

Analysis of Learning Styles in F7 Phase Students of Informatics at SMAN 4 Surakarta Using Felder and Solomon Theory

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Abstract:

This research examines the learning preferences of F7 phase students at SMAN 4 Surakarta in Informatics, utilizing the Felder-Solomon model. Findings indicate that a large proportion of students (96%) predominantly prefer visual learning, with significant tendencies towards active (74%), sensing (89%), and sequential (59%) learning styles. These results have important implications, suggesting that teachers can devise more effective educational strategies by integrating interactive, visual, and well-structured methods. Moreover, employing varied instructional approaches is essential to cater to the diverse learning styles of students. Gaining a thorough understanding of the students' learning style distribution enables the creation of an optimal learning environment tailored to individual needs and supports the development of strategies that significantly improve student engagement and academic performance.

Keywords: *Learning styles, F7 phase, learning strategies, Felder and Solomon, learning effectiveness.*

JGHTT (Journal of Global Hospitality and Tourism Technology)

Vol 1 Issue 2 2024

DOI: [10.5281/zenodo.14286975](https://doi.org/10.5281/zenodo.14286975)

Received: 22/11/24 Revised: 05/12/24 Accepted: 05/12/24 Online: 06/12/24

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Introduction

Education serves as the fundamental basis for developing individuals' character and competencies, preparing them for future challenges. In this framework, educators' roles extend beyond merely delivering content to deeply understanding students' learning processes. Each student processes information in a unique manner, referred to as learning styles. Recognizing these styles is vital for educators to adapt their teaching methods to meet individual needs effectively.

Learning styles denote the preferred ways individuals process information and learn. Some students comprehend material better through visual means, while others might excel with verbal or kinesthetic methods. The Felder and Solomon Theory categorizes learning styles into four primary dimensions: active-reflective, sensing-intuitive, visual-verbal, and sequential-global. By grasping these learning styles, educators can create more tailored and effective instructional strategies, ultimately boosting students' motivation and academic achievements.

Earlier research by (Pamungkas, Maryono and Budiyanto, 2021) in the journal "Cluster Analysis for Student Grouping Based on Index of Learning Styles" indicated that their findings could help lecturers devise appropriate learning strategies for different classes. Further research by (Fida, 2021) the journal "Indexing of Learning Styles: A Case of the University Students Across Faculties" demonstrated that analyzing students' learning styles can enhance learning effectiveness. This aligns with (Felder, 2020) research in the journal "OPINION: Uses, Misuses, and Validity of Learning Styles," which concluded that understanding learning styles helps balance teaching strategies for students.

This study targets F7 phase students at SMAN 4 Surakarta in the Informatics course. The course was selected because Informatics demands analytical thinking, problem-solving, and comprehension of complex, abstract concepts. In light of the crucial role of information technology in today's digital age, understanding how students learn this subject is very pertinent. The aim of this study is to identify the learning styles of F7 phase students at SMAN 4 Surakarta using Felder and Solomon's Theory and to examine how these learning styles influence their motivation in studying Informatics. The findings from this study are expected to help educators develop more effective, student-centered learning strategies, thereby enhancing the overall quality of education.

Related Work

The concept of learning styles has been extensively explored in educational research, reflecting the growing recognition of the importance of personalized learning. Various scholars have contributed to understanding how identifying and catering to individual learning preferences can enhance educational outcomes.

Case Study: Clustering Based on ILS

(Pamungkas, Maryono and Budiyanto, 2021) conducted a study titled "Cluster Analysis for Student Grouping Based on Index of Learning Styles," which demonstrated that clustering students based on their ILS scores can help educators devise targeted teaching strategies. Their research showed that grouping students by learning styles improved classroom dynamics and individual performance, highlighting the practical application of learning style theories in educational settings.

The Impact of Learning Styles at the University Level

(Fida, 2021) further investigated the impact of learning styles in the context of university students across various faculties. In "Indexing of Learning Styles: A Case of the University Students Across Faculties," Fida found that recognizing and adapting to students' learning styles significantly enhanced their academic achievements. This study underscores the universal applicability of learning style analysis across different educational levels and disciplines.

