Needs Analysis as Basis for the Development of an SSI-Based Module for Teaching Non-Mendelian Inheritance

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ABSTRACT

This study aimed to identify the learning needs of both students and Biology teachers in the lesson on non-Mendelian genetics, as a basis for developing a Socio-Scientific Issue (SSI)-based module. Specifically, it determines students' prior knowledge of the topic, problems encountered, and coping techniques, as well as teachers' difficulties in the teaching-learning process and their familiarity with the SSI-based module as an instructional tool for teaching non-Mendelian inheritance. The study employed a qualitative descriptive research design, using open-ended questions administered to 60 Grade 9 students and 5 Science teachers at the selected secondary school in Iligan City who had already learned about and taught non-Mendelian inheritance, respectively. The collected data were analyzed using thematic analysis to identify themes and codes. Results show that both students and teachers struggle with the abstract nature of non-Mendelian inheritance. Students have misconceptions, low retention, and rely on self-study despite teachers' effort and use of various strategies such as real-life examples, visual aids, and problem-based learning; thus, these strategies are not always effective. In addition, SSI-based instruction is limited and rarely used because teachers are unfamiliar with it. The findings highlight the need for a structured SSI-based module that uses real-world contexts to improve critical thinking, engagement, and decision-making skills among students. Also, such a module can help teachers teach effectively and assist students in understanding complex non-Mendelian inheritance.

Keywords— Socio-Scientific Issues (SSI), non-Mendelian Inheritance, Needs Analysis, Science Education, Genetics Learning

INTRODUCTION

Science is a core subject in the Philippines' K-12 curriculum, but despite curriculum changes, it continues to struggle to foster scientific literacy, as evidenced by poor international assessment results. The Philippines participation in the Programme for International Student Assessment (PISA) 2022, only about 23% of Filipino students reached basic science levels, which is far below the Organisation for Economic Co-operation and Development (OECD) average of 76% (OECD, 2023). In addition, the Philippines scored 249 in science in the 2019 Trends in International Mathematics and Science Study (TIMSS). The country ranked lowest among the 58 participating countries (International Association for the Evaluation of Educational Achievement (IEA), 2020). These results highlight a gap in students' scientific understanding and emphasize the urgent need for more effective, contextualized, and innovative teaching methods in science education.

Filipino students' poor science test scores highlight issues with resources and teaching, especially in complex topics that require higher-order thinking skills and the integration of concepts. Genetics, especially non-Mendelian inheritance, has been consistently recognized as one of the least mastered topics among Filipino secondary school students. According to Laguindab et al. (2025), non-Mendelian inheritance patterns remain challenging because they demand higher-order reasoning, abstraction, and visualization skills. Similarly, Galeza (2025) stated that the non-Mendelian Law of Inheritance is a difficult concept to learn because it involves abstract and complex ideas that require a thorough understanding of genetics. Moreover, studies by Eviota and Boyles (2022) and Santos et al. (2021) showed that non-Mendelian inheritance is among the least mastered competencies in Grade 9. Therefore, this highlights the importance of targeted instructional strategies that not only address students' conceptual challenges but also incorporate relevant socio-scientific issues to promote a deeper understanding, critical thinking, and real-world application of non-Mendelian inheritance concepts.

Instructional materials serve as a bridge between teachers and students, conveying instructions. They can also serve to motivate the teaching and learning process (Adalikwu & Iorkpilgh, 2013). However, science lessons often rely on traditional lecture approaches, which may not effectively enhance student learning (Macalikod & Simpal, 2025). Without effective teaching strategies and appropriate instructional resources, students might continue to struggle to grasp essential scientific principles (Fluther et al., 2022). Socio-scientific issues (SSI) are societal problems that directly link to science, enabling students to connect abstract scientific ideas with real-world challenges and ethical considerations. Instead of teaching only the concept, students are pressured to analyze and argue certain societal issues using scientific evidence. Through this, it enhances students' decision-making skills and critical thinking. Omictin et al. (2024) described SSI as open-ended, complex social issues that are conceptually connected to science. SSI-based instruction effectively teaches abstract scientific concepts by utilizing learning with ethical societal contexts, thus encouraging active learning. However, despite the known difficulties in teaching non-Mendelian inheritance, there are few studies that focus on the use of an SSI-based module as an instructional material specifically designed to address these difficulties at the secondary level.

In the context of non-Mendelian inheritance, which remains one of the least mastered competencies, this study aims to bridge the gaps by conducting a needs analysis to determine whether integrating a Socio-Scientific Issues (SSI)-based module is necessary for teaching the topic. The study aims to identify students' learning gaps, challenges, and misconceptions regarding non-Mendelian inheritance, and to examine teachers' instructional practices, the resources currently used, and their familiarity with SSI. The findings will serve as the foundation for developing an SSI-based instructional module that addresses the needs of both students and teachers, promotes critical thinking, enhances real-world application, and fosters students' decision-making skills regarding scientific societal issues, making abstract non-Mendelian inheritance more meaningful for students.

