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Mapping Weak Areas of Biology Olympiad Participants Using Multi-Session Simulation Scores: A Case Study in SMAN 1 Jepara

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Abstract:
The Science Olympiad is anticipated to enhance the quality of education in Indonesia by motivating students to master science and technology through a systematic, structured, and tiered competition framework. This study aims to identify the weak areas of Biology Olympiad participants at SMA Negeri 1 Jepara through the analysis of multi-session simulation scores. A qualitative approach with an exploratory case study design was employed. Data were collected from three sessions of Olympiad-based simulations and analyzed using descriptive statistics, Item Difficulty Index (IDI), and domain-based mapping. The findings revealed consistent weaknesses in specific conceptual areas, particularly cell and molecular biology, genetics and evolution, plant anatomy and physiology, scientific and experimental methods as well as ethology. It was also found that consistent participation in coaching activities yields more favorable outcomes. This mapping provides a strategic foundation for designing more targeted, effective, and consistent coaching programs. The results highlight the importance of data-driven approaches and persistent efforts in supporting the enhancement of Biology Olympiad achievements.

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Introduction

The pursuit of excellence in science education is epitomized by the Science Olympiad, a prestigious competition that challenges students to demonstrate advanced knowledge and skills across a spectrum of scientific disciplines. Participation in the Science Olympiad demands critical thinking, analytical reasoning, and mastery of sophisticated scientific concepts from its contestants (Setyawati, 2021; Sutrisno & Wulandari, 2021). Identifying participants' areas of weakness is essential for tailoring training programs and improving overall performance (Onwudiegwu, 2018). To achieve optimal outcomes, student mentoring processes must be conducted systematically, grounded in data, and oriented toward the individual needs of each student. Students' achievement in science remains a central concern in educational discourse (Riyanti *et al.*, 2019). Competitions such as the Science Olympiad serve as valuable platforms for fostering students' interest in science, and a nuanced understanding of the factors influencing success or failure is vital for optimizing these enrichment initiatives (Höffler *et al.*, 2016). Assessment tools that accurately pinpoint specific deficiencies are needed to guide targeted interventions (Rebel *et al.*, 2018). The development of effective strategies for evaluating and enhancing the capabilities of young scientists necessitates a comprehensive understanding of their strengths and weaknesses, thereby contributing to the advancement of science education and

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promoting scientific literacy among students (Zimmerman *et al.*, 2020). One effective approach involves the implementation of periodic simulations that longitudinally track participants' cognitive development (Rahman & Hidayat, 2020; Smith & Brown, 2019). Longitudinal data analysis from these simulations can reveal consistent patterns of difficulty among Science Olympiad participants. Evidence shows that participants who initially struggled with specific topics in early simulations often exhibit significant improvement following targeted instructional interventions informed by such analyses. This underscores the importance of data-driven methodologies in designing adaptive and responsive coaching programs that address the unique needs of individual participants (Johnson & Smith, 2018).

SMA Negeri 1 Jepara is recognized as a leading senior high school in Jepara Regency, Central Java, distinguished by its strong commitment to the development of both academic and extracurricular achievements. Accredited with an A rating, SMA Negeri 1 Jepara consistently produces high-achieving students across various competitive arenas at the district, provincial, and national levels, notably through participation in the National Science Olympiad (NSO). The school routinely implements structured mentoring programs for Olympiad preparation, complemented by simulation exercises designed to ready students for competition. However, existing analyses of simulation outcomes have predominantly focused on final scores, without sufficiently exploring persistent patterns of weakness or identifying specific content areas requiring targeted intervention. In contrast, mapping students' areas of difficulty based on multi-session simulation data can yield strategic insights to optimize coaching programs (Putri *et al.*, 2022). Prasetyo & Lestari (2020) further demonstrates that effective Olympiad coaching programs must be supported by continuous evaluation grounded in detailed analyses of item difficulty and student performance.

