SCIENTIFIC CULTURE

www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 3306-3315
Open Access. Online & Print

DOI: 10.5281/zenodo.19672067

THE ROLE OF NON-COGNITIVE DIAGNOSTIC ASSESSMENT IN IDENTIFYNG STUDENTS' LEARNING STYLES

Suyuti[1]*, Nur Sehang Thamrin[2], Mohamad Akbar[3]

[1]History Education Program, Faculty of Teacher Training and Education, Tadulako University. Indonesia
[2]English Language Education Program, Faculty of Teacher Training and Education, Tadulako University, Indonesia
[3]Islamic Education Program, Faculty of Teacher Training and Education, Tadulako University. Indonesia,
Email: suyuti@untad.ac.id (S.U.I.); second email.suyutisuyuti870@gmail.com (S.S.I.)

Received: 11/12/2025
Accepted: 02/02/2026

Corresponding Author: Suyuti
(https://orcid.org/0009-0006-8942-3975)

ABSTRACT

This study aims to eaaxamine the role of non-cognitive diagnostic assessment in identifying students' learning styles and to explore how this assessment could inform more personalized teaching practices, thereby enabling instructional design to be better tailored to students' needs. Based on the educational philosophy of Ki Hajar Dewantara, education should align with the innate tendencies of each child to create a learning environment that supports their development. Each student possesses a distinct learning style, including visual, auditory, and kinesthetic modalities. By understanding these learning styles, teachers can design more effective and adaptive instructional strategies. This research used a descriptive qualitative method, with data collected through observations and questionnaires involving a total student population of 1,511 individuals. By the research objectives, the sampling technique used was purposive sampling, resulting in a sample size of 456 students from SMAN 1 Palu. The results indicated that the majority of students had a kinesthetic learning style (50.00%), followed by visual (33.00%) and auditory (17.00%). These results highlighted the necessity of diverse and student-centered learning approaches to enhance comprehension and academic achievement. Therefore, non-cognitive diagnostic assessment is crucial in helping teachers create learning experiences that are more meaningful, effective, and inclusive for all students. conclusion Approaches that are tailored to students' characteristics are expected to enhance learning effectiveness, improve student motivation, and support better comprehension and application of learning materials. In addition, non-cognitive diagnostic assessment also had a significant positive impact on fostering students' self-confidence, self-motivation, and sense of responsibility. Through a deeper understanding of their own strengths and weaknesses, students felt more valued and were given greater opportunities to grow according to their individual potential.

KEYWORDS: Assessment, Diagnostic, Non-Cognitive, Learning Styles.

1. INTRODUCTION

One of the learning characteristics related to the absorption, processing, and delivery of information is students' learning styles (Awaludin et al., 2019; Yotta, 2023)Learning styles represent essential learning modalities. In understanding lessons, students require conceptual comprehension, theoretical frameworks, and formula-based calculations. Such comprehension processes are inseparable from the information processing that occurs within a child's cognitive structure, and this information processing reflects the student's way of thinking, which serves as an indicator of their learning style tenden cies(Djayadin & Mubarakah, 2021; Rodrigues & Oliveira, 2014)

Ki Hajar Dewantara proposed that education functions as a means to guide all of a child's innate tendencies toward well-being and happiness, enabling them to grow as individuals and contribute to society. At the same time, teachers must recognize that each child is unique and possesses different characteristics. Therefore, the teacher's role as a facilitator is to provide a learning environment that supports each child's natural development(Dewantara et al., 2023; Jumardi, 2014) This involves understanding that individual diversity in the classroom must serve as the foundation for instructional practices in schools and as a reference point in evaluating the learning process (Cahyadi et al., 2022)

Classically, there are three types of learning styles in the learning process: visual, kinesthetic, and auditory(Cardino & Ortega-Dela Cruz, 2020; Tomlinson et al., 2003) Students with a visual learning style tend to absorb information more effectively through visual representations such as images, tables, diagrams, graphs, mind maps, sketches, or symbols. Those with an auditory learning style prefer learning activities that involve storytelling, songs, rhymes, or chants. Meanwhile, kinesthetic learners absorb information more easily through physical activity, such as hands-on experiments, role-play, and movement-based activities. Children may use all three learning styles at different times based on their preferences. This aligns with the view of Rose and Nicholl, as cited in (Bobbi DePorter, Mark Reardon, dan Sarah Singer-Nourie, 2007), who stated that "in reality, we all possess all three learning styles, but typically, one tends to dominate."

