



The Interaction of Mini-Magz–Based Discovery Learning and Learning Motivation on Students’ Biology Learning Outcomes

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Abstract:

Background. Although Discovery Learning and innovative learning media have been widely applied in biology education, limited attention has been given to how students’ learning motivation interacts with media-supported Discovery Learning in shaping learning outcomes.

Aims. This study investigated the effects of Mini-Magz–based Discovery Learning and learning motivation, as well as their interaction, on students’ learning outcomes in the human excretory system topic.

Methods. We used a quantitative, quasi-experimental posttest-only control group design. We used purposive sampling to select 46 pupils from two classrooms out of 92 eleventh-grade students at SMA Baitul Makmur in Metro City, Indonesia. The control group received traditional training, while the experimental group received Mini-Magz-based Discovery Learning. We used a cognitive learning outcomes exam, a learning motivation questionnaire, interviews, and a Mini-Magz assessment rubric to gather data. To investigate the effects of the instructional model, learning motivation, and their interaction, we conducted preliminary tests of normality and homogeneity before hypothesis testing.

Result. The findings showed that Mini-Magz-based Discovery Learning significantly affected students’ learning outcomes. Highly driven students showed higher learning results than less motivated students. Learning motivation also had a major impact. Additionally, learning outcomes were linked to both instructional technique and students’ internal motivational elements, as the study discovered an interaction between the instructional model and learning motivation.

Conclusion: Instead of focusing only on instructional innovation, the study builds on earlier research by examining Mini-Magz-based Discovery Learning and learning motivation within an integrated analytical framework. These results imply that integrating student-centered Discovery Learning with captivating Mini-Magz media can support more active and meaningful biology learning while encouraging students’ learning motivation.

Keywords: Discovery Learning; Mini-Magz; learning motivation; learning outcomes; biology education; human excretory system



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INTRODUCTION

Learning is an interaction between students and different learning resources, with the goal of improving competence and changing behavior (Sulfemi, 2022). In reality, the models, techniques, and media educators use significantly affect students' learning outcomes (Sugiyono, 2021). However, in practice, many learning procedures remain teacher-centered, which makes students passive and less engaged in their own conceptual discovery (Khasinah, 2021). Classroom observations in grade XI at SMA Baitul Makmur, Metro City, revealed several biology learning issues, especially in the human excretory system. Teacher-student interaction was limited, textbook-summary exercises predominated, and instruction was repetitive. As a result, students' willingness to study was low, as shown by their low engagement, lack of focus, and tendency to get bored and sleepy during class. Students' learning success is significantly influenced by their drive to learn (Uno, 2021; Sari & Nugroho, 2023).

Because it necessitates knowledge of interconnected physiological processes and the relationship between organ form and function, the human excretory system is a highly difficult issue. As a result, students require a learning approach that promotes their active participation, critical thinking, and autonomous concept discovery. Discovery Learning is one such paradigm that stresses discovery through investigation, observation, and analysis (Bruner, 1961; Khasinah, 2021). This methodology requires engaging, relevant learning materials to be effective. One innovation is Mini-Magz, a condensed version of course content that students imaginatively create and present as a small magazine. Because it blends textual and visual components, this medium has been shown to increase students' conceptual understanding and motivation to learn (Tanjung et al., 2020; Mau et al., 2024).

Students' learning success is influenced by both internal and external elements, such as learning motivation and learning models and media. Highly motivated students are typically more engaged, persistent, and driven to achieve the best possible learning results (Emda, 2021; Uno, 2021). Based on this background, this study examined how learning motivation and Mini-Magz-based Discovery Learning affected students' learning outcomes in the human excretory system. This study is expected to address the highlighted learning issues and provide a more creative and effective alternative learning approach.

Although most Indonesian educators use the discovery paradigm, they still face difficulties. The results show that teaching students to produce fantasy story texts using the innovation model can enhance their writing abilities, particularly in originality, critical thinking, and idea organization. Because this method enables students to independently