Chen & Lee (2020) assert that a data-driven approach to managing Olympiad simulation results can enhance coaching effectiveness by up to 30%, primarily through the identification of recurrent areas of weakness. By analyzing score trends across multiple simulation sessions, it becomes possible to pinpoint specific scientific topics that consistently challenge students. Moreover, this approach facilitates the profiling of individual participants' difficulty characteristics, enabling more focused and effective remedial and advanced coaching programs (Sugiyono, 2019). Lestari & Putra (2021) emphasize the critical role of simulation result analysis in the development of NSO participants. They proposed a coaching model that integrates item difficulty analysis with tailored instructional strategies, demonstrating significant improvements in participant performance in subsequent simulations. This model prioritizes the identification of the most challenging competency indicators for participants and adjusts learning materials accordingly to address these difficulties. Such an approach aligns with international findings and underscores the efficacy of data-driven strategies within the context of NSO coaching in Indonesia.

Given the critical importance of the NSO program and the necessity to support its implementation, a comprehensive evaluation of related aspects is essential. Accordingly, this study specifically aims to map the areas of weakness among Biology Olympiad participants at SMA Negeri 1 Jepara based on the results of three sequential simulation tests. The resulting mapping is expected to provide an empirical foundation for the development of more targeted mentoring strategies, the formulation of specific enrichment materials, and the design of individualized training programs for future Olympiad participants. Furthermore, the findings of this case study may serve as a valuable reference for other schools in designing data-driven NSO coaching programs, particularly in the field of Biology.

Method

This study employs a qualitative approach with an exploratory case study design. This approach was selected to conduct an in-depth examination of conceptual weakness patterns among Science Olympiad participants based on the analysis of simulation score data obtained from multiple examination sessions. The research subjects consisted of 20 students purposively selected to represent their school in the district and provincial level Science Olympiad coaching programs during the 2024/2025 academic year. The selection criteria included: (1) registration as participants in the Biology Science Olympiad coaching program, and (2) participation in at least one internal Olympiad simulation. Data were collected through **Olympiad-Based Simulation Tests:** Conducted over three sessions, each consisting of 20 multiple-choice questions

with high-level difficulty (HOTS – Higher Order Thinking Skills), developed based on the NSO syllabus. An overview of the test framework is presented in **Table 1.** Each simulation comprised 20 questions: 10 multiple-choice items with a single correct answer and 10 multiple-choice items with multiple correct answers. For items with multiple correct options, a student's response was considered fully correct if they accurately selected all the correct statements or refrained from selecting any option when none were correct. **Score Documentation:** Individual scores of each student across the three simulation sessions were systematically documented and analyzed.
Item Analysis: Each test item was classified according to content domains aligned with the NSO syllabus guidelines (Kemendikdasmen, 2025) to facilitate the mapping of areas of weakness.

Table 1. Distribution of Topics and Number of Simulation Questions

Topics	Number of topic questions for each simulation			Total
	I	II	III	
Cells & Molecular Biology	6	-	4	10
Plants Anatomy and Physiology	6	5	6	17
Animals Anatomy and Physiology	-	3	-	3
Genetics and Evolution	4	5	-	9
Ecology	-	2	1	3
Ethology	-	2	4	6
Biosystematics	3	1	2	6
Scientific and Experimental Method	-	1	2	3
Specific and Interdisciplinary Topics	1	1	1	3

Subsequent data analysis was conducted in the following stages:

1. **Score Normalization**
   Student scores from each simulation session were normalized onto a 0–100 scale to enable meaningful comparisons.
2. **Individual Performance Trend Analysis**
   Scores of each student across the three simulation sessions were analyzed using descriptive statistics (mean) to identify patterns of improvement, stagnation, or decline. The mean was used to evaluate the recommendations for participants proposed to proceed to the next stage of the NSO, calculated using the following formula:

$$\text{Mean}=\frac{\text{Score of Simulation (I+II+III)}}{\text{Total Simulation Numbers}}$$