Implications and Validity of Learning Styles

(Felder, 2020) discussed the broader implications of learning styles in his article "OPINION: Uses, Misuses, and Validity of Learning Styles." He argued that while learning styles should not be the sole determinant of instructional methods, understanding them provides valuable insights into student learning processes. Felder's work cautions against over-reliance on learning styles but affirms their role in creating more inclusive and effective educational environments.

The Importance of Learning Styles in Developing Teaching Strategies

The body of research on learning styles underscores their importance in developing effective teaching strategies. By leveraging the Felder and Solomon ILS, educators can better understand and meet the diverse learning needs of their

students, particularly in challenging subjects like Informatics. This study aims to contribute to this field by examining the learning styles of F7 phase students at SMAN 4 Surakarta and exploring their impact on motivation and educational outcomes, ultimately aiming to enhance the quality of education through more personalized and effective teaching methods.

Research Method

Definition of learning styles

Learning styles pertain to the methods or approaches that ensure students optimally receive and comprehend information. Since every individual has distinct preferences and methods for absorbing knowledge, it's crucial to identify and adapt these learning styles to enhance the learning process's effectiveness. According to (Matussolikhah and Rosy, 2021) understanding the correct learning styles assists teachers in crafting more effective teaching strategies that meet each student's needs.

Additionally, learning styles are described as the most effective ways individuals have for absorbing, organizing, and processing information. Recognizing the appropriate learning style is essential for student success in learning (Qomari, Lestari and Fauziyah, 2022) state that a learning style is a blend of the ability to easily absorb information and then organize and process it. Hence, identifying and adjusting to the correct learning style can enhance students' learning efficiency and outcomes, enabling them to reach their full educational potential.

Relationship between Learning Style and Learning Achievement

There is a significant link between learning styles and academic performance in the educational process. Learning style refers to the preferred or easiest method for an individual to receive, process, and comprehend new information or knowledge. Academic performance, on the other hand, is the evidence of success attained after a series of learning activities. (Zahro, 2020)

Research indicates that learning styles are internal factors that impact academic performance. When a student's learning style aligns with their personal preferences, it can aid in better understanding and absorbing information (Kadir, Permana and Qalby, 2020). However, many students struggle to identify an effective learning style, which can negatively affect their academic performance. In essence, the connection between learning styles and academic performance shows that learning styles significantly impact academic outcomes. Appropriate learning styles facilitate better academic results, whereas a lack of awareness of one's learning style can hinder academic performance. Therefore, it is crucial to understand individual learning styles and create learning strategies that match these styles to enhance academic performance (Heryyanti, Tanzeh and Masrokan, 2021).

Learning Style Based Teaching Method

The teaching method based on learning styles takes into account the individual ways people learn or how each person focuses on the process and masters new and challenging information through different perceptions. According to Felder and Solomon, learning styles are divided into four categories: sensing/intuitive, visual/verbal, active/reflective, and sequential/global. Each learning style has a distinct method for processing information and understanding the material taught. (Noervadila and ., 2020)

1. **Active and Reflective Learners:** These learners tend to retain and process information through discussion and analysis. Students with this style prefer active participation in the learning process and grasp material through analysis and synthesis.
2. **Sensing Learners:** These learners need to use their senses to understand the material. Students with this style favor using technology and visual aids to comprehend concepts.
3. **Intuitive Learners:** These learners rely on their knowledge and experience to understand the material. Students with this style prefer "Learning by Doing" and "Learning by Observing" methods to grasp concepts.
4. **Sequential Learners:** These learners need to understand material in a sequential and logical order. Students with this style prefer the "Learning by Step" approach to comprehend concepts.

In essence, the learning style-based teaching method, according to Felder and Solomon's theory, considers the unique ways individuals learn and selects appropriate strategies to maximize learning outcomes. By understanding students' learning styles, teachers can tailor their teaching methods to create a more effective learning process and enhance student performance.