METHODOLOGY

Research Design

The study employed a qualitative research design to determine the need to integrate a Socio-Scientific Issues (SSI)-based module in teaching non-Mendelian inheritance. Data were collected through open-ended questionnaires to explore the experiences and challenges of both students and Science teachers in learning and teaching the topic. The collected data were analyzed using thematic analysis to identify recurring patterns and themes.

Participants

The participants of the study consisted of 60 Grade 9 students and 5 Science teachers from the selected secondary school in Iligan City. All participants had already completed the lessons on non-Mendelian inheritance, enabling them to provide relevant insights regarding learning difficulties, misconceptions, and instructional practices.

Instruments

Data were gathered using an open-ended questionnaire adopted and modified from Omictin et al. (2024). The instrument was designed to collect information on students' understanding, difficulties, and coping strategies in learning non-Mendelian inheritance, as well as teachers' challenges in the teaching-learning process, pedagogical approaches, and familiarity with Socio-Scientific Issues (SSI).

Data Collection

The questionnaire was administered to both students and teachers. Participants were given clear instructions

to provide detailed, honest, and reflective responses. After collection, the responses were organized, reviewed, and coded in preparation for thematic analysis.

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Data Analysis

Responses from the open-ended questionnaires were analyzed using thematic analysis to identify recurring patterns and themes related to students' understanding, difficulties, and coping strategies, as well as teachers' challenges, instructional strategies, and familiarity with SSI. For confidentiality purposes, respondents were assigned codes. *NAS-T1* refers to "Needs Analysis Survey: Teacher 1," while *NAS-S1* refers to "Needs Analysis Survey: Student 1."

Ethical Considerations

Prior to data collection, the researcher obtained approval by submitting a formal letter to the Department of Education (DepEd) Superintendent and the Research Program Coordinator of the Division of Iligan City. Upon approval, the signed letter was presented to the school principal of the participating secondary school.

Participants were informed about the purpose of the study and were assured that their responses would remain confidential. Participation was voluntary, and respondents had the right to withdraw at any time without any consequences. The study strictly adhered to ethical standards to ensure the protection of participants' rights, privacy, and well-being throughout the research process

RESULTS AND DISCUSSION

Table 1. Complete Responses on the Needs Analysis for Students on Non-Mendelian Inheritance

Themes	Codes	Mentions	Sample Answers
Definition of Non-Mendelian Inheritance	Distinction from Mendelian Inheritance	17	**NAS-S23; NAS-S7:**. "The patterns of inheritance that don't follow Mendel's laws, like incomplete dominance, codominance, and polygenic traits." **NAS-S12; NAS-S13; NAS-S36; NAS-S48; NAS-S54; NAS-S39:** "Non-Mendelian is a gene that goes to offspring that don't follow the dominant and recessive rules." **NAS-S15; NAS-23; NAS-S30; NAS-S43; NAS-S46; NAS-S50; NAS-S52; NAS-S57; NAS-S60:** "Non-Mendelian Inheritance doesn't follow Mendel's Law."
	Basic Conceptual Recognition	16	**NAS-S2; NAS-S6; NAS-S16; NAS-S19; NAS-38; NAS-S42; NAS-S24:** "In my opinion, non-Mendelian is a kind of trait of parents that pass down generation." **NAS-S22; NAS-S32; NAS-S49; NAS-S59:** "For me non-mendelian inheritance refers to pattern of inheritance. "
	Identification of Types of Non-Mendelian	18	**NAS-S40; NAS-S44; NAS-S45; NAS-S56; NAS-S33:** "For me, non-Mendelian is a genes that comes from your parents like blood types". **NAS-S20; NAS-S31; NAS-S34; NAS-S35; NAS-47; NAS-S41; NAS-S51; NAS-S53; NAS-S55; NAS-S37:** "Non-Mendelian is one of an incomplete dominance." **NAS-S1; NAS-S8; NAS-S10; NAS-S21; NAS-S5:** "Non-Mendelian is something that has multiple alleles." **NAS-S58; NAS-S18; NAS-S14:** "Non-Mendelian inheritance talks about incomplete dominance and codominance and the multiple alleles."
	Misconception/ Vague Understanding	6	**NAS-S9:** "As far as I remember non-Mendelian Inheritance is where you find out your someone elses phenotypes and genotypes based on your alleles." **NAS-S11:** "Its define the genetics of living things." **NAS-S25; NAS-S27; NAS-S29; NAS-S28:** "It is the method of getting the genes of the person, animals, plants"
	No Idea or Not Interested	2	**NAS-26:** "In my understanding, my preference on those types of topics never seem to interest me as a student." **NAS-S4:** "No idea po."

