of peer tutors, instructional media, and the learning environment as complementary learning resources. This approach is in line with the demands of twenty-first-century education, which emphasize self-directed learning and lifelong learning skills [26]. Unlike conventional teacher-centered instruction, the present study demonstrates that students can construct knowledge independently through exploration and interaction with multiple learning resources [27]. Therefore, this study provides a new perspective on fostering mathematics learning autonomy through a more constructivist and student-centered approach.

The implications of this study suggest that mathematics teachers should create learning environments enriched with various learning resources to encourage students' independent learning. The use of peer tutoring, diverse instructional materials, and relevant learning media can enhance students' engagement and participation in mathematics learning [28], [29]. Schools are also expected to provide adequate learning resources to support the effective implementation of Resource-Based Learning. In addition, the findings contribute practical insights for designing student-centered instructional strategies in mathematics education [30]. Consequently, Resource-Based Learning can serve as an effective alternative for improving the quality of mathematics instruction at the secondary school level.

Despite its contributions, this study has several limitations that should be considered when interpreting the findings. First, the study involved only one class with a relatively small number of participants, limiting the generalizability of the results [31]. Second, the intervention was conducted within two action cycles, making it difficult to capture the long-term development of students' learning autonomy. Third, the learning resources employed in the study were limited to materials available in the school environment. Therefore, future studies are recommended to involve larger samples, longer intervention periods, and technology-based learning resources to provide a more comprehensive understanding of mathematics learning autonomy [32].

4. CONCLUSION

This study concludes that the implementation of Resource-Based Learning through classroom action research effectively cultivated students' mathematics learning autonomy as reflected in improvements in initiative, self-confidence, and responsibility during the learning process. The findings also demonstrated that the increased level of learning autonomy was accompanied by better mathematics learning outcomes, indicating that the use of multiple learning resources contributed positively to students' academic achievement. These results confirm the expectation stated in the introduction that providing students with opportunities to learn independently through diverse learning resources can create more meaningful and student-centered mathematics learning experiences. In addition, the integration of peer tutors, worksheets, manipulative media, and library resources emerged as an important element in supporting the development of autonomous learning habits among students. The study further suggests that Resource-Based Learning can serve as an alternative instructional strategy for mathematics teachers seeking to strengthen students' self-regulated learning and optimize classroom practices. Nevertheless, future studies are recommended to involve larger samples, longer intervention periods, and more diverse educational settings in order to extend the applicability of the findings and enrich the body of knowledge regarding autonomy-oriented mathematics learning.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to the principal, mathematics teachers, and students of SMP Dahlia for their valuable cooperation and active participation throughout the research process. Appreciation is also extended to colleagues and academic supervisors for their constructive suggestions and support in completing this study. The author gratefully acknowledges all parties who contributed to the successful implementation of this research. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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