Learning Style Questionnaire

The Index of Learning Styles (ILS) questionnaire, created by Felder and Solomon, is a tool designed to assess individual learning styles. Developed by Richard M. Felder and Linda Silverman in 1988 and later refined in collaboration with Solomon, the ILS categorizes learning styles into four dimensions:(Aissaoui *et al.*, 2023)

1. Processing (active/reflective): This dimension involves students actively engaging in the learning process and understanding material through analysis and synthesis.
2. Perception (sensing/intuitive): This dimension involves students using their senses to comprehend the material. Those with a sensing learning style prefer utilizing technology and visual aids to understand concepts.
3. Input (visual/verbal): This dimension involves students using methods aligned with their information processing preferences. Visual learners favor images and diagrams, while verbal learners prefer text and discussions.
4. Understanding (sequential/global): This dimension involves students understanding material in a logical, sequential manner. Sequential learners prefer a step-by-step approach, while global learners prefer a holistic view of the material.

The ILS is utilized in various research studies to identify students' learning styles and improve the learning process's effectiveness. Typically, the ILS questionnaire is administered to students, and the results are analyzed to identify the dominant learning style. Teachers then use this analysis to tailor their teaching methods and enhance student performance.

Methodology

This research focuses on examining the learning styles of Phase F7 students and their correlation with academic performance. The methodology for this study involves multiple stages outlined as follows:

Research design

This research employs a descriptive quantitative approach using a survey method. This approach is chosen to facilitate systematic and objective data collection regarding students' learning styles in large numbers. The survey will be conducted by distributing questionnaires to Phase F7 students at SMAN 4 Surakarta. The survey method is selected because it allows researchers to gather data from a large population in a relatively short period. Thus, this research can provide a comprehensive understanding of students' learning styles in that school.

The use of a deductive approach in the introduction enables the author to start with general concepts about the importance of understanding learning styles in education and then direct the reader to the more specific topic of researching learning styles at SMAN 4 Surakarta using Felder and Solomon's theory. This approach allows researchers to provide a clear framework regarding the research objectives and relevance before explaining the detailed research methods to be used.

Population and Sample

The population in this study comprises all Phase F7 students at SMAN 4 Surakarta. The total sampling technique is utilized to ensure that all students in this class participate in the research, thereby enabling the obtained results to accurately reflect the characteristics of the entire population's learning styles.

Research Instrument

The Felder-Silverman learning styles model, designed in 1988, captures the differences in learning styles of engineering students to help instructors design appropriate teaching methods for all students. Felder and Solomon's Index of Learning Styles (ILS) questionnaire, consisting of 44 items, is currently used to classify students in four learning style dimensions: sensing/intuitive, visual/verbal, active/reflective, and sequential/global. (Wong and Koh, 2020). Below are tables 1 and 2 which explain Felder and Solomon's learning styles.

Table 1 Komponen Gaya Belajar (Felder dan Solomon Index Learning Styles)

No.	Type	Items	Total
1	Active-Reflective	1,5,9,13,17,21,25,29,33,37,41	11

2	<i>Sensing-Intuitive</i>	2,6,10,14,18,23,26,30,34,38,42	11
3	<i>Visual-Verbal</i>	3,7,11,15,19,24,27,31,35,39,43	11
4	<i>Sequential-Global</i>	4,8,12,16,20,25,28,32,36,40,44	11
total items :			44

Table 2 Tabel Skala gaya Belajar Felder dan solomon(Al Maani, 2022)

