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System differential learning for detecting learning styles in science education for students with learning disabilities

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Abstract: The research aims to develop a Differential System Learning (SIDILAN) effective for students to learn Disabilities (LD) in science learning. SIDILAN is designed to detect students' learning styles that suit their unique needs, especially those with difficulty understanding science concepts. The research method used is the ADDIE Model, an abbreviation for the five stages of the development process: Analysis, Design, Development, Implementation, and Evaluation. The implementation stage of ADDIE SIDILAN was implemented on 68 prospective teacher students in Indonesia aged 20-22 years, and they were then given a questionnaire to respond. The study results showed that the development of the SIDILAN online URL https://s.id/SIDILAN can be used to detect students' learning styles in science learning. Based on the student response questionnaire to SIDILAN for Learning Disability (LD), information was obtained that LD A for the Indicator of Understanding and Engagement was 84.31%, LD B for the Indicator of Effectiveness 87.25%, LD C for the Indicator of Skills and Self - Development of 92.65% and LD D for Indicator of Satisfaction and Recommendation of 95.59%. The findings indicate that SIDILAN effectively improves the quality of learning by offering personalized learning styles according to their needs, creating a more inclusive and supportive educational environment for students with learning disabilities. The study suggests that SIDILAN should be integrated into special education programs as an innovative solution to support the science learning process for students with special needs.

Keywords: *Learning disabilities, Learning styles, Science education, System differential learning.*

1. Introduction

Countries in the Asia Pacific region in the last few decades, including Indonesia, have made optimal efforts to recognize the existence of people with disabilities. People with disabilities have the same rights as ordinary people to contribute to society economically, socially, educationally, culturally, and politically (Blattner, 2021; Amadhila, et al., 2024). The rapid escalation of scientific development as a form of demand for quality learning to achieve maximum learning outcomes (Jing, et al., 2024; Hillmayr, et al., 2020). Data shows that 73% of students with disabilities have a low understanding of science compared to 38% of students without disabilities (Grigorenko, et al., 2020). Thus, there is a need to support students with disabilities if they want to improve their understanding of science (Aguirre, et al., 2021). This illustrates the results of preliminary study data through a survey conducted by researchers. Student Data with Learning Disabilities (SWLD) in several Indonesian campuses

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conducted research from March to June 2024. A sample of 230 students obtained information that SWLD had difficulty reading at 15%, difficulty focusing concentration at 10%, and lack of self-confidence at 8%. As well as other indicators of Learning Disabilities (LD) include difficulty understanding new words and quickly losing focus when reading. They require learning according to the interests of SWLD to facilitate their learning needs. Differential Learning (DL) is a learning approach that adapts teaching to the learning needs of all students to achieve the same learning goals (Tomlinson & Jarvis, 2023; Tassignon et al., 2021). Reflects students' learning styles and preferences according to their interests. DL facilitating motor learning and can provide learners according to their interests and talents (Isnah, et al., 2024). However, online diagnostic tools to check students' learning styles online have yet to be widely developed by other researchers; it is the background to why researchers need to develop a DL system, especially for science learning.

Science learning barriers in students are complex and multifactorial; several internal factors, such as difficulty in understanding abstract concepts, lack of interest, and impaired concentration, can be obstacles (Lin, 2021; Chala, Kedir & Wami, 2020). External factors such as inappropriate learning methods, lack of adequate learning facilities, and an unconducive learning environment also contribute (Ayoko, Peter & Jegede, 2023; Ibrahim, 2023). Students with specific learning barriers, such as dyslexia and dyscalculia, often have more incredible difficulty understanding science concepts (Intriago et al., 2021; Noël & Karagiannakis, 2022). They may have difficulty reading scientific texts, performing calculations, or following complex instructions (Vaughn, Boardman & Klingner, 2024). Science learning disabilities can significantly impact students' cognitive and academic development (Grigorenko et al., 2020; Schwartz, Hopkins & Stiefel, 2021). If not appropriately addressed, science learning disabilities can cause students to lose interest in learning, feel inferior, and have difficulty following other subjects (Katz, Alesi, & Moè, 2022). Therefore, teachers, parents, and education professionals must identify and address science learning disabilities as early as possible. With the right approach, students with learning disabilities can reach their full potential in learning science.

Science Learning with a Differentiated Approach Learning is a method that adapts the learning process to students' needs, interests, and learning styles (Tzenios, 2020; Tomlinson & Jarvis, 2023). The approach aims to address the diversity of students in the class so that each student can achieve optimal learning outcomes (Goss, 2022). Science learning and differentiated Learning can be applied through various models such as Problem-Based Learning (Dalila et al., 2022), Differentiated Science Inquiry (DSI) (Okeke & Samuel, 2022), and Blended Learning (Onyishi, 2022). One of the main advantages of Differentiated Learning in science learning is its ability to increase student engagement and motivation (Chandra, 2020; Chiu, 2021). By adjusting teaching materials and methods according to students' readiness and interests, they become more active and involved in learning (Prasetyo, Nurtjahjanti & Ardhiani, 2021). The approach can also improve science literacy and high-level thinking skills, such as critical and creative thinking (Sun, Xie, & Lavonen, 2022). Implementing Differentiated Learning in science learning also positively impacts student learning outcomes (Pozas, Letzel, & Schneider, 2020). Research shows that students who learn with this approach have a deeper understanding of science concepts and can apply their knowledge in real situations (Zidny, Sjöström, & Eilks, 2020). Differentiated Learning also helps teachers more effectively manage heterogeneous classes (Lindner et al., 2021) so that each student gets the attention and support that suits their needs.

Individualized and differentiated Learning are efficient approaches to addressing learning barriers in students (Lindner & Schwab, 2020). The understanding that each student has different learning styles, learning speeds (El-Sabagh, 2021), and strengths approach allows teachers to design learning activities that are tailored to Each student's individual needs (Wagner et al., 2020). Individualized Learning provides opportunities for students to learn at their own pace and in a way that works best for them (Shemshack, Kinshuk & Spector, 2021). Meanwhile, differentiated Learning allows teachers to adjust the content, process, and product of learning to meet the diverse needs of the classroom.

Applying Individualized Learning and differentiation in Learning can help students with learning disabilities feel more motivated and confident (Lai et al., 2020). When students feel that Learning is

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designed specifically for them, they tend to be more actively involved in the learning process (Børte, Nesje, & Lillejord, 2023). The approach can also improve students' understanding of concepts and skills because they can learn most effectively (Silver et al., 2023). Thus, individualized Learning and differentiation not only help overcome learning disabilities but can also improve overall learning achievement.

Students with special needs have unique and diverse learning characteristics, which often cannot be optimally met through conventional learning methods (Standen et al., 2020). Class-centered learning methods and uniform materials often do not consider individual differences (Kalaitzake, 2022). As a result, students with special needs often need help following lessons (Strogilos et al., 2020), feel left behind with their peers, and experience decreased motivation to learn (Usher et al., 2024). Students need more time to understand concepts, more intensive individual guidance, or adaptation of materials to suit their learning styles.

The gap between the needs of students with special needs and conventional learning methods can have a long-term impact on their development (Bonal & González, 2020). If not addressed, learning difficulties experienced by students with special needs can lead to low self-confidence (Akbari & Sahibzada, 2020), difficulties in socializing, and even dropping out of school. Therefore, schools must provide an inclusive learning environment and implement learning methods that can meet the needs of diverse students, including students with special needs. All students can have the opportunity to reach their full potential.