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Problems Encountered	No Response Difficult to Understand or Confusing topic	1 33	**NAS-S17** **NAS-S9; NAS-S12; NAS-S13; NAS-S21; NAS-S28; NAS-S29; NAS-S32; NAS-S43; NAS-S46; NAS-S48; NAS-S50; NAS-S52; NAS-S57; NAS-S59; NAS-S54; NAS-S20:** “The problems I encountered while learning non-Mendelian inheritance is I can’t understand it properly because its difficult.”
Coping Techniques	Poor Retention Problem Solving Understanding Steps Misconception Teaching-Related Difficulties Loss of Interest No Response Studying Hard Seeking Help from Teachers or Peers Reviewing Concepts Use of Technology	5 6 6 1 3 4 3 21 4 6 11	**NAS-S1; NAS-S4; NAS-S6; NAS-S7; NAS-S8; NAS-S11; NAS-S14; NAS-S30; NAS-S31; NAS-S38; NAS-S44; NAS-S45; NAS-S47; NAS-S49; NAS-S51; NAS-S25:** “The fact that learning non-Mendelian inheritance needed critical thinking because it’s a bit confusing.” **NAS-S5:** “This topic is very confusing and difficult.” **NAS-S2; NAS-17; NAS-S42; NAS-S60; NAS-S24:** “The problem I encountered was forgetting the past lessons.” **NAS-S33; NAS-S37; NAS-S41; NAS-S56; NAS-S53:** “Problem is if two homozygous we encountered how bloods connect.” **NAS-S23:** “The problems I encountered back then while learning non-Mendelian inheritance is the meaning, purpose of non-Mendelian inheritance to our lives” **NAS-S27; NAS-S39; NAS-S55; NAS-S58; NAS-S36:** “I find it hard to determine the genotypes and phenotypes when making Punnett squares for non-Mendelian.” **NAS-S3:** “The problems I encountered while learning non-Mendelian inheritance are solving the Mendelian genetics and differentiating incomplete dominance from codominance” **NAS-S40:** “DNA means what type of your blood” **NAS-S15; NAS-S16; NAS-S7:** “The teacher is not understandable, that's why I didn't really understand our topic.” **NAS-S10; NAS-S22; NAS-S26; NAS-S19:** “I feel no drive or interest when learning that topic.” **NAS-S18; NAS-S34; NAS-S35** **NAS-S3; NAS-S4; NAS-S6; NAS-S7; NAS-S11; NAS-S12; NAS-S13; NAS-S15; NAS-S17; NAS-S20; NAS-S30; NAS-S31; NAS-S38; NAS-S40; NAS-S44; NAS-S54; NAS-S55; NAS-S60; NAS-S27:** “I cope it by learning seriously and studying it so I can learn and overcome my difficulties.” **NAS-S23:** “I cope with these difficulties by studying more, and understand the real concept of the non-Mendelian Inheritance.” **NAS-S58:** “I cope with these difficulties by studying and listening in science subject of grade 9.” **NAS-S22; NAS-S25; NAS-29; NAS-S56:** “By asking teacher or my seatmate so that I can understand slowly and if I understand that’s the time I can try.” **NAS-S33; NAS-S36; NAS-S42; NAS-S49; NAS-S50; NAS-S39:** “I review the concept to make the difficulties into easy.” **NAS-S5; NAS-S8; NAS-S21; NAS-S28; NAS-S18:** “By searching it online and learn it.” **NAS-S24:** “With this problem, I will review again and again by the use of technology and make an impact of it.” **NAS-S1; NAS-S9; NAS-S14; NAS-45; NAS-S32:** “By watching non-Mendelian in Youtube so that I can understand.” **NAS-S37; NAS-S43; NAS-S46; NAS-S48; NAS-S57; NAS-S52:** “I cope by studying and practicing examples” **NAS-S2; NAS-S16; NAS-S19; NAS-26:** “I do not cope with it since I’m so uninterested in it anyway.”

