

Students' Initial Ability on The Concept of Heredity SMA Negeri 1 Seunagan

Silvia Uziaty¹, Nurlena Andalia^{2*}, Ibrahim²

¹Students of the Master of Biology Education Study Program, Postgraduate, Universitas Serambi Mekkah, Aceh, Indonesia

²Lecturer of the Master of Biology Education Study Program, Postgraduate, Universitas Serambi Mekkah, Aceh, Indonesia

*Corresponding Author: nurlena.andalia@serambimekkah.ac.id

Abstract. *The initial ability of students is an important factor that affects the success of biology learning, especially in abstract and conceptual heredity materials. This study aims to analyze the initial ability of students on the concept of heredity through the results of pre-test students in grade XII Health at SMA Negeri 1 Seunagan. This study uses a quantitative descriptive approach with 36 research subjects. The instrument used is in the form of a pre-test given before the learning of inheritance material is carried out. The data was analyzed descriptively to see the distribution and tendency of students' initial abilities. The results of the study showed that the students' pre-test scores were in the score range of 50 to 80. Most students scored in the medium category, with a predominance score of 60 and 70, while only a small percentage of students reached the high category with a score of 80. These findings indicate that in general, students' initial ability to the concept of heredity is still not optimal and shows that there is a significant variation in abilities within one class. This condition indicates the need for learning planning that takes into account the differences in students' initial abilities so that the learning process can take place effectively and meaningfully. Based on the results of the analysis, it can be concluded that the initial ability of grade XII students of SMA Negeri 1 Seunagan Health in hereditary material is in the medium category and still needs to strengthen the concept. The results of this research are expected to be the basis for teachers to design strategies, models, and learning media that are more in line with the characteristics and learning needs of students.*

Keywords: Early Ability, Pre-Test, Heredity, Biology Learning

1. Introduction

Biology learning at the high school level has a strategic role in shaping students' conceptual understanding of life phenomena and their application in daily life (Larasati, 2023; Titin & Kurnia, 2022; Asikin, 2024; Zaliani et al., 2024). One of the essential materials in biology is the concept of heredity (Jiyanto, 2022; Nerizka et al., 2021; Nur Amini & Naimah, 2020; Rohman, 2022; Wulandari et al., 2024), which discusses the mechanism of inheritance of traits from one generation to the next. This material is not only conceptual, but also demands strong logical, analytical, and abstract comprehension skills. Therefore, the success of learning heredity material is greatly influenced by the initial readiness and basic knowledge possessed by students before the learning process takes place.

Prior knowledge is one of the important factors that determine the effectiveness of learning. Learners do not come to class as individuals who are devoid of knowledge, but rather have brought with them previous learning experiences that can influence the way they understand new concepts. In the context of biology learning, good initial ability will make it easier for students to relate new concepts to the knowledge they already have, while low initial ability has the potential to cause misconceptions and learning

difficulties. Therefore, early ability measurement is an important step as the basis for effective and meaningful learning planning (Pamungkas et al., 2017; Rahmadani et al., 2022; Takaendengan et al., 2022).

The concept of heredity is known as one of the complex biological materials and often causes difficulties for students (Arifin et al., 2021; Firdaus et al., 2024). This material covers various abstract concepts such as genes, chromosomes, alleles, Mendel's law, crossing, and inheritance of traits in humans. Various studies show that students often have difficulty understanding the relationship between these concepts, especially when learning is not based on mapping students' initial abilities. As a result, the learning process tends to be one-way and less able to accommodate the learning needs of students optimally.

One of the efforts to identify students' initial abilities is through the implementation of pre-tests before learning begins. The pre-test functions as a diagnostic tool to determine the initial level of students' understanding of the material to be studied. The results of the pre-test can provide an overview of students' learning readiness, variations in abilities in one class, and potential misconceptions that need to be addressed from the beginning. Thus, teachers can design learning strategies, models, media, and approaches that are more in line with the characteristics of students.

At SMA Negeri 1 Seunagan, especially in class XII Health, heredity material is part of the biology curriculum which has a high level of complexity and requires a mature conceptual understanding. Based on previous learning experiences, there are variations in students' ability to understand genetic concepts. However, empirical data on students' initial ability in heredity materials is still limited and has not been systematically documented. This causes learning planning is often not fully based on the real conditions of students' abilities. Therefore, this study aims to analyze the initial ability of students on the concept of heredity through the results of pre-test students of grade XII Health at SMA Negeri 1 Seunagan.

This analysis is expected to provide an objective picture of the level of students' initial understanding, the distribution of abilities, and aspects of the concept of heredity that still need special attention in learning. The results of this research are not only useful for teachers in designing more effective learning, but can also be the basis for the development of data-based biology learning strategies oriented towards improving students' conceptual understanding.

Thus, the study of students' initial ability in heredity materials is important as a first step in improving the quality of biology learning in high school, especially in facing the challenges of learning abstract and conceptual materials such as genetics.