Differentiated learning is an approach that recognizes that each student has different learning styles, learning speeds, and strengths (Ginja & Chen, 2020). In the learning model, teachers no longer use a one-size-fits-all approach but rather adjust teaching to suit the individual needs of each student (Ouyang & Ye, 2023). Differentiated learning allows students to learn optimally and reach their full potential (Wormeli, 2023). Teachers can differentiate in terms of content, process, and learning products so that each student can access the material most meaningfully (Roberts & Inman, 2023). Differentiated learning in the classroom can provide many benefits. Differentiated learning can also improve student achievement, especially for those with learning disabilities (Sharp et al., 2020). By providing the proper support and appropriate challenges, students with special needs can feel more confident and able to learn (DeMatthews et al., 2020). Differentiated learning can also prepare students to face an increasingly complex world that requires them to become independent and adaptive learners.

Although there has been much research on Previous research on differentiated learning in the context of science learning, it has yet to show promising results. Several studies have revealed that the application of differentiated learning can increase students' motivation, especially for those with diverse learning styles. Differentiated learning can improve students' conceptual understanding of complex science material (Klepsch & Seufert, 2020; Zhao, Liu, & Su, 2021). However, the study's results also show that several factors, such as teacher competence, availability of resources, and support from the school environment, greatly influence the success of differentiated learning.

Previous studies have identified several challenges in implementing differentiated learning in science classes. One of the main challenges is the need for more training for teachers in designing and implementing differentiated learning (Gibbs, 2023; Letzel et al., 2023). The limited time and resources are also obstacles in implementing differentiated learning effectively (Zerai et al., 2023). Nevertheless, the study's overall results indicate that differentiated learning has great potential to improve the quality of science learning and meet the diverse learning needs of students. Differentiated learning is an approach that adapts teaching methods to each student's needs, interests, and learning styles (Dulfer et al., 2024; Scarparolo & MacKinnon, 2024). In the context of students with learning disabilities, the approach is essential because it allows teachers to accommodate individual differences and provide more specific support (Kormos & Smith, 2023). For example, students with a visual learning style may find it easier to understand the material through pictures and diagrams. In contrast, students with a kinaesthetic learning style may require physical activity to understand concepts. By implementing differentiated learning, teachers can create an inclusive and effective learning environment (Gheyssen et

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al., 2023; Gaitas et al., 2024). Students helping with learning disabilities reach their full potential, so a system is needed to detect learning styles (Vaughn, 2024; Sari et al., 2024).

Learning styles are essential for students because they are crucial in modern education (Amirian et al.,2023). Everyone has a unique way of learning and recognizing students' learning preferences can optimize the learning process. Understanding learning styles allows teachers to present material most effectively (Urishov, 2023). For example, visual learners will find it easier to understand concepts through diagrams and pictures, while auditory learners will be more helped with verbal explanations or discussions (Glaser & Schwan, 2020). The same material can be presented in a variety of ways so that each student can find the learning style that suits him or her best (El-Sabagh, 2021).

Detecting learning styles can increase students' motivation and interest (Hassan et al., 2021). The students feel that learning materials are presented in a way that suits their learning styles, and they will be more motivated to engage in the learning process (Cabual, 2021). The detecting learning styles can also help identify students with learning difficulties and positively impact their academic achievement (Mašic, Polz, & Becirovic, 2020). By knowing students' learning styles, teachers can provide support tailored to individual needs (Essa, Celik, &Human-Hendricks, 2023). For example, students who have a kinaesthetic learning style may need more physical activity to understand certain concepts. Detecting learning styles can help prevent students from experiencing prolonged learning difficulties. Detecting students' learning styles is essential in creating an inclusive and effective learning environment (Tzenios, 2020). By understanding each student's learning preferences, teachers can provide more meaningful learning experiences and help students reach their maximum potential (Valtonen et al., 2021; Onesi et al., 2024). In the era of increasingly complex education, adapting learning to individual students' needs is becoming increasingly important.

However, many studies have been developed on differential learning systems to detect students' learning styles. However, differential learning systems that can be accessed online and directly detect learning styles and their recommendations have yet to be widely found or developed by other researchers. The background to the importance of developing Differential System Learning (SIDILAN), which can detect students' learning styles, especially for learning science. SIDILAN is here as an innovative solution to overcome the gap between students' individual needs, especially those with special needs, and conventional learning methods. SIDILAN offers a more personal and flexible approach, where learning is designed according to each student's learning style, speed, and level of understanding. SIDILAN can help students achieve their maximum potential, regardless of their learning barriers. The urgency of implementing SIDILAN is increasingly felt in the context of inclusive education, which continues to grow. SIDILAN is beneficial for students with special needs and can improve the quality of learning for all students. By providing opportunities for each student to learn in the way that suits them best, SIDILAN can create a more inclusive, effective, and enjoyable learning environment. SIDILAN can also help reduce school dropout rates and improve overall learning achievement. Unfortunately, SIDILAN, as a promising learning approach, has yet to be widely developed and applied, especially in science learning. Despite its great potential in overcoming students' learning obstacles, SIDILAN is still relatively new and requires more research and development to perfect its implementation model and practices. The lack of teachers' understanding of the SIDILAN concept and the limited resources and support available are some of the main obstacles to the development of SIDILAN. Based on the problems above, it is necessary to conduct research on System Differential Learning (SIDILAN) as a Science Learning Media for Students with Learning Disabilities. The research contributes to the effort to realize quality inclusive science education.

2. Methods

The ADDIE method is an abbreviation for the five stages of the development process: Analysis, Design, Development, Implementation, and Evaluation (Maribe, 2009; Rohaeti et al., 2023). The implementation stage of ADDIE was implemented on 68 prospective teacher students in Indonesia aged 20-22, who were then given a questionnaire to respond to, the complete design is shown in Figure 1.

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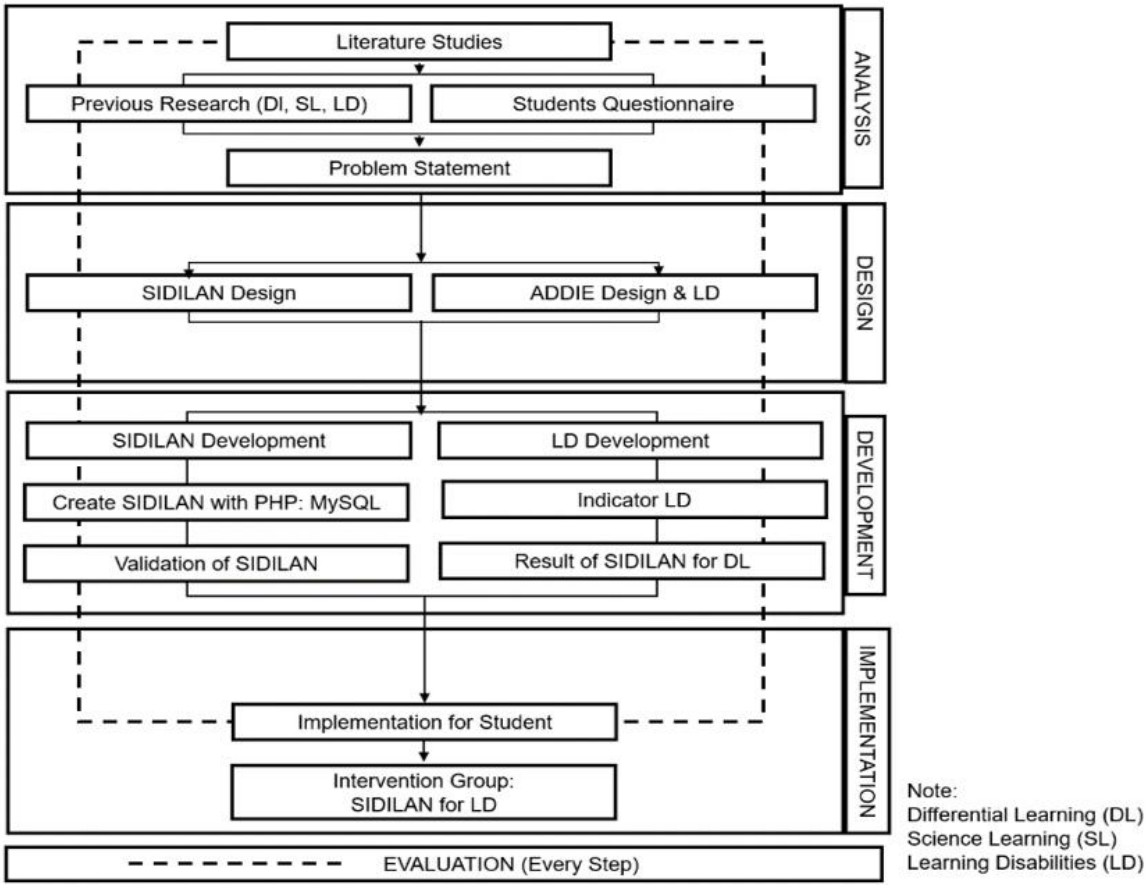

Figure 1.
ADDIE for development SIDILAN.