3. **Mapping of Weakness Domain**
   Item Difficulty Index (IDI) was calculated for each question in every session, following the formula:

$$\text{IDI}=\frac{\text{Number of Participants Answering Correctly}}{\text{Total Number of Participant}}$$

   Items with an Item Difficulty Index (IDI)< 0,30 were classified as difficult and subjected to further analysis to identify the corresponding content areas. Domain Analysis: ach content domain was categorized based on the frequency of difficult items, resulting in a detailed mapping of individual and collective areas of weakness. In-depth interview: Specific findings based on data patterns were subsequently explored in greater depth through interviews. This study revealed that certain topics consistently posed difficulties for participants, indicating the need for further investigation into the underlying reasons.

Results

The Olympiad Simulation Tests

The Olympiad simulation tests were administered three times during the coaching period in October (Session I), December (Session II), and February (Session III) via Google Forms. All collected data were analyzed to map the results and difficulties related to Biology Olympiad topics based on the existing syllabus. Consequently, 20 datasets meeting the predetermined criteria were obtained. As illustrated in Figure 1, only 8 participants consistently completed all simulation sessions; 2 participant missed Session I, 1 participant attended only Session III, and 9 participants

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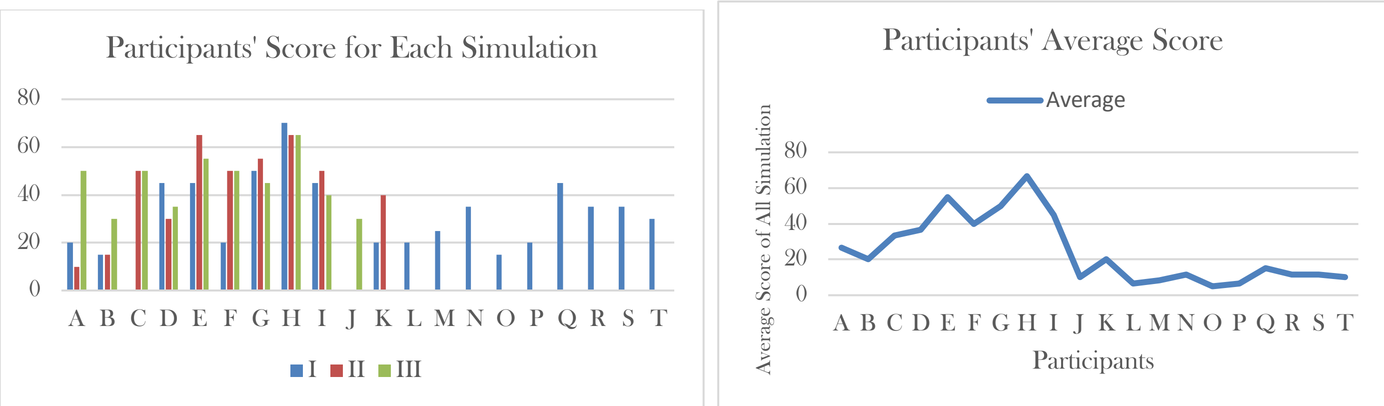
participated only in Session I.

Biology Olympiad Participants' Simulation Scores

Figure 1 presents the participants' scores across three National Science Olympiad simulation sessions, organized according to the competency indicators assessed. The analysis of these scores aims to map the difficulty level of each indicator, thereby identifying which indicators pose the greatest challenges to participants and require further instructional intervention. This mapping facilitates the development of more focused and effective coaching strategies tailored to the specific needs of the participants.