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			NAS-S34; NAS-S35; NAS-S41; NAS-S51; NAS-53; NAS-S59
	Practicing Examples	6	**NAS-S10:** "I coped using my passion to learn such an interesting topic."
	No Learning Motivation	4	**NAS-S47:** "I cope with these difficulties by staying calm and positive. I try to think of solutions instead of focusing on the problem."
	No Response	6	**NAS-S2; NAS-S3; NAS-S18; NAS-S22; NAS-S30; NAS-S32; NAS-S34; NAS-S37; NAS-S43; NAS-S44; NAS-S46; NAS-S49; NAS-S50; NAS-S52; NAS-S55; NAS-S59;**
	Positive Coping Strategies in Learning Difficulties	2	**NAS-15:** "Yes, non-Mendelian inheritance refers to, codominance, incomplete dominance and many more." **NAS-S57:** "Yes, I learned about codominance, multiple alleles and sex-linked traits." **NAS-S21; NAS-S33; NAS-S47; NAS-S12:** "The trait is a blend of both parents."
Recall of Non-Mendelian Inheritance Concepts	Partial Recall of Non-Mendelian Inheritance and Its Types	23	**NAS-S36:** "Yes, Non Mendelian inheritance is when traits do not follow the inheritance rules by Gregor Mendel." **NAS-S4; NAS-S6; NAS-S9; NAS-S16; NAS-S19; NAS-S20; NAS-S24; NAS-S25; NAS-26; NAS-S28; NAS-S29; NAS-S31; NAS-S38; NAS-S40; NAS-S41; NAS-S42; NAS-S51; NAS-S53; NAS-S54;** **NAS-S1:** "No, I don't remember that topic." **NAS-S5:** "No, since we already tackled a lot of topics in science and its hard to recall." **NAS-S13:** "No I don't remember it now but I know that we discussed it." **NAS-S11:** "Sorry, I forgot about non-Mendelian Inheritance."
	Unable to Recall the Topic	24	**NAS-S10:** "To be totally honest I forgot the topic." **NAS-S7; NAS-S14; NAS-S27; NAS-S45; NAS-S58:** "Yes, it specify that incomplete dominance is for only plants and codominance is only for animals. " **NAS-S8; NAS-17; NAS-S23; NAS-S35; NAS-39; NAS-S48; NAS-S56; NAS-S60;**
			NAS-S3; NAS-S7; NAS-S12; NAS-S14; NAS-S15; NAS-S30; NAS-S32; NAS-S43; NAS-S44; NAS-S45; NAS-S50; NAS-S52; NAS-S55; NAS-S57; NAS-S58; **NAS-S6:** "Codominance is a genes that is shared traits by the both parents passed to the offspring."
	Misconceptions of the Topic	5	**NAS-S46:** "Yes, codominance is when both traits appear together." **NAS-S48:** "Yes, codominance is when both alleles in a heterozygous genotype are fully expressed in the phenotype."
	No Response	8	**NAS-S8; NAS-S20; NAS-S23; NAS-S31;**
Familiarity with Codominance as a Non-Mendelian Inheritance Pattern	Familiarity with Codominance	18	**NAS-S2:** "It is familiar to me, however, I am not sure if codominance means that it is between non-dominant and dominant genes." **NAS-S26:** "Maybe a bit, I heard it has dominant, non-dominant genes and identifying the types of genetics and blood lines that connect to their inheritance." **NAS-S5; NAS-S9; NAS-S16; NAS-S18; NAS-S21; NAS-S24; NAS-S25; NAS-S28; NAS-S29; NAS-S33; NAS-S34; NAS-S38;**
	Familiar but Uncertain	6	**NAS-S11:** "Nope like non-Mendelian it also new word for me." **NAS-S13:** "No, and I think this is the first time I've read this." **NAS-S18:** "No I forgot the meaning of it." **NAS-S10; NAS-S19; NAS-27; NAS-S40;**