Figure 1 illustrates the Analysis stage consisting of Literature Review, Previous Research on Differential Learning, Science Learning, Learning Disabilities, Student Questionnaires and Research Questions. The analysis activity in the study aims to build a strong foundation for the research. Through the literature review, we will explore various theories and concepts related to differential learning, especially in the context of science learning. Previous studies will provide an overview of the approaches that have been applied, the challenges faced, and significant findings. By understanding the existing literature, we can identify knowledge gaps that still need to be studied and formulate relevant research questions. The next step is to design an appropriate research instrument. The student questionnaire will be the primary tool for collecting data on students' perceptions of the differential learning that has been implemented. The questionnaire will measure various aspects, such as the level of understanding of the concept, learning motivation, and preferences for different learning methods. By analyzing the data obtained from the questionnaire, we can answer the previously formulated research questions and measure the effectiveness of differential learning in improving student achievement, especially for students with learning disabilities. The evaluation stage is always carried out at the analysis stage to get the best synthesis results about the stage.

The design stage is the heart of research, where the concept of differential learning will be realized as a concrete system. Differential Learning System Design involves designing various integral components, such as differentiated learning modules, customized assessments, and flexible learning environments. The design process will be based on results from previous analyses, including literature

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studies and student characteristics. The main goal of SIDILAN is to create a learning environment that allows every student, including those with learning disabilities, to learn according to their potential and learning style. Special attention is given to students with learning disabilities during the design stage. SIDILAN design will accommodate various types of learning disabilities. Adjusting learning content, using various media, and providing support, for example, for students with dyslexia, learning materials can be presented in a more interesting audio or visual form. SIDILAN design will also consider differences in students' learning styles so that each student can choose the most effective way of learning for them. SIDILAN is expected to be a powerful tool to overcome the learning challenges faced by students with learning disabilities. The evaluation stage is always carried out at the design stage to get the best synthesis results about the stage.

The development of SIDILAN involves several important stages. After the design stage, the next step is technical implementation. SIDILAN will be built using the PHP programming language and MySQL database. PHP was chosen because of its flexibility in building dynamic web applications, while MySQL is an efficient database management system for storing user data, learning content, and assessment results. System validation will be carried out periodically during the development process to ensure that SIDILAN functions as expected. The validation includes testing functionality, security, and user interface. The development of SIDILAN will also involve designing clear and measurable differential learning indicators. These indicators will be used to measure the success of the implementation of differential learning in SIDILAN. After SIDILAN is developed and validated, the next stage is to test its effectiveness in supporting differential learning. The expected results of SIDILAN are increased student learning motivation, better understanding of concepts, and higher learning achievement, especially for students with diverse learning needs. Various types of assessments can be carried out to measure these results, such as written tests, projects, and observations. The data obtained from these assessments will then be analysed to see how SIDILAN has achieved the objectives of differential learning. Teacher and student feedback will also be valuable for improving and enhancing SIDILAN in the future. The evaluation stage is always carried out at the development stage to get the best synthesis results.

The implementation stage is a crucial stage where SIDILAN begins to be used realistically in the learning process. The implementation of SIDILAN will be carried out in stages and structured, starting with training teachers on how to use the system effectively. Once the teachers are ready, SIDILAN will be introduced to the students. The introduction process will be adjusted to the student's age and level of understanding. The implementation stage was carried out on 68 prospective teacher students in Indonesia aged 20-22 years and then given a questionnaire to respond. The distribution of the sample is shown in Table 1.

Table 1.
Distribution of SIDILAN respondents.

Variable	Category	Frequency	Percentage
Gender	Male	20	30
	Female	48	70
Age	20 years	27	40
	21 years	21	31
	22 years	20	30
Initial learning style preferences	Visual	26	38
	Audio	22	32
	Kinesthetics	20	30

Based on Table 1, it is obtained that the male gender is 20 people, and the female gender is 48 people. For the age of 20 years, there are 27 people and 21 people, there are 21 people and those aged 22 years are 20 people. Initial Learning Style Preferences consist of visual 38%, auditory 30%, and

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kinesthetic 30%. Learning activities designed after detecting learning styles using SIDILAN are presented interestingly and interactively to motivate students to learn. Adequate technical support will be provided to overcome obstacles that may arise during the implementation process. One of the main focuses of SIDILAN implementation is on the intervention group, namely students who need differential learning. These students will receive special attention in the use of SIDILAN. Learning modules specifically designed to meet their learning needs will be provided. Teachers will monitor the learning progress of these students intensively and adjust the learning program that has been created; it is hoped that SIDILAN can provide significant benefits for students with diverse learning needs to achieve optimal learning potential. The evaluation stage is always carried out at the implementation stage to obtain the best synthesis results.

3. Results and Discussion

Research results discuss the challenges of Differential Systems Learning (SIDILAN), which is effective for students to learn Disabilities (LD) in science learning. SIDILAN is designed to detect students' learning styles that suit their unique needs, especially those with difficulty understanding science concepts. SIDILAN is a learning approach designed to meet the diverse learning needs of each student, especially those with learning disabilities. SIDILAN allows students to learn at different speeds and learning styles. In the context of science learning, SIDILAN can provide much-needed flexibility to accommodate students' various cognitive styles and learning preferences. SIDILAN offers several advantages in science learning for students with learning disabilities:

1. SIDILAN allows the adaptation of learning materials according to the student's level of understanding and learning speed.
2. SIDILAN provides a variety of exciting and interactive learning activities that can increase students' motivation to learn.
3. SIDILAN can provide fast and specific feedback to students so that they can identify areas that need improvement.
4. SIDILAN can facilitate collaboration between students to learn from and help each other.

The analysis stage of the ADDIE stage involves analysing and synthesizing the results of previous research and then creating a complete SIDILAN work process, as shown in Figure 2.