2. Methods

Types and Approaches to Research

This study uses a quantitative approach with a descriptive type of research. The quantitative descriptive approach was chosen because this study aims to objectively describe the initial ability of students on the concept of heredity based on the results of the pre-test without providing specific learning treatments or interventions. The data obtained was analyzed to determine the level, distribution, and tendency of students' initial abilities.

Research Subject and Location

This research was carried out at SMA Negeri 1 Seunagan in the 2025/2026

academic year. The subjects of the study were all students of class XII Health 1 which amounted to 36 people, consisting of male and female students. The sampling technique used is total sampling, because the entire class population is used as a research subject to obtain a comprehensive overview of the initial ability.

Research Instruments

The instrument used in this study is a pre-test in the form of written questions that are prepared based on indicators of competency achievement in heredity material. The pre-test questions cover the basic concepts of heredity, including the definition of heredity, genes and chromosomes, alleles, Mendel's law, simple crossing, and inheritance of traits in humans. The instrument was arranged in the form of objective questions with an assessment scale of 0–100. Before use, the instrument has been adjusted to the applicable curriculum and validated by the biology teacher.

Data Collection Techniques

Data collection is carried out by providing pre-tests to students before learning heredity material is carried out. The test is given in one meeting with a predetermined processing time. Students are asked to work on the questions independently without the help of other learning resources. The results of the pre-test work are then collected and assessed in accordance with the scoring guidelines that have been set.

Data Analysis Techniques

The data from the pre-test results were analyzed using quantitative descriptive analysis techniques. The analysis was carried out by calculating the minimum grade, maximum grade, and frequency distribution of students' grades. Furthermore, pre-test scores are categorized into initial ability levels, namely low, medium, and high categories. The results of the analysis are presented in the form of tables and narrative descriptions to provide a clear picture of the students' initial ability on the concept of heredity.

Research Procedure

1. The research procedure is carried out through several stages, namely:
2. The preparation stage includes the preparation of pre-test instruments and the determination of research subjects.
3. The implementation stage, namely giving pre-tests to students before learning heredity material begins.
4. The data processing and analysis stage, in the form of scoring pre-test results and descriptive data analysis.
5. The reporting stage, which is the preparation of research results and discussions based on the findings obtained.

3. Results & Discussion

Results

The results of this study were obtained from the analysis of the data of the pre-test scores of heredity material which was attended by 36 students of class XII Health 1 SMA Negeri 1 Seunagan. Pre-tests are given before learning heredity material is carried out with the aim of finding out students' initial ability to basic concepts of heredity. The following are the results of student scores in the following table.

Table 1. Class XII Health Academic Year 2025/2026

Name	Male/Female	Pre-Test Scores
Abdul Razakul Fatahul Alim	M	50
Aja Uzlifia Ullya	F	60
Audia Poeh Lena	F	60
Ayu Fadhillah MD	F	80
Azkya Humairah	F	70
Caesar Syabil Afnan	M	50
Chandra Purnama	M	50
Cintya Ramadhani	F	60
Cut Mella Annisa	F	60
Dario Dwi Ahyan	M	50
Deby Salsabila Qhairani	P	60
Farah Maulina Amren Zakaria	F	70
Gevan Sandrean Mexi	M	50
Icha Gustianda	F	60
M. Alfi	M	70
M. Faizin Al Khaliqi	M	50
M. Hazel Musdariansyah	M	80
Maulidia Nabila	F	60
Najmiatul Humaira	F	60
Nanda Ariansyah	M	60
Nazhifah Salsabila	F	70
Nissa Mahira	F	70
Noviza Hijriah	F	70
Putri Adilla Husni	F	60
Putri Natasya	F	60
Ratu Langi	F	80
Rosma Dila	F	70
Saira Maghfirah	F	70
Silka Amelia	F	70
Silva Aiyalismi	F	60
Siti Dwi Syakira	F	70
Susan Maulida	F	60
Syifa Zahirah	F	70
Syurahbil Ardhian	M	70
Yuni Ronalia	F	60
Zahratul Nahya	F	60

Based on the results of the descriptive analysis, the students' pre-test scores are in the range of 50 to 80 scores. The lowest score obtained by students is 50, while the highest score is 80. The average (mean) of students' pre-test scores is 63.33, with a median score of 60. These findings show that in general, students' initial ability to inheritance material is in the medium category.

The distribution of pre-test scores showed that a score of 60 was the most dominant score, obtained by 15 students (41.67%). Furthermore, a score of 70 was obtained by 12 students (33.33%). Meanwhile, a score of 50 was obtained by 6 students (16.67%), and only 3 students (8.33%) achieved a score of 80. This distribution of values indicates that most students do not have an optimal mastery of the concept of heredity before learning begins.

If categorized based on the initial ability level, students with a score of ≤ 59 are included in the low category, scores of 60–69 are included in the medium category, and $\geq$ scores of 70 are included in the high category. Based on this categorization, there were 6 students (16.67%) who were in the low ability category, 15 students (41.67%) were in the medium category, and 15 students (41.67%) were in the high category. Although the proportion of medium and high categories is relatively balanced, there are still a number of students with low initial abilities who require special attention in the learning process.