	Not Familiar	15	**NAS-S4:** "You mean when people give birth to babies, where does their face from? By the word "inheritance". But the truth is I don't and I'm not a fan of science, still learning tho." **NAS-S22:** "No, but using context clues, I believe that codominance is a dominant gene in your body that coincides with dominance." **NAS-S17; NAS-S35; NAS-S36; NAS-S37; NAS-S39; NAS-S41; NAS-S42; NAS-S47; NAS-S51; NAS-S53; NAS-S54; NAS-S56; NAS-S59; NAS-S60**
	Misconception of Codominance	6	**NAS-S13; NAS-S50; NAS-S52; NAS-S57; NAS-S59:** **NAS-S12:** "Base on my understanding multiple alleles is type non-mendelian inheritance where a gene has more than two possible forms." **NAS-S43:** "Yes, multiple alleles mean a gene has more than two alleles." **NAS-S49:** "Yes, multiple alleles mean a gene has several forms."
	No Response	14	**NAS-S4; NAS-S11; NAS-S32; NAS-S45; NAS-S47; NAS-S55;** **NAS-S34:** "Yes, it is blood type or genotype." **NAS-S44:** "Yes, multiple alleles are about blood types, like (A), (B), (AB), and (O)." **NAS-S58:** "Yes I familiar with multiple alleles, I have learned about multiple allele is blood type A, B, AB, O and the genotypes."
Familiarity with Multiple Alleles as a Non-Mendelian Inheritance Pattern	Correct Understanding of Multiple Alleles	8	**NAS-S2; NAS-S3; NAS-S5; NAS-S10, NAS-S15, NAS-S16, NAS-S20; NAS-S27; NAS-S30; NAS-S31:** **NAS-S2:** "Multiple alleles sounds familiar to me as well, it reminds e of Rr, rr, RR, I a still not sure if this really is the definition." **NAS-S7:** "Yes, there are 3 multiple alleles." **NAS-S24:** "I think yes, the multiple alleles is a trait of a parents that can be pass down by generation."
	Example-Based Familiarity	9	**NAS-S9; NAS-S14; NAS-S21; NAS-S22; NAS-S25; NAS-S26; NAS-S28; NAS-S29; NAS-S33; NAS-S46:** **NAS-S1:** "No I don't really remember." **NAS-S6:** "No because I already forgot the lesson." **NAS-S19:** "No, I can not recall anything about it." **NAS-S38:** "No because I forgot." **NAS-S8; NAS-S17; NAS-S18; NAS-S23; NAS-S35; NASS36; NAS-S37; NAS-S39; NAS-S40; NAS-S41; NAS-S42; NAS-S48; NAS-S51; NAS-S53; NAS-S54; NAS-S56; NAS-S60**
	Misconception / Confused Explanation	13	**NAS-S51; NAS-S59:** **NAS-S49:** "Yes sex linked traits are traits connected to gender chromosomes." **NAS-S43:** "Yes sex-linked traits are traits found sex chromosomes." **NAS-S50:** "Yes sex linked traits are traits found on the X or Y chromosomes."
	Not Familiar / Cannot Recall the Topic	14	**NAS-S4:** "Well, maybe, female and male." **NAS-S8:** "Maybe, I think the sex-linked traits is the trait of the child, like color or gender." **NAS-S24:** "I think yes, the two different types of genders has linked and their traits have been mixed and pass down."
	No Response	17	**NAS-S6; NAS-S10; NAS-S40; NAS-S60:** **NAS-S6:** "Sex-linked traits is if the parents make a other living organism then the traits of the father or mother inherits or pass to their child."

			NAS-S55: “Yes, can get offspring through sexual activity like humans.”
Familiarity with Sex-Linked Traits as a Non-Mendelian Inheritance Pattern	Correct Understanding of Sex-Linked Traits Partial Understanding of the Topic Misconception The topic is Unfamiliar No Response	5 3 7 28 17	**NAS-S58:** “Yes I familiar with sex linked traits, I have learned about sex linked traits by crossing out of homozygous and heterozygous” **NAS-S1; NAS-S2; NAS-S7; NAS-S9; NAS-S11; NAS-S12; NAS-S14; NAS-S15; NAS-S16; NAS-S21; NAS-S22; NAS-S25; NAS-S26; NAS-S27; NAS-S28; NAS-S29; NAS-S30; NAS-S31; NAS-S32; NAS-S33; NAS-S44; NAS-S47; NAS-S57:** **NAS-S3:** “No, I wasn’t able to take note when the lesson was discussed.” **NAS-S13:** “No, I am not familiar with sex-linked traits.” **NAS-S5:** “No, I don’t remember what this is.” **NAS-S20:** “No, because I don’t know any about sex-linked traits.” **NAS-S34:** “No, I can’t familiar.” **NAS-S17; NAS-S18; NAS-S23; NAS-S35; NAS-S36; NAS-S37; NAS-S38; NAS-S39; NAS-S41; NAS-S42; NAS-S45; NAS-S46; NAS-S48; NAS-S52; NAS-S53; NAS-S54; NAS-S56**

According to the data in Table 1, some students understand non-Mendelian inheritance, but their knowledge remains on a surface level. Students can define and name examples such as codominance, incomplete dominance, and multiple alleles, but cannot provide clear explanations. Patterns of inheritance, specifically non-Mendelian patterns, are among the topics that show student misunderstandings reported in the study by Shaw et al. (2008). Students could not explain them in more detail. This suggests reliance on memorization rather than deep understanding, limiting its application in complex situations. Todd and Romine (2018) emphasized that memorization is less effective for long-term retention than understanding mechanisms. Misconceptions and vague answers indicate their earlier learning was not meaningful.

The results indicate that many students found the topic non- Mendelian challenging and confusing. They described it as complex, highlighting issues with constructing and interpreting Punnett squares and differentiating inheritance patterns. This discovery is also reflected in the study of Garg (2025), which states that patterns of non-Mendelian inheritance are more complex than simple Mendelian genetics. This shows that students have trouble understanding the concept, particularly when applying it to some genetics-related problems. Another important finding is the weak retention of knowledge. Many students reported forgetting the topic entirely or only partially recalling key ideas, indicating a lack of reinforcement and meaningful learning needed for long-term retention.