uncover the content and meaning in the text, they are more engaged, excited, and challenged during the learning process. The use of instructional technologies, classroom creativity, and teamwork among educators are all on the rise. Teachers can create more creative and efficient ways to deliver instructional content using the invention model. Despite these advantages, obstacles remain, including inadequate infrastructure, a lack of technical expertise, and limited technological readiness among students and teachers. To fully execute this strategy, teachers frequently need to learn on their own. Educators hope a more adaptable, user-friendly, and accessible learning approach will emerge. A curriculum that supports discovery models, continuous training, and the use of digital devices in classrooms is necessary. To achieve more efficient and equitable learning, cooperation between the government and educational institutions is required (Yulianti et al., 2025). Teachers have an optimistic outlook on how learning methods will evolve in the future. To support more engaging and productive learning, they want to use learning models that are more varied, advanced, adaptable, and accessible. Modern devices, reliable internet connections, and ongoing teacher training are all necessary supports. The recommendations also focus on choosing a suitable learning model, creating a strategic plan, and modifying the curriculum to match the skills needed to apply the relevant learning model. To achieve this goal, the government and educational institutions must work together to ensure learning models are integrated optimally and improve learning quality. Both students and teachers benefit greatly from educational technology in language acquisition, particularly when training junior high school pupils to produce fantasy writing. By using an interactive method and offering a wider variety of content, the innovation model promotes student engagement in learning to produce fantasy literature. In addition to increasing access to education, discovery models in education give teachers opportunities to develop their abilities, creativity, and teamwork. However, the educational discovery paradigm can enhance students' critical thinking, creativity, and involvement in the learning process.

METHOD

This investigation employed a quantitative, quasi-experimental methodology. An experimental class and a control class comprised the two groups in the study's posttest-only control group design (Santoso & Madiistriyatno, 2021). The population comprised all 92 eleventh-grade students at SMA Baitul Makmur. Purposive sampling, a method where samples are chosen depending on particular factors, was used to choose the sample (Swarjana, 2022). With 46 pupils in total, Class XI C was designated as the experimental class and Class XI D as the control class. Students' learning outcomes were the dependent variable, and learning

motivation and the Mini-Magz-based Discovery Learning paradigm were the independent variables. The data collection tools included a learning outcomes test (posttest) to gauge students' cognitive abilities, a learning motivation questionnaire with a Likert scale (Arikunto, 2020), interviews, and a Mini-Magz assessment rubric as supporting data. To ascertain the impact of each independent variable and their interaction on the dependent variable, precondition tests (normality and homogeneity) were used to assess the data before hypothesis testing.

A popular student-centered teaching strategy, discovery learning, enables students to build knowledge through individual concept discovery, problem solving, observation, and exploration. Learning resources that encourage students to actively interact with difficult scientific ideas can increase the efficacy of Discovery Learning in biology instruction. One such medium is Mini-Magz, which combines student-generated summaries, visual components, and succinct textual explanations. Prior studies have shown that Mini-Magz-assisted Discovery Learning can greatly enhance students' cognitive biology learning outcomes, notably in the topic of the human excretory system. Similarly, this manuscript acknowledges Mini-Magz as a succinct, visually appealing, and captivating medium that fosters students' ability to organize knowledge, condense information, and think creatively. However, learning outcomes are not solely determined by instructional methods and learning materials. Students' intrinsic traits, especially their motivation to learn, may affect their engagement, perseverance, focus, and success. Thus, by examining learning motivation alongside the interplay between instructional and learner-related elements, this paper expands the analysis of Mini-Magz-based Discovery Learning. Research Deficit: Although evidence supports both Mini-Magz and Discovery Learning, a significant knowledge gap remains regarding how variations in students' learning motivation affect the efficacy of Mini-Magz-based Discovery Learning. Closely related previous studies mainly examined whether Mini-Magz-assisted Discovery Learning improved learning outcomes in cognitive biology compared with traditional teaching methods. Tanjung et al., for instance, investigated Mini-Magz-assisted Discovery Learning on the human excretory system, but instead of using learning motivation as an extra explanatory element in the reported design, they concentrated on cognitive learning outcomes. Prior research has examined Mini-Magz alongside a learner-related variable. One such study explored students' learning interest and how it interacted with the instructional strategy by combining Mini-Magz with STAD cooperative learning. But rather than Discovery Learning, learning motivation, and the human excretory system, the study focused on STAD, learning interest, ecosystem material, and junior secondary students. To close this gap, this

study integrates learning motivation and Mini-Magz-based Discovery Learning into a single analytical framework. Specifically, it tests whether these factors interact to affect biology learning outcomes.