Overall, the results of the study show that the initial ability of students in grade XII Health 1 SMA Negeri 1 Seunagan in hereditary material still varies and tends to be at a moderate level. This variation in ability reflects the difference in understanding of basic genetic concepts among students, so learning heredity materials needs to be designed adaptively by considering the conditions of these initial abilities.

Discussion

The results of the study showed that the initial ability of students in grade XII of Health 1 State High School 1 Seunagan on the concept of heredity was in the medium category with a significant variation in ability. The range of pre-test scores obtained by students, which is between 50 and 80, indicates that there is a difference in the knowledge background and learning readiness of students before learning heredity material is carried out. This is in line with the view of constructivism which states that learners bring diverse initial knowledge into the learning process, which in turn will affect the way they understand new concepts.

The dominance of pre-test scores at scores of 60 and 70 shows that most students already have a basic understanding of the concept of heredity, but this understanding is not yet deep and comprehensive. Students may already be familiar with basic terms such as genes, chromosomes, and trait inheritance, but still have difficulty relating these concepts in their entirety, especially in the application of Mendel's law and cross-sectional analysis. This shows that students' initial understanding is still at the level of concept recognition, not at the level of complete conceptual understanding.

A small number of students who obtained high scores (score of 80) showed that there was a group of students who had good initial skills. Students in this category are suspected to have stronger previous learning experiences, either through classroom learning, independent learning, or other learning resources. The existence of students with high initial abilities in one class can be a positive potential if used appropriately, for example through collaborative learning or group discussions, so that it can help other students who are still experiencing difficulties.

On the other hand, the presence of students with low scores (score of 50) shows that there are still groups of students who have a weak initial understanding of the concept of heredity. This condition needs special attention because heredity material is hierarchical and interrelated between concepts. If students do not have an adequate initial understanding, then they have the potential to experience ongoing difficulties and form misconceptions during the learning process. Therefore, the results of this pre-test confirm the importance of early ability identification as an initial step in learning planning.

The variation in initial abilities found in this study shows that learning heredity material cannot be delivered with a uniform approach. Teachers need to design adaptive and differentiated learning, taking into account the differences in students' initial abilities. Students with low initial abilities need reinforcement of basic concepts and visual or contextual assistance, while students with higher abilities may be given challenges in the

form of more complex analytical or problem-solving problems. Thus, learning can take place more effectively and meaningfully for all students.

The findings of this study also reinforce the importance of using pre-tests as diagnostic tools in biology learning. The pre-test not only serves to determine the initial achievements of students, but also provides important information for teachers in determining learning strategies, model selection, and appropriate media use. In the context of heredity material, the results of the pre-test can be the basis for determining whether learning needs to begin with reinforcement of basic concepts, discussion of misconceptions, or directly on the application of concepts through case studies.

In addition, the initial ability of students in the medium category shows that there is still a great opportunity to improve learning outcomes through appropriate learning interventions. With learning planning based on initial ability data, teachers can optimize the learning process so that students not only memorize concepts, but also be able to understand and apply them in the context of daily life, especially related to the inheritance of traits in humans and health.

The results of this study are in line with various previous studies that stated that early ability has a strong correlation with student learning outcomes. Students with better initial abilities tend to understand new concepts more easily, while students with low initial abilities need more time and intensive learning strategies. Therefore, mapping initial abilities through pre-tests is a strategic step in improving the quality of biology learning, especially in abstract materials such as heredity.

Overall, this discussion emphasizes that students' initial ability in heredity materials at SMA Negeri 1 Seunagan still needs reinforcement through planned, adaptive, and data-based learning. The results of this research can be the basis for teachers and education researchers to design biology learning that is more effective, innovative, and oriented towards improving students' conceptual understanding.

4. Conclusion

Based on the results of the research and discussion, it can be concluded that the initial ability of students in grade XII of Health 1 SMA Negeri 1 Seunagan on the concept of heredity is in the medium category, with a pre-test score range between 50 to 80. Most students obtained scores of 60 and 70, which indicates that students already have a basic understanding of the concept of heredity, but this understanding is not yet fully deep and comprehensive.

The results of the pre-test also showed that there was a significant variation in initial ability within one class, both in the low, medium, and high categories. This variation indicates the difference in the knowledge background and learning readiness of students before learning heredity material is carried out. This condition emphasizes the importance of early ability identification as a basis for designing adaptive learning in accordance with the characteristics of students. Overall, the results of this study confirm that the implementation of pre-tests has an important role as a diagnostic tool to map the initial abilities of students. The information obtained from the results of the pre-test can be used by teachers as the basis for planning more effective strategies, models, and learning media, especially in abstract and conceptual heredity materials. With learning designed based on students' initial abilities, it is hoped that students' conceptual understanding and biology learning outcomes can be optimally improved.

5. References

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