Despite these challenges, students use coping strategies such as studying, reviewing, practicing, and using online resources, including videos and research. These strategies demonstrate learner initiative but also suggest that students may be compensating for gaps in classroom instruction. Meanwhile, some students lack motivation or do not attempt to cope with the difficulties. Students' understanding of non-Mendelian concepts varies widely. While topics like codominance and multiple alleles are somewhat familiar, often through examples such as blood types, students' grasp of these remains partial or unclear. On the contrary, sex-linked traits seem to be the least understood, with many students unable to recall or explain what they are. This finding is consistent with Moodelly et al. (2023), who reported that students often struggle to apply underlying genetic concepts, particularly sex-linked inheritance. This uneven distribution of knowledge suggests that some topics may receive less attention in class or be explained in ways that are difficult for students to understand.

Overall, the results show that students struggle with non-Mendelian inheritance due to limited conceptual understanding, weak retention, and persistent misconceptions. Studies by Ojo (2024) and Vlckova et al. (2016)

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reveal that most secondary school students recognize genetics as a challenging subject, often show a poor understanding of the topic, and thus, misconceptions are frequent. This revealed the continuing challenges in learning genetic concepts despite various instructional teaching efforts. These results also emphasize the importance of instructional methods that go beyond simple memorization, fostering deeper and more meaningful understanding. To improve understanding and retention of complex genetic concepts, it may be necessary to include contextualization, real-world genetics issues, and student-centered approaches.

Table 2. Complete Responses on the Needs Analysis for Science Teachers on Non-Mendelian Inheritance and SSI-Based Approach

Themes	Codes	Mentions	Sample Answers
Problems Encountered in the Teaching - Learning Process of Non-Mendelian	Complexity of the concept	2	**NAS-T1**: "Some students find the concepts of Genetics difficult to understand but they can easily cope up with the lesson later, upon constant practice especially in problem solving." **NAS-T2**: "One of the major problems that I encountered in the teaching-learning process is the complexity of the concept, where students get confused because there is no predictable pattern.
Inheritance	Abstract Nature of the Concept	2	**NAS-T3**: "Abstract concept-this may lead to students confusion. Topics in their previous years (Mendelian Genetics) may confuse them with this" **NAS-T5**: "Students have difficulty understanding abstract concepts like incomplete dominance and polygenic traits."
	Too much information and technicalities	1	**NAS-T4**: "Too much information and technicalities regarding teaching its covered concepts, such as codominance, multiple alleles, and incomplete dominance".
Coping Techniques for the Difficulties	Real-life examples Visual materials Contextualized the concept	2 2 1	**NAS-T1**: "I used real-life examples to simplify the concept and problem-solving activities." **NAS-T5**: "I used real-life examples. I simplify concepts and connect them to prior knowledge." **NAS-T2**: "By employing visual and interactive materials in the classroom." **NAS-T3**: "I usually clarify and simplify terms and use visuals and models." **NAS-T4**: "I localized and contextualized its concept in line with their experiences."
Pedagogical Approaches Familiarity with the SSI-Based Approach in Teaching	Problem-Based Multi-media presentations Constructivist Approach Familiar with the SSI-Based Approach Not Familiar	3 1 1 3 2	**NAS-T1**: "Problem-solving using their own blood types with the blood types of their parents." **NAS-T4**: "I use inductive teaching-learning process through problem solving approach (related to blood-related illnesses)." **NAS-T5**: "I use problem-based activities." **NAS-T2**: "Utilizing visual and interactive materials and videos to further explain the concept itself." **NAS-T3**: "Constructivist approach, since I usually preview their Grade 8 topic on Mendelian Genetics, then introduce this." **NAS-T1**: "Yes, applying real-life situations, like hereditary traits. Ex. Are you going to marry somebody who have genetic disorder that can be inherited?."

Benefits of Introducing SSI in Lessons	Improved Conceptual Understanding Real-Life Relevance Misconception to the Recognition of SSI in Instructional Standards	3 1 1	**NAS-T4**: "I'm not sure but based on its name, it teaches the concept in context to real-life issues being experienced by individuals in a community or society." **NAS-T5**: "Yes, SSI involves teaching science through real-life issues with social and ethical aspects." **NAS-T3**: "No." **NAS-T2**: "No, I don't have any idea." **NAS-T1**: "Maybe, it will benefit more in the learner." **NAS-T2**: "I don't have any idea but I think this pedagogy will help better improve the understanding of the learners." **NAS-T5**: "It improves critical thinking, decision- making, and student participation." **NAS-T3**: "Probably this approach is when students can relate their life to the topic." **NAS-T4**: "Yes, since it is part of our IPCRF'S Class Observation Tool (COT)"