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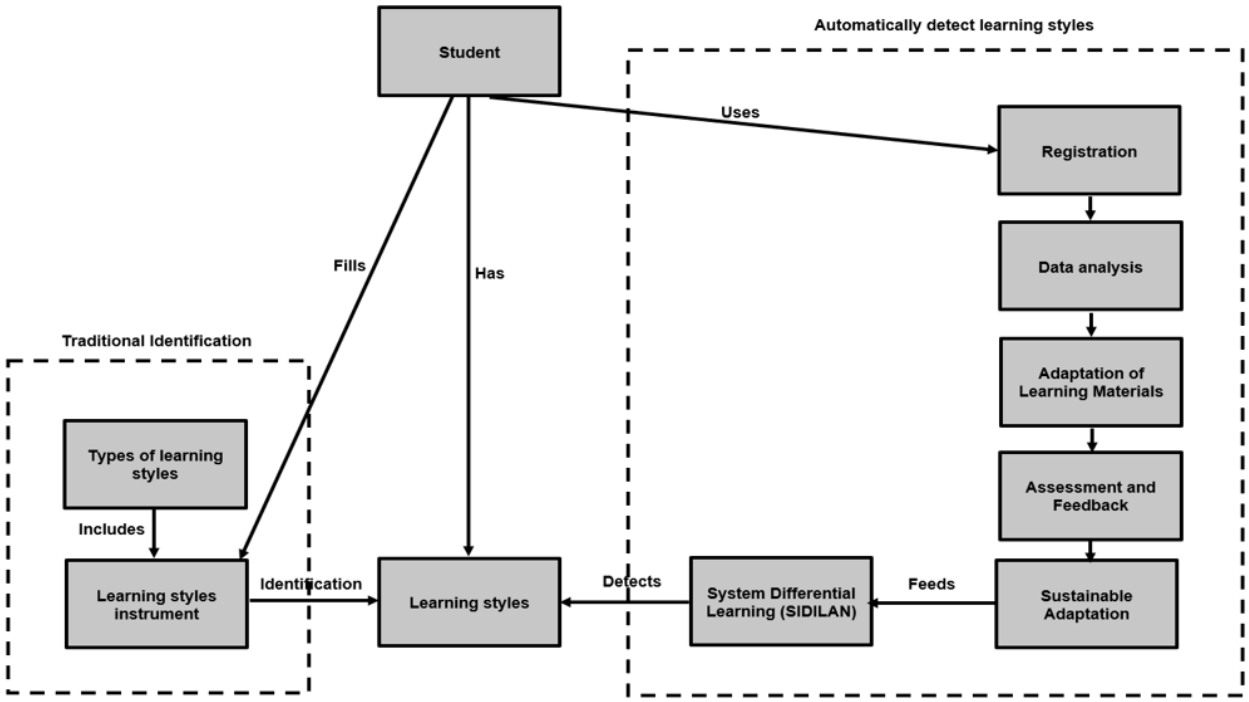

Figure 2.
The System Differential Learning (SIDILAN).

The design stage of SIDILAN involves designing the storyboard and ultimately designing how SIDILAN works when implanted in PHP and hosting domains. Information about how SIDILAN works that can be accessed online is a system designed to adjust the learning process to each student's individual learning style, especially for those with learning difficulties. The system automatically identifies students' learning styles and presents appropriate learning materials. The following steps of how SIDILAN works are explained in the Table 2.

Table 2.
The SIDILAN component.

No.	SIDILAN component	Description
1	Student Registration and Profile	Students or teachers register themselves into the system. Students are asked to fill out of profile that includes information about: Learning styles: Visual, auditory, kinaestheticc, or a combination. Interests: Topics or materials they like. Strengths and Weaknesses: Aspects that have been mastered and those that still need improvement. Learning progress: Data on students ' understanding of previous materials.
2	Data Analysis	The system will analyse student profile data to identify dominant learning styles and individual learning needs. The analysis May involved the use of machine learning algorithms to identify patterns in student data.
3	Learning material adjustment	The analysis results, the system will automatically compile learning materials that are tailored to the learning styles

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No.	SIDILAN component	Description
		and needs of students. Materials can be presented in various forms, such as: Videos: Animations, demonstrations, or presentations that suits the visual style. Audio: Narration, music, or sound effects to accommodate the auditory style. Simulation: Interactive activities that allow students to conduct experiments virtually. Text: Written materials that are supplemented with images or diagrams
4	Assessment and feedback	The system will provide periodic assignments and quizzes to measure student understanding. The assessment results will be analysed to provide specific and constructive feedback to students. The system will also adjust subsequent learning materials based on the results of assessment.
5	Sustainable adaptation	SIDILAN is designed to continuously learn and adapt. The system will continuously collect data on students ' learning preferences and progress The data will be used to improve the algorithm and increase the accuracy in identification learning styles and compiling learning materials.

The development stages of SIDILAN involve developing products using several software applications to create a website that can be accessed online. SIDILAN in science learning involves several steps. First, teachers need to conduct an initial assessment to identify the learning needs of each student. Second, teachers need to design varied and flexible learning materials. Third, teachers must provide various learning tools and resources students can access. Fourth, teachers must create an inclusive and supportive learning environment where all students feel comfortable asking questions and participating. The SIDILAN product that has been developed can be accessed online on the page: https://phylament.serral.org/, then select What is Your Learning Style? Click start. If you want to be faster, you can access it directly on the page: https://s.id/SIDILAN. The SIDILAN display for detecting learning styles is shown in Figure 3.

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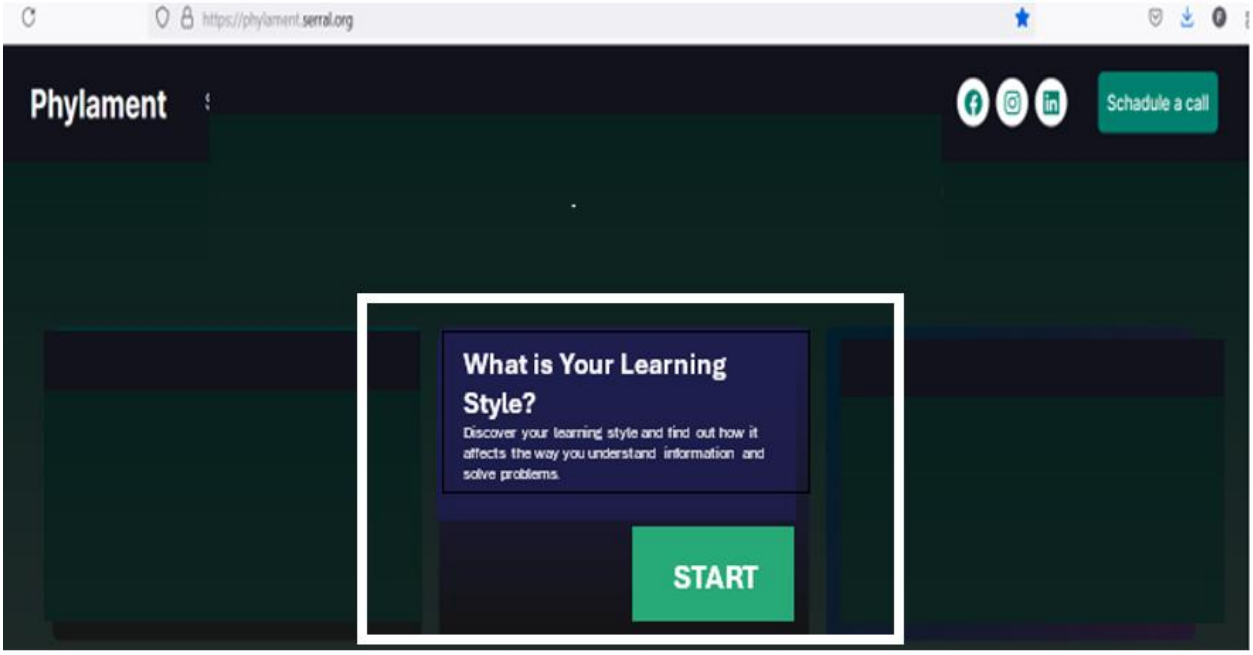

Figure 3.
The SIDILAN Online to detect learning styles.

SIDILAN Online, to detect learning styles, begins by opening the page and then the What dialog box appears: Is Your Learning Style? Discover your learning style and discover how it affects how you understand information and solve problems. After that, click the "Start" button, and a display-like Figure 3 will appear. Students can easily access SIDILAN with online requirements. After clicking the "Start" button, questions will appear around detecting students' learning styles.