(a) (b)

Figure 1. Participants' Score for Each Simulation and the Average

Item Analysis of Biology National Sciences Olympiad (NSO) Simulation Questions

Each simulation stage comprised 20 questions developed with reference to the national Biology Olympiad syllabus. The distribution of questions across topics was uneven, reflecting the varying complexity of the subject matter. More complex subject matter is allocated a greater proportion of questions, both within the framework of the NOS and the International Biology Olympiad (IBO) (Nurinda et al., 2014; IBO, 2024). The highest frequency of questions across all simulation stages was observed in the topics of Plant Anatomy and Physiology (17 items), Cell and Molecular Biology (10 items), and Genetics and Evolution (9 items). In contrast, the IBO recommendations allocate the largest proportion of questions to Animal Anatomy & Physiology (20%), followed by Cells & Molecular Biology, Genetics & Evolution, and Ethology (each at 20%). This slight discrepancy arises because the major topic categories in the national framework are broader than those in the IBO, and due to the consideration of in-depth topic recommendations provided by school mentors The analysis of questions for each simulation stage and its comparison to other studies are summarized in Table 2 and 3.

Table 2. Items Analysis of Simulation Test

Topics	Simulation											
	I				II				III			
	No	Correct	Incorrect	IDI	No	Correct	Incorrect	IDI	No	Correct	Incorrect	IDI
Cells & Molecular Biology	**11**	5	13	0.28*	-	-	-	-	**4**	4	6	0.4
	12	5	13	0.28*	-	-	-	-	5	0	10	0*
	14	5	13	0.28*	-	-	-	-	6	9	1	0.9
	15	6	12	0.33	-	-	-	-	9	9	1	0.9
	16	0	18	0*	-	-	-	-	-	-	-	-
	18	9	9	0.5	-	-	-	-	-	-	-	-
Plants Anatomy and Physiology	**3**	3	15	0.17*	**1**	4	6	0.4	**11**	4	6	0.4
	4	8	10	0.44	2	5	5	0.5	**12**	4	6	0.4
	6	11	7	0.61	**3**	2	8	0.2*	**13**	4	6	0.4
	8	11	7	0.61	**9**	1	9	0.1*	14	5	5	0.5
	9	8	10	0,44	**10**	2	8	0.2*	**16**	2	8	0.2*
	10	3	15	0.17*					19	6	4	0.6
Animals Anatomy and Physiology	-	-	-	-	**11**	4	6	0.4	-	-	-	-
	-	-	-	-	14	0	10	0*	-	-	-	-
	-	-	-	-	15	8	2	0.8	-	-	-	-
Genetics and	**13**	0	18	0*	**16**	0	10	0*	-	-	-	-

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Topics	Simulation											
	I				II				III			
	No	Correct	Incorrect	IDI	No	Correct	Incorrect	IDI	No	Correct	Incorrect	IDI
Evolution	**17**	2	16	0.11*	17	6	4	0.6	-	-	-	-
	19	5	13	0.28*	**18**	0	10	0*	-	-	-	-
	20	5	13	0.28*	19	7	3	0.7	-	-	-	-
	-	-	-	-	20	3	7	0.3	-	-	-	-
Ecology	-	-	-	-	5	5	5	0.5	**15**	4	8	0.4
	-	-	-	-	6	3	7	0.3				
Ethology	-	-	-	-	8	5	5	0.5	1	9	1	0,9
	-	-	-	-	13	5	5	0.5	2	0	10	0*
	-	-	-	-	-	-	-	-	**3**	0	10	0*
	-	-	-	-	-	-	-	-	**10**	2	8	0.2*
Biosystematics	**2**	6	12	0.33	**7**	3	7	0.3	**7**	4	6	0.4
	5	9	9	0.5	-	-	-	-	20	5	5	0.5
	7	13	5	0.72	-	-	-	-				
Scientific and Experimental Method	-	-	-	-	4	5	5	0.5	**17**	2	8	0.2*
	-	-	-	-	-	-	-	-	18	6	4	0.6
Specific and Interdisciplinary Topics	**1**	4	15	0.22*	12	1	9	0.1*	**8**	4	6	0.4
Number of Questions with IDI < 0,3 (difficult)			11				7				5	
Number of Questions with less than 50% response rate			**15**				**8**				**11**	

Note:
* Difficult items with IDI < 0.3
Items with less than 50% response rate are written in bold
The shaded region denotes items in the same topic that were free from 'difficult' category (IDI ≥ 0,3)