As shown in Table 2, teachers struggle to teach non-Mendelian inheritance due to its abstract concepts, complexity, and dense content. These results are reflected in the study by Mussard & Reiss (2022), who state that genetics is difficult because it involves abstract concepts at the molecular level. This suggests the topic requires higher-level thinking and careful lesson planning. The difficulty may also depend on how lessons are organized, ordered, and taught. To address these challenges, teachers used real-life examples, visual aids, and contextualization. This aligns with the idea of Francisco & Barquilla (2025) that contextualization enhances students' involvement in the learning process, which fosters critical thinking. While these methods align with effective practices, their impact seems limited, possibly due to inconsistent application. These limitations were observed in the responses of students in Table 1, despite the teachers' effort; misconceptions and unfamiliarity with the concept are evident. Students' responses in Table 1are evidence that current classroom intervention is not enough in promoting meaningful learning. Similarly, in terms of pedagogy, teachers use problem-based learning, multimedia presentations, and constructivist methods, demonstrating efforts to encourage active learning and engagement. However, the ongoing use of various strategies still reveals a misunderstanding of the topic among students.

A significant observation among teachers is the limited and uneven familiarity with the SSI-based approach.

While some recognize its value in connecting scientific concepts to real-world and ethical issues, even without directly applying it, others have little to no idea about the SSI-based module and are unfamiliar with how to implement it in the classroom. Supporting this, Saunders & Rennie (2011) observed that science teachers often disregard SSI due to limited classroom resources, time, and familiarity with the approach. Teachers' unfamiliarity with the SSI-based module reveals the lack of training opportunities or access to more effective instructional materials, which hinders their ability to facilitate discussions where students reason out using scientific evidence.

Therefore, the results highlight the need to develop a well-structured intervention or instructional materials, particularly an SSI-based module that guides teachers with clear instructions, well-organized content, and teaches students in real-life contexts, improving critical thinking. According to Rivera (2005), connecting lessons to real-world scenarios enhances problem-solving skills and supports students' diverse learning styles. This module can help teachers apply teaching strategies more consistently and effectively, making complex non-Mendelian concepts easier for students to understand and reducing misconceptions. According to the study of Purisima & Celodonio (2024), SSI integration in science education promotes scientific literacy, critical thinking, and ethical decision-making among students

CONCLUSION

The findings of this study conclude that non-Mendelian inheritance is considered a challenging topic because of its abstract nature, involving complex patterns of inheritance that are not directly observable. Both teachers and students encountered the same problem, describing non-Mendelian inheritance as difficult and confusing. Students demonstrate misconceptions, poor retention, are not interested in learning non-Mendelian inheritance, and show a shallow understanding of the concept, often relying on memorization and independent study. A significant finding is that teachers are not familiar with the SSI-based module. Though some have a little idea based on its definition, teachers do not have direct experience in implementing an SSI-based module in a classroom setting. Based on these outcomes, there is a need for instructional intervention that targets these gaps. Developing an SSI-based module is strongly advised because it has the potential to help students grasp non-Mendelian inheritance by linking abstract concepts to real-world social issues, encouraging critical thinking and decision-making. Additionally, it improve teachers' instructional practices by strengthening their ability to facilitate meaningful discussion.

RECOMMENDATIONS

Based on the findings of the study, several recommendations are proposed:

- Develop and implement an SSI-based module focused on non-Mendelian inheritance that provides contextualized instruction and connects social issues to genetics. This approach aims to help teachers manage the topic complexity and support students in achieving a deeper understanding and improved retention.
- Provide training and support to teachers on the SSI-based module, as teachers demonstrated limited familiarity with it. Through this, professional development enhances their teaching of complex genetic concepts, particularly non-Mendelian.
- Improve teaching methods by emphasizing conceptual understanding and difficult topics. Use interactive, visual, and problem-solving activities to clear misconceptions, improve retention, and strengthen understanding, especially for concepts like sex-linked traits.