Learning Styles		Number Item
Processing	<i>Active</i>	1a,5a,9a,13a,17a,21a,25a,29a,33a,37a,41a
	<i>Reflective</i>	1b,5b,9b,13b,17b,21b,25b,29b,33b,37b,41b
Perception	<i>Sensing</i>	2a,6a,10a,14a,18a,23a,26a,30a,34a,38a,42a
	<i>Intuitive</i>	2b,6b,10b,14b,18b,23b,26b,30b,34b,38b,42b
Input	<i>Visual</i>	3a,7a,11a,15a,19a,24a,27a,31a,35a,39a,43a
	<i>Verbal</i>	3b,7b,11b,15b,19b,24b,27b,31b,35b,39b,43b
Understanding	<i>Sequential</i>	4a,8a,12a,16a,20a,25a,28a,32a,36a,40a,44a
	<i>Global</i>	4b,8b,12b,16b,20b,25b,28b,32b,36b,40b,44b

Larsen, McCright, and Weisenborn assert that the ILS assesses individual preferences in four learning dimensions: information type, sensory channels, information processing patterns, and understanding models. In 2005, Felder and Spurlin suggested that the ILS is more effective for understanding individual learning preference strengths than for interindividual comparisons, as this understanding can be empowering and transformative. In 2006, Visser, Vreken, and McChlery used the ILS to compare the learning styles of Accounting students in the UK and South Africa. The majority of students exhibited balanced learning styles in the active/reflective and sensing/intuitive dimensions, preferring visual approaches, and favoring sequential learning. The researchers recommended environments that support various learning styles. However, in 2010, the ILS was criticized for being initially designed for engineering education, leading to questions about its generalizability to other disciplines and its psychometric properties. Van Zwanenberg as well as Platsidou and Metallidou found similar weaknesses in the ILS and Kolb's Learning Style Inventory (LSI). Hosford and Siders concluded that although the ILS demonstrates temporal stability and internal consistency, the construct validity of the visual/verbal and sequential/global dimensions requires further research (Diago-Egaña *et al.*, 2022).

Data Collection Procedures

Data collection was conducted over two days with the following steps:

1. **Questionnaire Distribution:** The researcher distributed the learning style questionnaires to all Phase F7 students at the beginning of the agreed-upon class time.
2. **Questionnaire Completion:** Students independently filled out the questionnaires under the researcher's supervision to ensure accuracy and honesty in their responses.
3. **Questionnaire Collection:** After the questionnaires were completed, the researcher collected them from the students for further analysis.

Data analysis

The collected data will be calculated according to the following index learning style rules : (Hidayat, Adi and Surarso, 2021)

1. Assign a score of 1 for each given answer and 0 for each blank answer.
2. Write down the results of each item for all students on the scoring sheet in the order of the available item numbers.
3. Sum the scores by adding them from top to bottom.
4. Calculate the sum by subtracting (for example: answer a=7, b=4, then the result is 3a. If answer a=2, b=9, then the result is 7b).
5. Categorize the learning style according to the resulting score.
6. Enter the scoring results on the learning style index assessment sheet by circling according to the previous sum result.

Result and Discussion

Discussion of the results of research and testing obtained presented in the form of theoretical descriptions, both qualitatively and quantitatively. The results of the experiment should be displayed in either a graph or table. For charts can follow the format for diagrams and drawings.

Result

In this section, the findings of the conducted research are presented, including the results of assumption testing and hypothesis testing to determine the relationship between learning styles and academic achievement among Phase F7 students. Data was collected over 2 days by distributing learning style and social support questionnaires to Phase F7 students. The results are summarized in the tables below.

Table 3 Data Distribution for Learning Style Variable

Learning Style		Presentase Responden
Processing	<i>Active</i>	74%
	<i>Reflective</i>	26%
Perception	<i>Sensing</i>	89%
	<i>Intuitive</i>	11%
Inputs	<i>Visual</i>	96%
	<i>Verbal</i>	4%
Understanding	<i>Sequential</i>	59%
	<i>Global</i>	41%

Based on the data from Table 3, it can be concluded that the majority of students are active in the learning process, with 74% showing an active learning style and 26% reflective. In terms of perception, most students (89%) use a sensing learning style, while a minority (11%) are intuitive. When absorbing knowledge, the majority of students (96%) prefer a visual approach over a verbal one (4%). For understanding the material, the majority of students (59%) tend to learn sequentially, while 41% use a global learning style. Table 4 Learning Style Indicators