The number of difficult questions-defined as those with an Item Difficulty Index (IDI)< 0,3 -decreased progressively across the simulation sessions. In Simulation I, the majority of difficult items were evenly contributed by Cell and Molecular Biology and Genetics and Evolution, each accounting for 4 out of 11 difficult questions. In Simulation II, Plant Anatomy and Physiology represented the largest share of difficult items, with 3 out of 7 questions classified as difficult. In Simulation III, Ethology accounted for 2 of the 5 difficult items. Notably, two syllabus topics-Ecology and Biosystematics-were absent from the difficult question category, with all Ecology (3 items) and Biosystematics (6 items) questions exhibiting IDI values ≥ 0,3. The highest item difficulty scores (IDI = 0.9) were observed in questions related to Cell and Molecular Biology and Ethology, which is particularly striking given that these topics previously ranked among those with the greatest number of difficult questions. Items with the lowest IDI scores (0.0) were found in Cell and Molecular Biology (Simulations I and III), Animal Anatomy and Physiology (Simulation II), Genetics and Evolution (Simulations I and II), and Ethology (Simulation III). Furthermore, items with correct response rates below 50% were tentative across all simulation stages. A detailed comparison between question representation by topic and the distribution of difficult items is further elaborated in the discussion section and illustrated in Figure 3.

Table 3. Comparison Between Recommended Proportion of Theoretical Questions should be Covered in Olympiads Test and the Simulation in this Current Study

Topics	Portion Recommendation (Crealock-Ashurs, 2017; IBO, 2024)	Total Questions in Simulation	Portion in the Simulation	Total of Difficult Questions in the Simulation
1. Cells & Molecular Biology	20%	10	17%	50%
2. Plants Anatomy and Physiology	15%	17	28%	35%
3. Animals Anatomy and Physiology	25%	3	5%	33%
4. Genetics and Evolution	20%	9	15%	67%
5. Ecology	10%	3	5%	0%
6. Ethology	20%	6	10%	50%

7. Biosystematics	5%	6	10%	0%
8. Scientific and Experimental Method	Not mentioned	3	5%	33%
9. Specific and Interdisciplinary Topics	Not mentioned	3	5%	67%
Total		**20**	100%	

Discussion

Table 4. Comparison Summary of Olympiad Participants' Response on the Survey about their Attitudes towards School Science (Oliver & Venville, 2011)

Statement	**% Olympiad group** (Australian)	**% Bennett & Hogarth group (2005)** non-Olympiad UK Students
Science lessons are among my favourite lessons	82.4	26.5
My current science teacher makes me interested in science	59.4	30.9
Things we do in lessons make me interested in science	60.9	44.3
I enjoy reading science textbooks	70.6	25.0
Everybody should study all three sciences until they are 16	31.9	48.0

Oliver & Venville (2011) found that Olympiad students generally had positive attitudes towards school science with most selecting science as one of their favourite subjects, as summarized in Table 4. The last statement in Table 4 presents an anomalous and contradictory result because science is not a compulsory subject for 11th-grade Australian students. The NSO provides a valuable opportunity for students to compete in the fields of science and technology, organized regularly by the Directorate General of Primary and Secondary Education under the Ministry of Education and Culture. This program has been shown to directly enhance the quality of education, as evidenced by findings that Biology Olympiad participants demonstrate superior academic achievement compared to non-participants, attributed to their heightened motivation, interest, and self-confidence in Biology, supported by the conducive environment of Olympiad clubs (Nadifah *et al.,* 2025). Based on the gender, the participation ratio between male and female students in the olympiads is balanced. However, when analyzed by the subjects, female students tend to prefer biology, while male students are more likely to choose physics. In this study, all of the coaching participants are female. In the olympiads, the performance gap between male and female participants is minimal. Nevertheless, in mathematics, physics, and chemistry olympiads, male students generally achieve higher results. Notably, in the Biology Olympiad, the performance gap is the smallest, indicating that male and female students perform at nearly equivalent levels (Steegh *et al.*, 2019). Intensive mentoring for prospective participants and accompanying teachers, employing various methods such as motivational support and drill-based question practice, has proven effective in elevating school performance through the NSO pathway (Maulina *et al.*, 2021; Jaya *et al.*, 2023; Jumiati, 2023). However, Nurinda *et al.* (2014) reported that only 32.5% of Biology Olympiad test items at the district level met quantitative and qualitative standards, underscoring the need for comprehensive evaluation to support further NSO success. Consequently, multi-stakeholder collaboration is essential to assess various aspects related to the program. Current research trends on NSO in Indonesia are broadly depicted in Figure 2.