This study is innovative because it examines the combined and interactive roles of instructional innovation and students' learning motivation rather than just the isolated efficacy of Mini-Magz-based Discovery Learning. The study specifically assesses three relationships: the impact of learning motivation on learning results, the impact of Mini-Magz-based Discovery Learning on learning outcomes, and the relationship between learning motivation and the instructional model. The study reports significant effects for both parameters and an interaction between them. Therefore, the contribution lies in offering a more comprehensive explanation of biology achievement by linking an external instructional factor (Mini-Magz-based Discovery Learning) with an internal learner aspect (learning motivation), rather than in introducing Mini-Magz itself. While earlier research has shown that Mini-Magz and Discovery Learning can improve students' cognitive learning outcomes, most evidence has focused on the direct impact of the teaching method. Little research has examined how students' intrinsic traits, especially learning motivation, interact with Mini-Magz-based Discovery Learning to determine biology learning outcomes. This gap matters because students' motivation to participate in the learning process may affect how effective an innovative teaching technique is. Thus, this study is novel in combining learning motivation and Mini-Magz-based Discovery Learning into a single analytical framework and analyzing both their individual effects and their interaction in predicting students' learning outcomes in the human excretory system topic. Thus, the purpose of this study was to examine: (1) the impact of Mini-Magz-based Discovery Learning on students' learning outcomes; (2) the impact of learning motivation on students' learning outcomes; and (3) the relationship between learning motivation and the instructional model.

METHODS

This study examined the impacts of learning motivation and Mini-Magz-based Discovery Learning on students' learning outcomes on the human excretory system using a quantitative, quasi-experimental methodology. An experimental group and a control group were included in the study's posttest-only control group design. The control group received traditional training, while the experimental group was taught using Mini-Magz-based Discovery Learning. The following is a representation of the research design:

Group	Treatment	Posttest
Experimental	Mini-Magz–based Discovery Learning	O ₁
Control	Conventional instruction	O ₂

O₁ represents the experimental group's posttest learning-outcome score, while O₂ represents the control group's.

1. Sample and Population

The study population consisted of 92 eleventh-grade students from SMA Baitul Makmur in Metro City. The researchers used purposive sampling to select the sample, choosing classes based on criteria aligned with the study's goals. Class XI D was designated as the control group and Class XI C as the experimental group. Both classes had 46 pupils.

2. Research Factors

The study explored one dependent variable and two independent factors. The instructional model, which included both traditional instruction and Mini-Magz-based Discovery Learning, was the first independent variable. Students' motivation to learn was the second independent variable, which was classified based on the results of the learning motivation questionnaire. Students' cognitive learning outcomes in the human excretory system topic served as the dependent variable. Thus, the study looked at three primary effects: (1) how learning outcomes were affected by Mini-Magz-based Discovery Learning; (2) how learning motivation affected learning outcomes; and (3) how learning motivation and the instructional model interacted to determine students' learning outcomes.

3. Research Tools and Information Gathering

The study used a learning outcomes test, a learning motivation questionnaire, interviews, and a Mini-Magz assessment rubric to gather data. After the instructional intervention, students' cognitive achievement was assessed using the learning outcomes test as a posttest. Students' motivation during the learning process was evaluated using a Likert-type scale in the learning motivation questionnaire. The Mini-Magz assessment rubric and interviews served as auxiliary tools to provide further details on how the learning activities and students' Mini-Magz products were implemented. The instruments listed in the submitted manuscript are these ones.

4. Experimental Procedure

The study had three primary phases: planning, implementation, and assessment. The researchers created instructional materials and Mini-Magz exercises, established the experimental and control groups, and set up the research tools at this phase. Students in the

experimental group engaged in educational activities utilizing Mini-Magz-based Discovery Learning during the deployment phase. Active student participation in exploring information, identifying and analyzing pertinent concepts, and organizing learned material into Mini-Magz products were key components of the learning process. Students in the control group, on the other hand, received traditional instruction on the same subject related to the human excretory system. Both groups took the posttest to gauge their learning outcomes following the instructional session. The Mini-Magz assessment rubric and interviews supplied supporting information, and the motivation questionnaire evaluated students' motivation to study.

5. Data Analysis

The quantitative data underwent multiple levels of analysis. Students' learning outcomes and motivation were first summed up using descriptive statistics. Second, to determine whether the data met the assumptions required for hypothesis testing, precondition analyses used homogeneity and normality tests. To ascertain (1) the impact of the instructional model on learning results, (2) the impact of learning motivation on learning outcomes, and (3) the interaction between the instructional model and learning motivation, hypothesis testing was then carried out. We used the study criteria to determine statistical significance.

6. Important additions before submission

The number of students in each class; criteria used for purposive sampling; number and length of instructional sessions; precise Discovery Learning syntax; number and type of test items; motivation indicators and number of questionnaire items; instrument validity and reliability results; method used to classify high versus low motivation; statistical software; significance level (e.g., $\alpha = .05$); and ethical approval/consent procedures are just a few of the details that the manuscript should still include for greater methodological transparency. The current publication does not include these specifics, merely stating that precursor tests and hypothesis testing were carried out. Adding these elements would make the Methods section more replicable and appropriate for an international education journal.