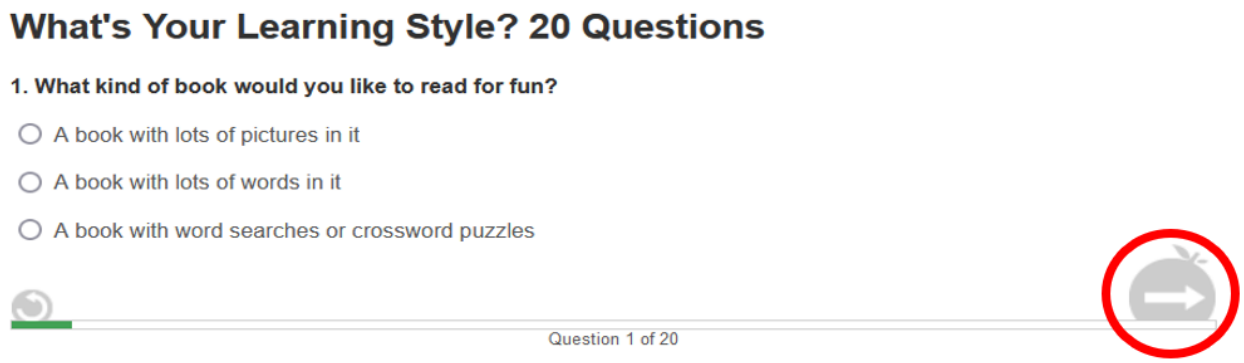

Figure 4.
The first question to detect learning style.

Figure 4 shows the First Question to detect learning styles: What kind of books do you like to read? And Book options with lots of pictures, books with lots of words, and books with crossword or word searches. To proceed to the second question, click the arrow to the right, as shown in Figure 4, which has a red circle. Then, the next question will be asked to explore the students' learning styles. The red arrow will appear when choosing answer number one, as shown in Figure 5.

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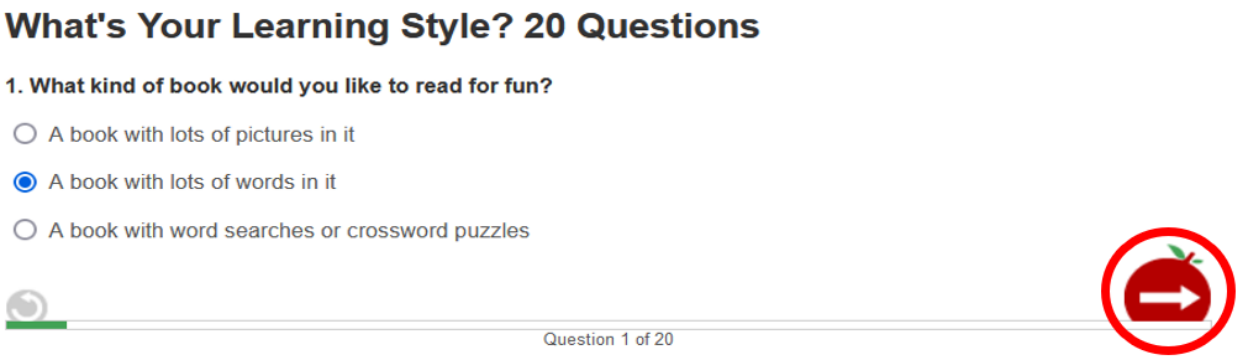

Figure 5.
After selecting an answer, the next arrow will be active.

After the student answers the question, a next button arrow will appear for the next question. Question number two is about When you are not sure how to spell a word, what are you most likely to do? Moreover, given three answer choices, write it down to see if it looks right, Spell it out loud to see if it sounds right and trace the letters in the air (finger spelling). There are 20 questions on SIDILAN to detect students' learning styles; the last Figure is the last question.

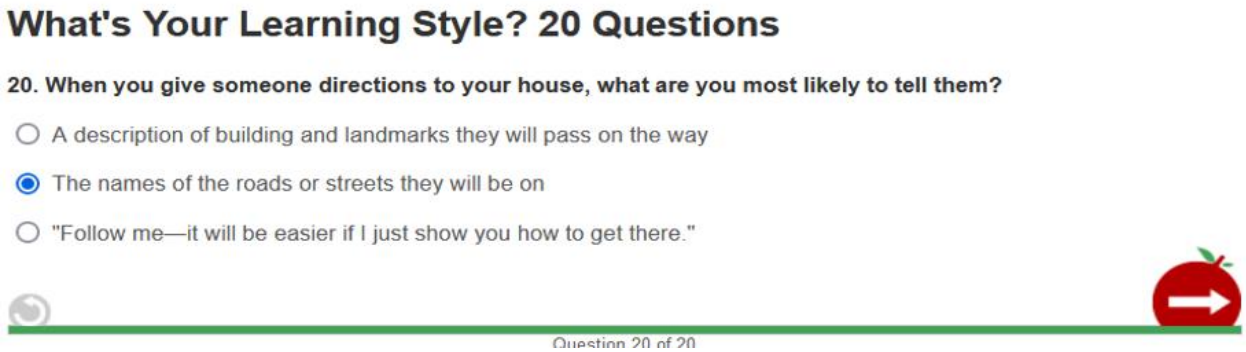

Figure 6.
Question number 20 (Last question).

Figure 6 shows the last question to detect students' learning styles. The question is with the Top of Form question: When you give someone directions to your house, what are you most likely to tell them? With three answer choices: A description of buildings and landmarks they will pass on the way, The names of the roads or streets they will be on and follow me - it will be more straightforward if I just show you how to get there. After completing 20 questions, the user will reach the final stage of clicking the white arrow. A person's learning style score will be generated, as shown in the following Figure.

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Figure 7.
Example of SIDILAN results in detecting student learning styles.

The results of the SIDILAN trial to detect students' learning styles can be seen from the scores in the Figure above. The score results show a person's learning style; the results above show one example of a student's learning style. After that, there is an explanation, for example, the score results. Students tend to be dominant auditory and visual, with the same score of 35%, and tactile or kinesthetic, with 30%. Furthermore, SIDILAN will provide recommendations to students if they already know their learning style, as shown in Figure 8, 9 and 10.

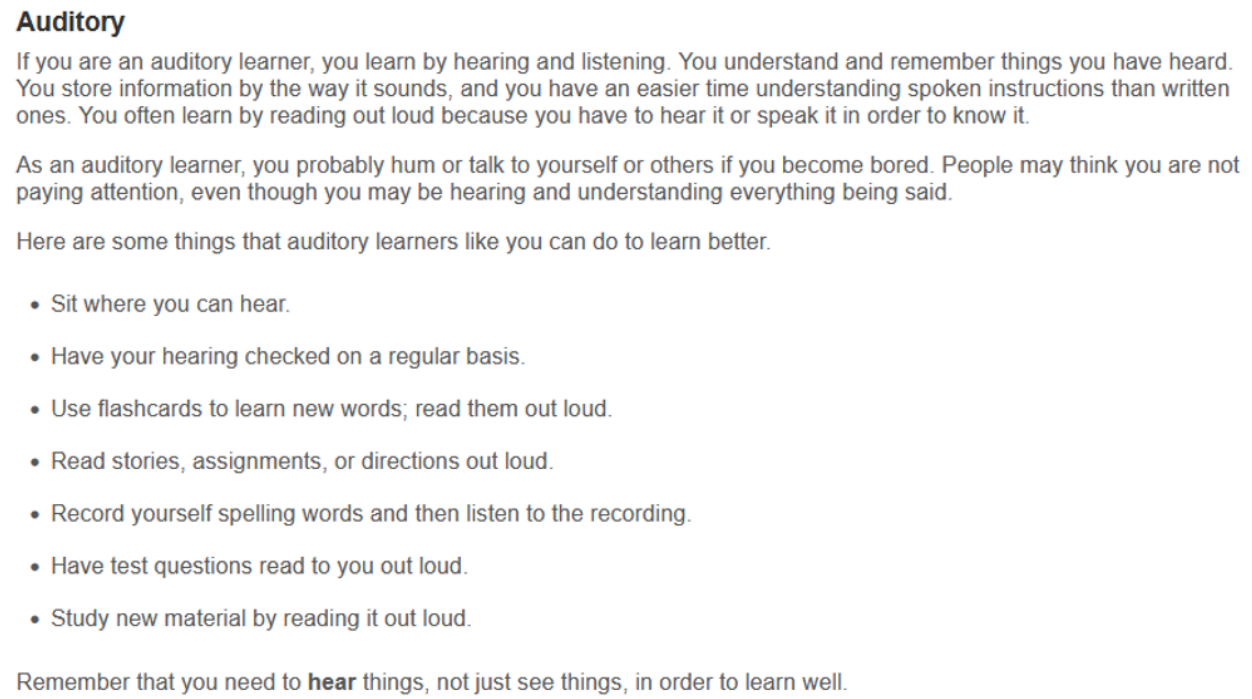

Figure 8.
The SIDILAN provides advice if the learning style is auditory.