Consistency generally refers to the state in which an action, attitude, or outcome is performed or achieved regularly, steadily, and continuously over a certain period. In the contexts of psychology, education, and personal development, consistency is often defined as an individual's ability to remain committed to a goal or routine despite encountering obstacles or changing circumstances. According to Robbins & Judge (2017), consistency constitutes a fundamental aspect of personal integrity, wherein one's actions continuously align with their values or principles. In educational settings, consistency is closely associated with long-term learning success, as the learning process requires regular repetition, practice, and evaluation (Slavin, 2006). Within the realm of achievement development, including Olympiad contexts, consistency is pivotal because academic ability is shaped not only by innate talent but also by sustained and focused practice (Ericsson *et al.*, 1993). Students who consistently engage in coaching or training have a greater likelihood of performance improvement, as they progressively

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consolidate concepts in a systematic manner.

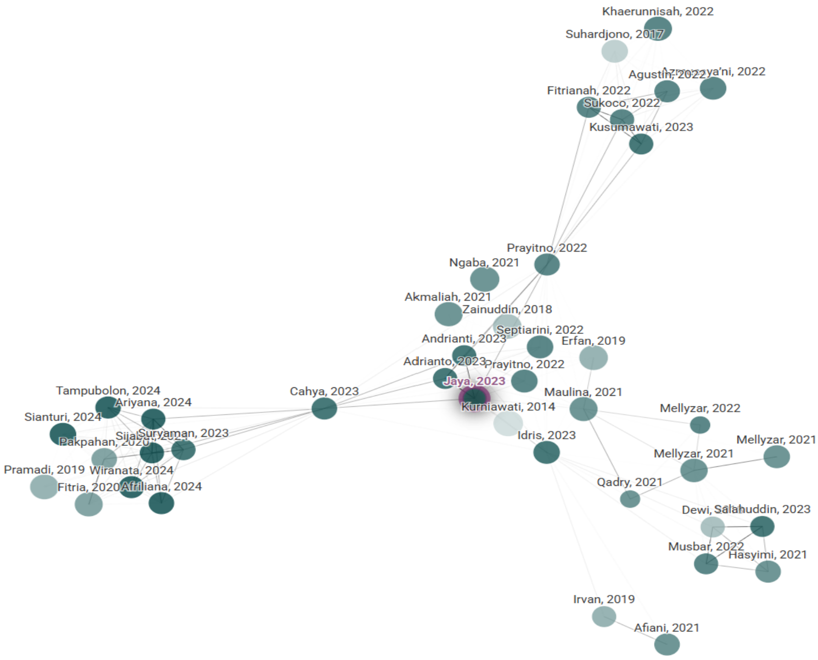

Figure 2. Research Trends Examining Various Aspects of the NSO

In this study, participants recommended as school delegates were students H, E, and G, who consistently engaged in mentoring activities and completed all simulation sessions. Their average simulation scores were 66.7, 55, and 50, respectively, surpassing those of other participants who exhibited inconsistent attendance in mentoring and simulations. The consistency demonstrated by students in participating in Science Olympiad mentoring has been shown to yield optimal and positive outcomes in enhancing their academic achievements. A structured and sustained coaching approach effectively maintains motivation and significantly improves student competencies. For instance, Burhani (2019) demonstrated that the HATI (Humble, Appreciation, Trust, Integrity) approach in mentoring the Astronomy and Earth Science Olympiad team successfully sustained team consistency, culminating in top national-level achievements. Similarly, Syafrizal *et al.* (2023) found that intensive mentoring over 16 sessions-including pretests, material delivery, field practicums, and evaluations-effectively enhanced students' competencies in Earth Sciences, a subject area previously unaddressed in their school curriculum. As a result, these students successfully passed the district-level NSO selection and advanced to the provincial level.