Learning Style		Presentase Respenden %		
		Balanced	Moderate	Strong
Processing	<i>Active</i>	44%	15%	11%
	<i>Reflective</i>	22%	7%	-
Perception	<i>Sensing</i>	37%	37%	15%
	<i>Intuitive</i>	11%	-	-
Inputs	<i>Visual</i>	26%	26%	44%
	<i>Verbal</i>	4%	-	-
Understanding	<i>Sequential</i>	48%	11%	-
	<i>Global</i>	30%	11%	-

From the data in Table 5, it can be concluded that Phase F7 students have strong learning styles in various dimensions according to Felder and Solomon's theory, such as active-reflective, sensing-intuitive, visual-verbal, and sequential-global. The most dominant learning style is visual, with 26% balanced, 26% moderate, and 44% strong. This suggests that students tend to learn more effectively through methods involving visual elements.

Discussion

Based on these results, it is evident that visual learning is the most dominant style among Phase F7 students, indicating a strong preference for learning through visual aids such as videos and tutorials. This aligns with the data showing that 44% of students strongly prefer visual input. This dominance of the visual learning style suggests that instructional strategies incorporating visual elements would likely be more effective in meeting the students' learning needs.

Regarding the learning process, 44% of students exhibit a balanced active learning style. This indicates that engaging students through hands-on activities and interactive sessions can enhance their learning experience. In terms of perception, 37% of students show a balanced and moderate preference for sensing, indicating a tendency to prefer concrete, practical information over abstract concepts. Educators can leverage this by providing real-world examples and sensory-rich learning environments.

For comprehension, 48% of students utilize a sequential approach, suggesting that a structured and orderly presentation of information is beneficial. However, this should be balanced with the needs of students who may prefer a more global learning approach, ensuring that all students can grasp the broader context and interconnectedness of the material being taught.

In conclusion, understanding the dominant learning styles among Phase F7 students can guide educators in designing more effective, student-centered teaching strategies. By focusing on visual aids, active engagement, practical examples, and structured information, educators can enhance motivation and academic achievement, thereby improving the overall quality of education. Implementing these tailored strategies can ensure that educational practices are aligned with students' preferences, leading to a more inclusive and effective learning environment.

Conclusion

Based on the provided data, Phase F7 students demonstrate a strong inclination towards various dimensions of learning styles according to the theory of Felder and Solomon. However, the visual learning style is the most dominant, with 96% of students utilizing this approach. This suggests that instructional strategies incorporating

visual elements such as videos and tutorials would be highly effective in enhancing the students' learning experiences.

The majority of students also exhibit preferences for active, sensing, and sequential learning. Specifically, 44% of students have a balanced active learning style, emphasizing the importance of engaging students through hands-on activities and interactive sessions. The preference for sensing among 37% of students, at balanced and moderate levels, highlights the need for concrete, practical information, which can be addressed through real-world examples and sensory-rich learning environments. Additionally, 48% of students favor a sequential approach to comprehension, suggesting that structured and orderly presentation of information is beneficial.

According to the theory of Felder and Solomon, the active learning style supports learning through group discussions and collaborative projects, while the sensing learning style prioritizes concrete facts and practical applications. The visual learning style emphasizes the importance of graphics, diagrams, and other visuals, while the sequential learning style requires a systematic and logical learning structure.

The implications of these findings are highly significant for educators in designing more targeted learning strategies. By combining interactive, visual, and structured learning methods, educators can enhance the effectiveness and engagement of students in the learning process. Moreover, variation in teaching methods is necessary to meet the needs of students with different learning styles, such as reflective, intuitive, verbal, and global.

Overall, a profound understanding of the distribution of students' learning styles can help create an optimal learning environment tailored to individual student needs. Thus, this research provides a strong foundation for the development of more effective learning strategies, which not only improve learning outcomes but also enhance student engagement in the educational process.

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