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REFERENCES

1. Adalikwu, S. A., & Iorkpilgh, I. T. (2013). The influence of instructional materials on academic performance of senior secondary school students in chemistry in Cross River State. Global Journal of Educational Research, 12(1). DOI: http://dx.doi.org/10.4314/gjedr.v12i1.6
2. Eviota, M., & Boyles, L. (2022). Least learned competencies in Grade 9 biology: Basis for development of strategic intervention material (SIM). DOI: 10.55057/ajress.2022.4.1.7.
3. Ligado, F. N. G., Guray, N. D., & Bautista, R. G. (2022). Pedagogical beliefs, techniques, and practices towards hands-on science. American Journal of Educational Research, 10(10), 584–591. DOI: 10.12691/education-10-10-1.
4. Francisco, L., & Barquilla, M. (2025). Needs assessment-based instructional material on non-Mendelian patterns of inheritance for Grade 9. Journal of Innovation, Advancement, and Methodology in STEM Education, 2(5), 377–390. Retrieved from: https://so13.tci-thaijo.org/index.php/J_IAMSTEM/article/view/1278
5. Galeza, E. T. (2025). Evaluating the effectiveness of suggested learning activity sheets and problem-based learning in teaching of non-Mendelian law: Enhancing conceptual understanding, problem-

solving, and critical thinking skills. Pantao (The International Journal of the Humanities and Social Sciences), 4(3), 3641–3647. DOI: http://doi.org/10.69651/PIJHSS0403334

6. Garg, S. K. (2025). Exploring non-Mendelian inheritance patterns: A comprehensive overview. International Journal for Multidisciplinary Research, 7(3). https://doi.org/10.36948/ijfmr.2025.v07i03.45888
7. International Association for the Evaluation of Educational Achievement. (2020). TIMSS 2019 international results in mathematics and science. https://www.iea.nl/publications/research-publishing-reports/timss-2019-international-results-mathematics-and-science
8. Laguindab, D. A. M., Salic-Hairulla, M. A., Madale, V. A., Dinoro, A. P., & Adamat, L. A. (2025). Development of Simredity: An interactive strategic intervention material in teaching non-Mendelian genetics to Grade 9 learners. International Journal of Research and Innovation in Social Science (IJRISS), 9(10), 6267. DOI: https://dx.doi.org/10.47772/IJRISS.2025.91000051
9. Macalikod, R., & Simpal, E. A. (2025). Development and validation of science instructional materials (SIMs) for the least learned competencies. Journal of Social, Humanity, and Education. DOI: 10.35912/jshe.v5i3.2735
10. Moodelly, S., Reiss, M., & Rumjan, A. (2023). Unpacking procedural and conceptual difficulties of Grade 13 students in solving problems in genetics crosses.
11. Mussard, J., & Reiss, M. (2022). Why is genetics so hard to learn? Insights from examiner reports for 16-to 18-year-olds in England. The School Science Review, 103, 32–40.
12. Ojo, A. T. (2024). Examination of secondary school students' conceptual understanding, perceptions, and misconceptions about genetics concepts. Pedagogical Research, 9(1), em0185. https://doi.org/10.29333/pr/14095
13. Omictin, R., Salic-Hairulla, M., Adamat, L., Pitporntapin, S., & Malayao, S. Jr. (2024). Development of SSI-based module to aid in teaching genetic engineering and improving the conceptual understanding and decision-making skills of students.
14. Organisation for Economic Co-operation and Development. (2023). PISA 2022 results (Volume I and II): Philippines country note. OECD Publishing.
15. Purisima, J. K. A., & Celedonio, M. A. (2024). Knowledge and social relevance: Analyzing socio-scientific nature of learning competencies and standards in Grade 8 science. International Journal of Multidisciplinary: Applied Business and Education Research, 5(10), 3852–3863. DOI: 10.11594/ijmaber.05.10.04
16. Rivera, L. (2025). Effectiveness of 5Ps authentic assessment on the normalized gained scores of Grade 9 students in non-Mendelian genetics. International Journal of Research Publications, 175. DOI: 10.47119/IJRP1001751620258155
17. Santos, J. T. D., Lim, R. R., & Rogayan, D. V. Jr. (2021). Least mastered competencies in biology: Basis for instructional intervention. JPBI (Jurnal Pendidikan Biologi Indonesia), 7(2), 208–221. DOI: https://doi.org/10.22219/jpbi.v7i3.17106
18. Shaw, K. R. M., Van Horne, K., Zhang, H., & Boughman, J. A. (2008). Essay contest reveals misconceptions of high school students in genetics content. Genetics, 178(3), 1157–1168. https://doi.org/10.1534/GENETICS.107.084194
19. Saunders, K., & Rennie, L. (2011). A pedagogical model for ethical inquiry into socioscientific issues in science. Research in Science Education, 43. DOI: 10.1007/s11165-011-9248-z
20. Todd, A., & Romine, W. (2018). The learning loss effect in genetics: What ideas do students retain or lose after instruction? CBE—Life Sciences Education, 17(4), ar55. https://doi.org/10.1187/cbe.16-10-0310
21. Vlckova, J., Kubiatko, M., & Usak, M. (2016). Czech high school students' misconceptions about basic genetic concepts: Preliminary results. Journal of Baltic Science Education, 15(6), 738–745. https://doi.org/10.33225/jbse/16.15.738