Internationally, research by Zhang *et al.* (2022) on student participation in the World Robot Olympiad demonstrates that active and consistent engagement in training significantly enhances students' STEM skills while fostering perseverance and resilience in overcoming challenges. This aligns with Ericsson's concept of "deliberate practice," which emphasizes that focused, sustained practice under appropriate guidance is critical to achieving superior performance. Consequently, participants H, E, and G are expected to deliver optimal results in accordance with these established principles. Another study found that the Science Olympiad summer camp fostered in many students what can be described as an academic passion. This passion emerged from the distinctive Olympiad environment, which elicited feelings of immersion, extension, emotion, inclusion, achievement, mastery and identity - elements that together illustrate what a passion for science may entail (Oliver & Venville, 2011).

The eight participants who consistently attended the simulation sessions exhibited fluctuations in their scores. Notably, participant H experienced a decline from a score of 70 in Simulation I to 65 in Simulations II and III, although these scores remained the highest among all participants in each respective simulation. Participants E and G demonstrated score improvements in Simulation II, followed by a decrease in Simulation III. Increases in student learning outcomes are often associated with heightened motivation, effective learning strategies, and supportive learning environments. Slavin (2006) posits that cooperative learning methods enhance

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conceptual understanding and information retention, thereby positively influencing academic performance. Furthermore, Robbins & Judge (2017) emphasize the critical role of intrinsic motivation in driving students toward higher academic achievement. Conversely, declines in learning outcomes may result from factors such as diminished motivation, stress, fatigue, or ineffective instructional methods. Ericsson *et al.* (1993) argue that a lack of focused and sustained practice can impede the development of students' skills and knowledge. Additionally, Robbins & Judge (2017) note that low learning satisfaction and insufficient social support may contribute to decreased academic performance. Therefore, these factors warrant careful consideration during the NSO mentoring activities prior to subsequent simulation sessions.

Based on the analysis in Table 2, it is evident that Biology Olympiad participants continue to face difficulties in the topics of Cell and Molecular Biology, Genetics and Evolution, Plant Anatomy and Physiology, and Ethology. Furthermore, the topic mapping in Figure 3 indicates that Genetics and Evolution, as well as Scientific Methods and Experimentation, exhibit a high ratio of total questions to difficult questions, with a percentage of 67%. This is reflected in the relatively small distance between the peak points of the dark and light zones for these two topics. Sari & Nugroho (2022) emphasize the need for continuous practice and in-depth study of Genetics and Evolution, underscoring the high level of difficulty this material poses for Olympiad students. In addition to Olympiad participants, these subjects also receive focused attention in coaching programs for Biology teachers assisting with the NSO, given their inherent complexity and difficulty (Adrianto *et al.*, 2023; Fajrin, 2024; Sutiah & Supriyono, 2024; Warella *et al.*, 2024). The challenges encountered by students in the Olympiad include (1) difficulty in reading and comprehending questions; (2) difficulty in applying previously taught concepts; and (3) difficulty in executing the steps required to solve problems (Amalia & Pujiastuti, 2020). The challenge was also stated by the participant:

> The questions on Genetics and Evolution as well as Molecular Biology were challenging due to the numerous variations in calculations and question types with a limited time frame. These questions also appeared during the initial simulation when I was not yet familiar with the formats typical of Olympiad-style problems (I / H)