DISCUSSION

The findings demonstrate that students' learning outcomes are positively impacted by the Mini-Magz-based Discovery Learning methodology. This is because the model positions students as active learners who participate in idea discovery.

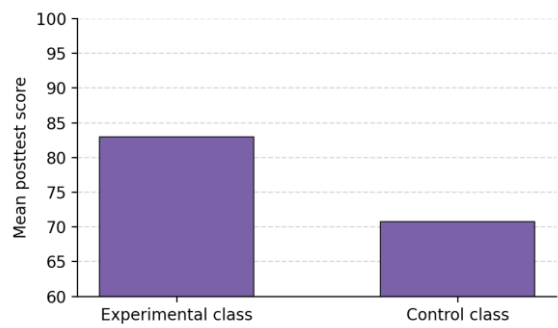


Figure 1. Learning outcomes of the experimental and control classes

Enhancing pupils' comprehension is another significant benefit of using Mini-Magz as a teaching tool. Mini-Magz helps students grasp difficult excretory system ideas by presenting information in a clear, visually appealing, and captivating manner. Additionally, creating Mini-Magz strengthens students' ability to organize knowledge independently, summarize information, and think creatively. Learning outcomes are also impacted by learning motivation. Students with high levels of motivation are typically more engaged, attentive, and persistent learners. On the other hand, unmotivated students are more likely to be inactive and have less success comprehending the subject matter. The relationship between the learning model and learning motivation demonstrates that students' internal circumstances as well as the method employed determine how effective learning is. When there is strong learning motivation, a good learning model produces the best outcomes. Therefore, integrating Mini-Magz with Discovery Learning is a successful method for raising students' motivation and learning outcomes. Jayanti and Komariah (2022). The purpose of this study is to ascertain how students' concept comprehension in class XI is affected by discovery learning on cell material. Quasi-experiments and a non-equivalent pretest-posttest control group design were employed in this study's quantitative research methodology. Lesson plans, student workbooks, and textbooks were used as learning resources. Reasoned multiple-choice written examinations with 20 pretest-posttest questions were used as data collection tools. The Madrasah Aliyah Batu Bara served as the research site. The study's population consisted of all three XI IPA classes, and a cluster random sampling technique was utilized to select a sample of 60 students from two classes. Class XI IPA 2 is a control group that employs traditional learning techniques, while Class XI IPA 1 is an experimental group that uses the discovery learning paradigm. ANCOVA was used in this study's data analysis. The findings demonstrated that students' conceptual understanding of cell material was impacted by the discovery learning strategy.

Adlini & Manalu (2024). This study examined the impact of the Project-Based Learning (PjBL) model on students' creative thinking during the digestive system course at SMAS Brigjend Katamso II. This study used a quasi-experimental design with a non-equivalent control group. All XI students at SMAS Brigjend Katamso II, comprising four classes and 135 students, were included in the study population. Two classes made up the research sample using the Cluster Random Sampling technique: Science 2, the experimental class with 34 students, and Science 3, the control class with 34 students. A descriptive test with four questions was employed as the research tool to measure pupils' capacity for original thought. A t-test with normality and homogeneity conditions was used to test this study's hypothesis. H_a was approved while H_o was rejected because the post-test t-test analysis yielded t-count 4.34 and t-table 1.69, indicating that $t\text{-count} > t\text{-table}$. Thus, the project-based learning paradigm has an impact on the capacity for creative thought.

CONCLUSION

The study's findings support the following conclusions: (1) students' learning outcomes in the subject of the human excretory system are significantly impacted by the Mini-Magz-based Discovery Learning model; (2) students' learning outcomes are significantly impacted by learning motivation; and (3) there is an interaction between the learning model and learning motivation in influencing students' learning outcomes. Thus, when combined with initiatives to boost students' enthusiasm to study, Mini-Magz-based Discovery Learning can be an effective teaching strategy for enhancing students' learning results.

RECOMMENDATIONS

1. For educators: The Mini-Magz-based Discovery Learning paradigm is recommended as a creative teaching option, especially for difficult subjects like the excretory system. To boost students' enthusiasm to study, teachers should also establish a stimulating, dynamic classroom environment.
2. For schools: It is anticipated that schools will employ more creative learning models and media, have sufficient facilities, and provide teachers with training to enhance their capacity to create creative lessons.
3. For students: It is anticipated that students will take an active role in their education, become more motivated to learn, and use resources like Mini-Magz to assist them comprehend the content on their own.

4. For future researchers: To get more thorough results, future researchers are encouraged to expand this study to different subjects and incorporate additional characteristics, such as creativity or affective and psychomotor elements.

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