An auditory learner learns the best of listening and listening. You understand and remember things that you hear. You retain information based on the sound it makes, and you know oral instructions better than written instructions. You often learn to read aloud because you must hear or say it to understand it. As an auditory learner, you may hum or talk to yourself or others if bored. People may think you are not paying attention, even though you may hear and understand everything being said.

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Here are some things that auditory learners like you can do to learn better. Sit in a place where you can hear. Check your hearing regularly. Use flashcards to learn new words; read them out loud. Read stories, assignments, or instructions out loud. Record yourself spelling words and then listen to the recording. Have test questions read out loud. Learn new material by reading it out loud. Remember that you need to hear something, not just see something, to learn well. If students have a visual learning style, SIDILAN provides suggestions such as the following Figure.

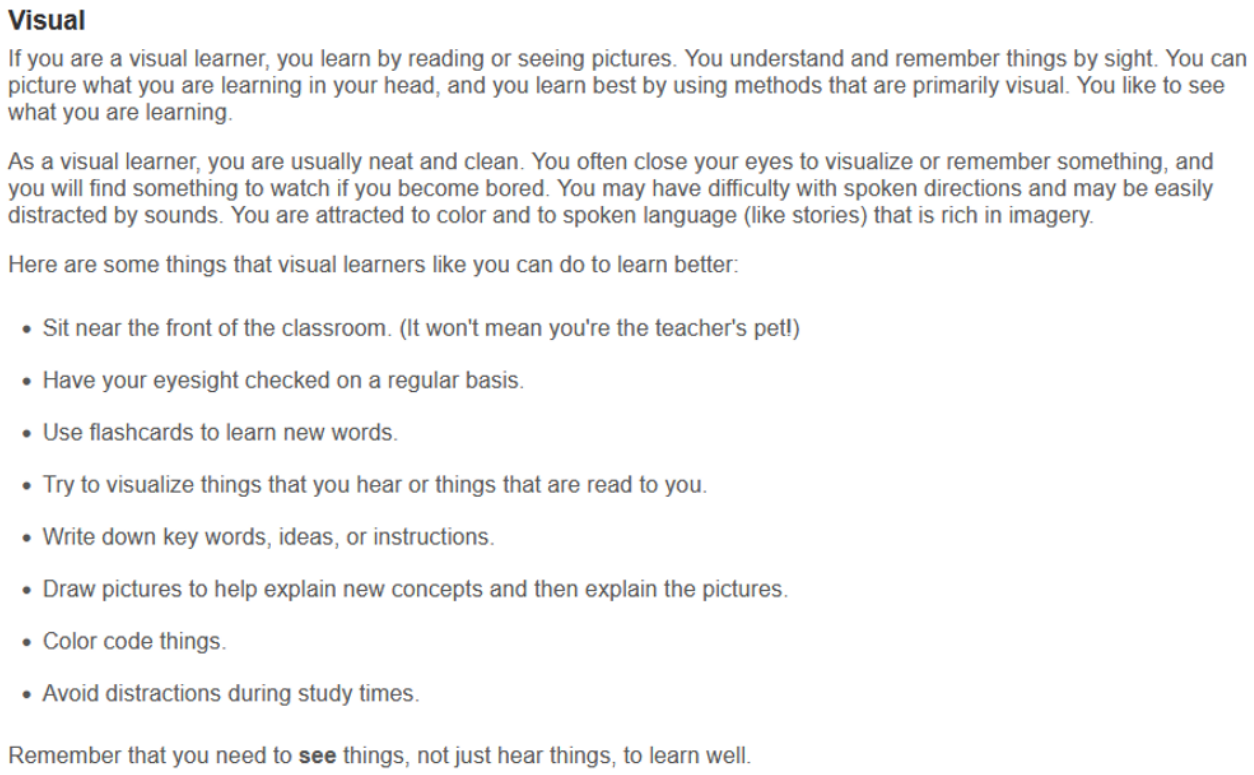

Figure 9.
SIDILAN provides suggestions if the learning style is Visual

Visual Learners learn best by reading or looking at pictures. You understand and remember things of sight. You can picture what you are learning in your head, and you learn best using primarily visual methods. You like to see what you are learning. As a visual learner, you are usually neat. You often close your eyes to visualize or remember something, and you will look for something to watch if you are bored. You may have difficulty with verbal directions and may be easily distracted by noise. You are attracted to colours and spoken language (such as stories) that are rich in imagery. Here are some things visual learners like you can do to learn better: Sit near the front of the class. (That doesn't mean you are the teacher's favourite.) Check your vision regularly. Use flashcards to learn new words. Try to visualize things you hear or things that are read to you. Write down keywords, ideas, or instructions. Draw pictures to help explain new concepts and then explain the pictures. Colour-code objects. Avoid distractions during study time. Remember that you need to see something, not just hear something, to learn well. If students have a Tactile or kinaesthetic learning style, SIDILAN provides suggestions such as the following Figure.

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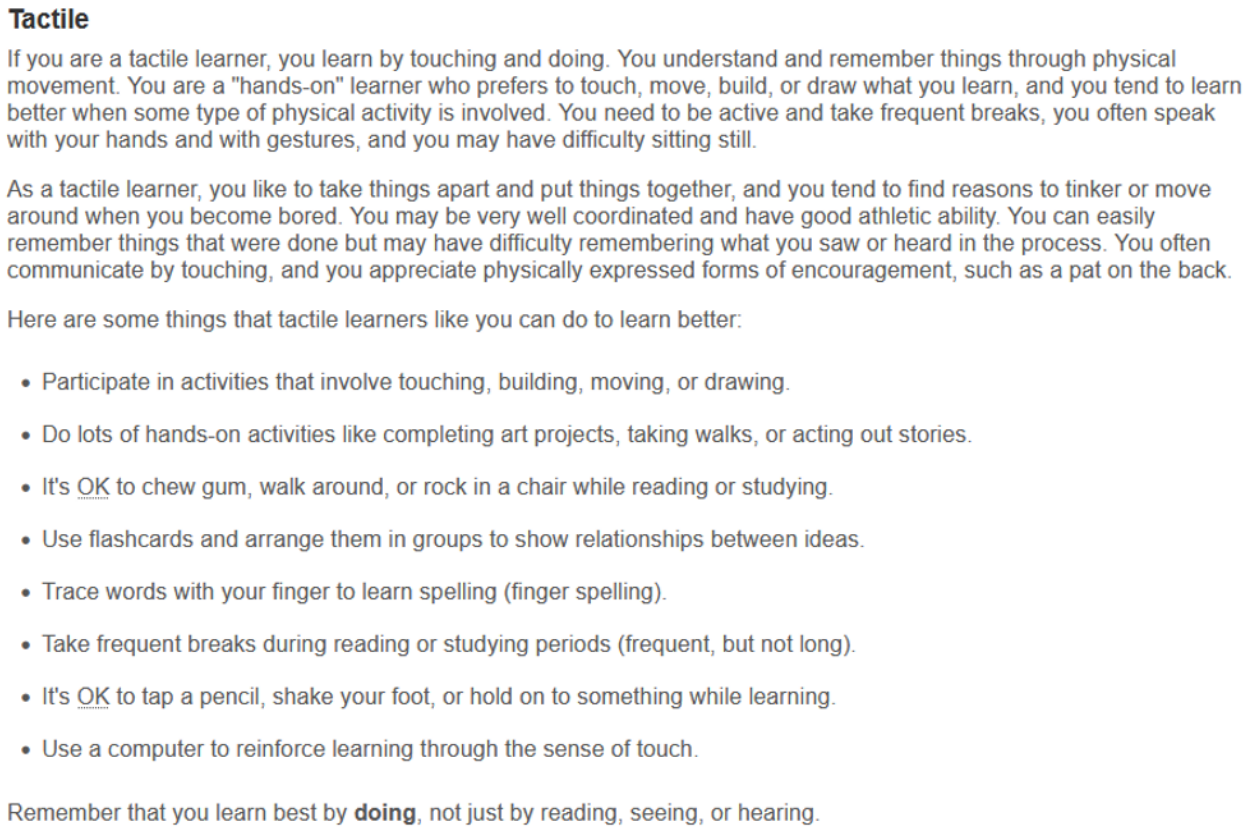