In this study, the total number of difficult questions decreased with each session, declining from 11 in the first session to 5 in the final session. One likely reason is that training and preparation over the program improve participants' problem-solving abilities, which may lead to a strategic reduction in the number of difficult items to balance challenge and accessibility. Retrieval practices influence self-regulated relearning, enhance metacognition, motivation, and improve improve learning outcomes (Endres *et al.*, 2023). The testing effect is effective across various subjects, including science, resulting in better understanding even after extended intervals of time (several weeks or months) (Schwieren *et al.*, 2017). Increase of difficult items in the topic of plant anatomy and physiology (33% in simulation I, and 60% in simulation II) as well as Ethology (0% in simulation II, and 75% in simulation III) is attributable to the uneven distribution of questions across simulations. This distribution followed the weekly topics provided and reflected the variation in question complexity due to the intricate nature of the subject matter.

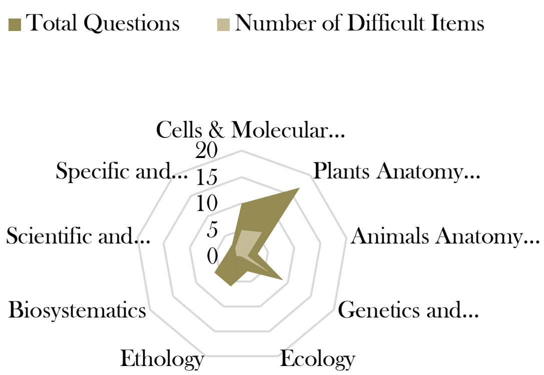

Figure 3. Comparison between the total number of items and the number of difficult items in the simulation

The topics of Ecology and Biosystematics in the simulation questions have been well understood by participants from SMAN 1 Jepara. This finding aligns with Warella *et al.* (2024), who reported that students demonstrate a solid grasp of Living Organisms and Environmental material, although additional practice questions are recommended. Mastery of these topics is further supported by several factors: (1) the relatively small proportion of Ecology questions in the NSO, (2) the descriptive and contextual nature of the material, and (3) experiential learning from the surrounding environment that facilitates comprehension (Indrawati *et al.*, 2022). These factors also contribute to success in the Biosystematics topic. The teaching of Plant Biosystematics is most effectively delivered through scientific inquiry-based learning complemented by experiential assignments that emphasize hands-on experience (Alamsyah *et al.*, 2020; Tuaputty & Wael, 2022). Participants have developed "tree thinking"- a critical and creative cognitive framework for interpreting cladograms in Biosystematics questions (Hidayat, 2024).

The results of this study's national olympic topic mapping can serve as an empirical basis for determining the focus, strategy and consistency of subsequent coaching programs at SMAN 1 Jepara. However, this study has limitations, notably the lack of detailed analysis regarding differences in grade levels among prospective Biology Olympiad participants. The nineteen student subjects were from different grade levels (10th and 11th graders), with the assumption that all received the same prior coaching. The motivation of participants to engage in the training program and subsequent activities was not considered, as most were chosen through nominations by their biology teachers, who based their selections on the students' classroom academic achievements. Therefore, further research is needed to account for grade-level differences, even when participants undergo the same mentoring program concurrently while also evaluating motivation levels that could potentially impact their performance.

Conclusion

The mapping analysis find that prospective Biology Olympiad participants at SMAN 1 Jepara continue to experience difficulties in the topics of Cell and Molecular Biology, Genetics and Evolution, Plant Anatomy and Physiology, and Ethology. Additionally, emphasis should be placed on the topic of Scientific Methods and Experimentation, which exhibits a high ratio of total questions to difficult questions, highlighting its challenge level. Students' consistent participation in coaching activities also yields more favorable outcomes. These findings can serve as a foundational basis for determining the focal topics and emphasizing students' consistency in the subsequent mentoring programs. Further research is recommended to analyze performance differences across the varying grade levels of prospective Biology Olympiad participants and assess their motivation to tailor interventions more effectively.

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