Figure 10.
SIDILAN provides suggestions if the learning style is tactile or Kinaesthetic.

A Visual Learner learns best of touching and doing. You understand and remember things through physical movement. You are a “hands-on” learner who prefers to touch, move, build, or draw what you are learning, and you tend to learn better when some physical activity is involved. You need to be active and take frequent breaks, you often talk with your hands and gestures, and you may have difficulty sitting still. As a tactile learner, you enjoy taking things apart and putting them together, and you tend to find reasons to tinker or move around when bored. You are probably very well coordinated and have good athletic ability. You can easily remember things you have done but may have difficulty remembering what you saw or heard. You often communicate through touch, and you appreciate physical forms of encouragement, such as a pat on the back. Here are some things a tactile learner like you can do to learn better: Participate in activities that involve touching, building, moving, or drawing. Do lots of hands-on activities such as completing art projects, going for walks, or acting out stories. It's okay to chew gum, walk around, or rock in your chair while reading or studying. Use note cards and arrange them in groups to show relationships between ideas. Trace words with your finger to practice spelling (finger spelling). Take regular breaks during reading or studying (often, but not for long). It's okay to tap your pencil, wiggle your foot, or hold something while studying. Use a computer to reinforce tactile learning. Remember that you learn best by doing, not just by reading, seeing, or hearing.

The analysis, design, and development stages have been carried out, so the next stage is the implantation stage with a questionnaire of student responses to SIDILAN for Learning. Disability (LD). The results obtained information that LD A for the Indicator of Understanding and Engagement was 84.31%, LD B for the Indicator of Effectiveness 87.25% LD C for the Indicator of Skills and Self -

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Development 92.65%, and LD D for the Indicator of Satisfaction and Recommendation of 95.59%. The complete results of SIDILAN development to detect learning styles are shown in Figure 11.

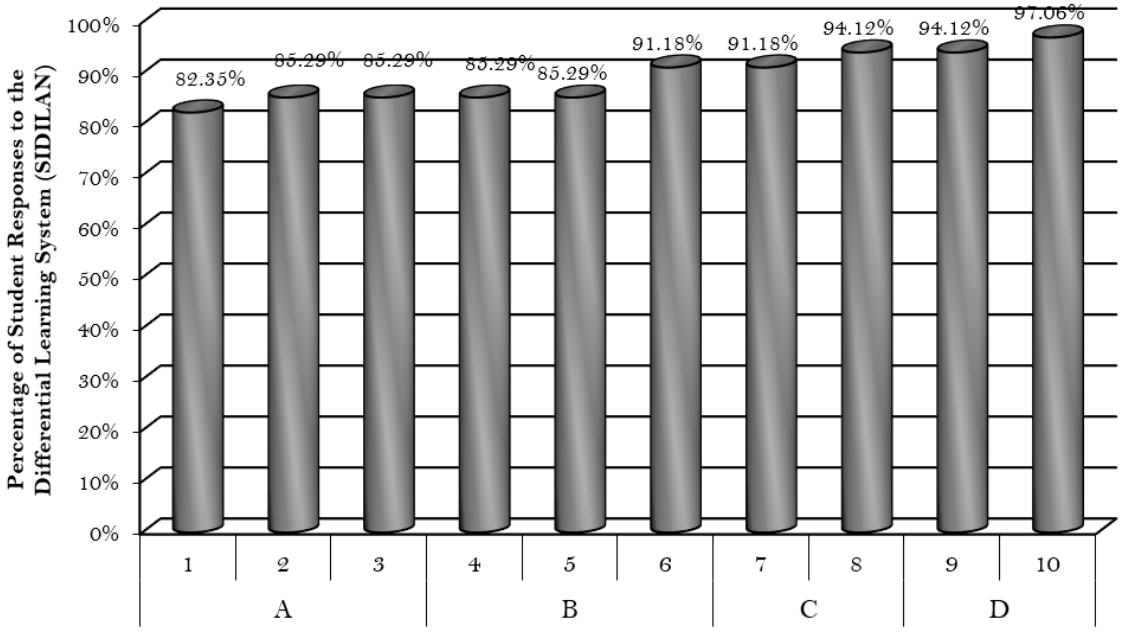

Figure 11.
Percentage of Student Responses to the SIDILAN.
Note:

A: Indicator of understanding and engagement
I understand the purpose of the differential learning system (SIDILAN)
I feel helped in detecting learning styles with SIDILAN
How easy is it for you to use the features on SIDILAN

B: Indicator of effectiveness
SIDILAN helps me understand my learning style better
SIDILAN helps me overcome learning difficulties that I face of learning style
Do you experience technical difficulties when using SIDILAN

C: Indicator of skills and self -development
SIDILAN helps me develop better learning skills after I know my learning style
SIDILAN helps me feel more confident in learning after I know my learning style

D: Indicator of Satisfaction and Recommendation
I am satisfied with the questions about learning styles in SIDILAN
I will recommend SIDILAN to my friends who have learning difficulties

Figure 11 explains about Percentage of Student Responses to the Differential Learning System (SIDILAN) there are 4 indicators and 10 questions in the form of a Likert scale questionnaire 1-4 given to students to measure responses. Student responses to SIDILAN are carried out with 10 questions contained in the description of Figure 11. Student responses to SIDILAN are lowest in question 1 at 82.35% which asks about what I understand the purpose of the SIDILAN. Meanwhile, the highest student response score for SIDILAN was 97.06 with the question I will recommend SIDILAN to my friends who have learning difficulties.

Learning barriers in students are complex and multifactorial. Several internal factors such as difficulty in understanding abstract concepts, lack of interest, and concentration disorders can be obstacles to learning science. Science learning with a Differentiated Approach Learning is a method that adapts the learning process to the needs, interests, and learning styles of students (Gheyssens, et al., 2022; Tomlinson, & Jarvis, 2023). Individual and differentiated learning are very effective approaches in overcoming learning barriers in students (Magableh, & Abdullah, 2020). Students with special needs have unique and diverse learning characteristics, which often cannot be optimally met through conventional learning methods. The gap between the needs of students with special needs and conventional learning methods can have a long-term impact on their development. Differentiated

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learning is a learning approach that recognizes that each student has different learning styles, learning speeds, and strengths. The application of differentiated learning in the classroom can provide many benefits. Differentiated learning is an approach that adapts teaching methods to the needs, interests, and learning styles of each student.

Learning styles are important for students because they are a crucial step in the modern world of education. Detecting learning styles can increase students' motivation and interest in learning. When students feel that learning materials are presented in a way that suits their learning styles, they will be more motivated to engage in the learning process. Differential System Learning (SIDILAN) is here as an innovative solution to overcome the gap between the individual needs of students, especially those with special needs, and conventional learning methods. The urgency of implementing SIDILAN is increasingly felt in the context of inclusive education which continues to grow. SIDILAN is not only beneficial for students with special needs but can also improve the quality of learning for all students.

The results of the study show that the results of development of the SIDILAN online URL: https://s.id/SIDILAN can be used to detect students' learning styles in science learning. Based on the student response questionnaire to SIDILAN for Learning Disability (LD), information was obtained that LD A for Indicator of Understanding and Engagement was 84.31%, LD B for Indicator of Effectiveness of 87.25% LD C for Indicator of Skills and Self-Development 92.65%, and LD D for Satisfaction and Recommendation 95.59%. The findings show that SIDILAN is effective in improving the quality of learning by offering personalized learning styles according to their needs, thus creating a more inclusive and supportive educational environment for students with learning disabilities.

Research on Differential Learning Systems aimed at detecting students' learning styles has provided interesting findings. Based on various journal publications, it is known that each student has a unique learning style, be it visual, auditory, or kinaesthetic (Zuana, et al., 2023). By identifying these learning styles, learning can be adjusted to be more Effective. The results of the study showed that the application of differential learning can increase students' learning motivation, understanding of concepts, and overall learning outcomes (Rogowsky, et al., 2020; Halif, et al., 2020). The study also highlighted the importance of the role of teachers in designing and implementing varied learning to accommodate differences in students' learning styles.

The findings of the study have significant implications for classroom learning practices. Teachers need to pay more attention to differences in students' learning styles and design varied learning activities. The use of various learning media, such as images, videos, group discussions, and physical activities, can help students learn better, schools need to provide adequate resources to support the implementation of differential learning, such as teacher training, development of diverse learning materials, and use of relevant technology. Further research can be conducted to explore other factors that influence the success of differential learning, such as student characteristics, classroom culture, and the broader learning context.

Differential learning has become an important approach in science education, especially for students with learning disabilities (Marlina, Kusumastuti & Ediyanto, 2023; Krishan, & Al-rsa'i, 2023). Several previous studies have shown that learning that is tailored to students' learning styles can help improve their engagement and understanding of difficult science concepts (Troussas, et al., 2023). Through differential learning strategies, students with cognitive disabilities or learning disabilities can more easily understand the subject matter because the method allows them to learn at the pace and in the way that is most effective for them. The results of the study published in the journal state that the use of interactive learning media that is tailored to student's learning styles, such as visual, auditory, or kinaesthetic, has a significant positive impact on improving students' problem-solving skills and critical thinking abilities.

Furthermore, other studies have also revealed that differential learning not only improves the understanding of scientific concepts but is also able to increase students' self-confidence and motivation. In the context of science education, students with learning difficulties often feel marginalized because teaching methods are not appropriate to their needs (Pfeifer, Cordero, & Stanton, 2023; Tefera, &

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Artiles, 2023). However, through a differential learning approach, they are allowed to experience a more inclusive and enjoyable learning process. Previous studies have also emphasized the importance of developing flexible learning systems, such as Differential System Learning, which can identify and adjust materials according to students' specific needs, so that the learning process becomes more effective and efficient for students with learning disabilities.

Differential Learning System that can detect students' learning styles is one of the innovative solutions to face challenges in education, especially for students with diverse learning needs. The main recommendation in the implementation of the system is the development of technology that can automatically identify individual learning styles, be it visual, auditory, or kinaesthetic. The using data-based diagnostic methods, the system can monitor students' preferences in absorbing information and adjust the most appropriate teaching strategies. The use of technology-based platforms such as interactive applications or digital modules can strengthen the effectiveness of the system (Feng, 2024). The teachers provide personalized materials and support a more inclusive and adaptive learning experience (Aas, 2023).

The integration of Differential Learning Systems into the education curriculum requires special training for teachers and educators to understand how the system works and to utilize it optimally. Educators are expected to be able to interpret the results of learning style detection to direct students to the right learning method while providing feedback that is by their development. Another recommendation is the need for continuous evaluation of the effectiveness of the system in improving student learning outcomes, especially for those with learning difficulties. With the systematic and data-based approach, the learning process can be more adaptive, and relevant, and provide better results for various student learning styles.

SIDILAN has the main advantage of automatically detecting students' learning styles, thus enabling a more personalized and adaptive learning process. With technology that can analyse students' learning preferences be it visual, auditory, or kinaesthetic. SIDILAN can provide recommendations for the most appropriate teaching methods for everyone. This increases the effectiveness of learning because the materials and approaches provided can be adjusted to the way students best absorb information. SIDILAN helps educators identify the specific needs of each student, including students with learning difficulties so that they can be given more appropriate and focused support. Another advantage is SIDILAN flexibility which allows integration with various learning platforms, whether in online or blended formats. Learning, or interactive modules. The system can also collect and analyse data continuously, providing an overview of the development of students' learning styles over time. The feature teachers can not only provide appropriate materials but also monitor changes in learning preferences and adjust teaching strategies as needed. As a result, the learning experience becomes more dynamic and supports increased student engagement and understanding in the learning process. The advantages of using SIDILAN are first, Personalized learning or learning materials are tailored to the individual needs of students. Time efficiency: Students can learn at a pace that suits their abilities. Second, students are more motivated because the learning materials are relevant and interesting. Third, students can understand the learning materials more easily.

For improvement of the SIDILAN in the future, it is recommended that a system be developed to enrich more comprehensive data analysis, including the integration of psychometric data and student behaviour during the learning process. Improvements in SIDILAN with Artificial Intelligence (AI) capabilities in understanding students' emotional contexts, such as motivation or stress levels, can also improve the accuracy of learning style detection. Integration with virtual reality (VR) or augmented reality-based learning technology reality (AR) can provide a more immersive and adaptive learning experience, creating a more interactive and engaging learning environment for various types of student learning styles. The development is expected to support more holistic and inclusive learning, especially for students with learning disabilities. The study suggests that SIDILAN be integrated into special education programs as an innovative solution to support the science learning process for students with special needs.

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4. Conclusion

The research purpose to develop a Differential System Learning (SIDILAN) that is effective for students to learn Disabilities (LD) in science learning. SIDILAN is designed to detect students' learning styles that suit their unique needs especially those who have difficulty in understanding science concepts. The findings show that SIDILAN is effective in improving the quality of learning by offering personalized learning styles according to their needs and creating a more inclusive and supportive educational environment for students with learning disabilities. Developing SIDILAN) which is effective for students to detect learning styles in students with Learning Disabilities (LD) in science learning requires a comprehensive and adaptive approach. SIDILAN must be able to identify various learning styles such as visual, auditory, and kinaesthetic, and adjust teaching methods that suit the individual needs of students. Using technology such as machine learning and data analysis, SIDILAN can provide personalized recommendations, helping students design more effective and inclusive learning strategies.

Furthermore, SIDILAN must also be equipped with evaluation tools that can measure the effectiveness of the teaching methods applied. The is important to ensure that the approach used helps LD students in understanding science material. With an integrated and data-based system, students can more easily monitor student progress and make necessary adjustments in real time. The development of effective SIDILAN not only improves the quality of learning for LD students but also provides a more meaningful and enjoyable learning experience. The findings show that SIDILAN is effective in improving the quality of learning by offering personalized learning styles according to their needs and creating a more inclusive and supportive educational environment for students with learning disabilities. The study suggests that SIDILAN be integrated into special education programs as an innovative solution in supporting the science learning process for students with special needs.

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