Each student holds distinct characteristics, and they show different learning styles in their learning processes (Ilman et al., 2024; Susilo & Sarkowi, 2018). Learning style is defined as an individual's process of receiving, organizing, and processing incoming information (Lenny et al., 2018). A student's learning style plays a crucial role in their success during the learning process. Understanding each child's potential and allowing them the freedom to learn according to their natural tendencies is essential (Martika & Hermayawati, 2016)

Experts have defined learning styles in various ways. (Dyah Kusuma et al., 2018; Sibarani, 2021) stated that learning style refers to an activity that students find engaging when learning together with their peers at school. Meanwhile, Hamzah B. Uno (2010:180) argued that learning style indicates the fastest and most effective way for individuals to absorb external information.

According to other scholars, (as cited in (Chetty et al., 2019; Samsuri et al., 2024) defined learning style as the habit chosen by students in their learning activities, both in the classroom and in open environments. Keefe (Ermiyanto et al., 2023; Iskak et al., 2023) explained that learning style relates to how children learn and the methods they prefer to use when learning.

An individual's learning style is a combination of how they absorb, organize, and process information (Bobbi DePorter, Mark Reardon, dan Sarah Singer-Nourie, 2007). Based on the various definitions of learning style presented above, it can be concluded that learning style refers to an individual's habitual approach to learning. These learning habits reflect students' behaviors in receiving, inputting, and processing the instructional information they obtain. Such habits represent the most suitable and comfortable choices for learners, thereby enhancing the effectiveness of the learning process.

According to (Bobbi DePorter, Mark Reardon, dan Sarah Singer-Nourie, 2007), there are three learning styles: visual, auditory, and kinesthetic. Visual learners learn through what they see, auditory learners through what they hear, and kinesthetic learners through movement and touch.

Diagnostic assessment is categorized into two types: cognitive diagnostic assessment, which evaluates students' knowledge and understanding, and non-cognitive diagnostic assessment, which relates to students' psychological or social attributes, one of which is learning style (Joebagio, 2017; Magdalena, 2015).

Cognitive diagnostic assessment significantly affects students' characteristics, particularly in understanding their learning styles (Sari & Jusar, 2018; Valiente, 2008).he analysis of learning styles is part of non-cognitive diagnostic assessment.

Learning style refers to the dominant way students receive stimuli and information, retain it, process it, think critically, and solve problems

. Among the three learning styles, individuals often tend to favor one over the others. This is in line with the view of Bandler and Grinder, as cited in DePorter, Readon, and Nourie (2007:165), who stated that although most people have access to all three modalities, namely visual, auditory, and kinesthetic, almost everyone tends to prefer one dominant modality

Understanding students' learning styles has long been regarded as essential for designing effective instructional strategies(Cheng & Chau, 2016; "Kolb's Learning Styles," 2012) While much attention has been given to cognitive assessment, recent research has emphasized the importance of non-cognitive factors such as motivation, resilience, and self-efficacy in shaping students' learning behavior. However, empirical evidence remains very limited regarding how non-cognitive diagnostic assessment can help identify and support students' learning styles in the classroom(Khoeron et al., 2016; Li et al., 2022)

As widely recognized, students possess a variety of learning styles and exhibit different learning preferences. Without such understanding, educators may overlook important dimensions that influence student engagement and academic achievement. Therefore, this study aimed to examine the role of non-cognitive diagnostic assessment in identifying students' learning styles and to explore how this assessment can inform more personalized instructional practices, so that learning design can be better aligned with students' needs(Ivinson, 2001; Sofhiya et al., 2023).

Although previous studies have explored in depth the relationship between cognitive assessment and student learning outcomes, this study offers a new perspective by specifically focusing on the use of non-cognitive diagnostic assessment to map and understand students' learning styles. It also aims to explore more personalized learning approaches by examining aspects beyond students' academic abilities, such as motivation, interest, perseverance, self-confidence, and learning anxiety.

2. MATERIALS AND METHODS

This study used a descriptive method with a qualitative approach. According to Satori et al. (2010:199), qualitative research, also referred to as naturalistic research, is an approach used to address research problems that require a deep and comprehensive understanding of the research object to draw conclusions within the relevant time and situational context. The descriptive method refers to a research approach that describes, illustrates, and examines events based on facts, which are then used to formulate research conclusions.

2.1. Type of Research

Based on the aforementioned perspectives, this study adopted a descriptive qualitative research design using observation and questionnaires as data collection strategies. Yuliani (2018) stated that descriptive qualitative research is a method that applies a qualitative approach through an inductive process, beginning with a specific event and subsequently drawing conclusions or generalizations from that event. Observation, as described by Fatoni (2011), is a data collection technique conducted by directly observing the research object and recording all relevant information related to its condition or behavior. This study was conducted at SMA Negeri 1, located in the city of Palu, with a total student population of 1,511 students. In line with the objectives of the research, the sampling technique used was purposive sampling, resulting in a sample size of 456 students.

2.2. Data Collection Techniques

The data collection techniques used in this study included questionnaires, interviews, observations, learning inventories, and initial portfolios. The analysis technique involved categorizing the collected data into specific learning style groups, meaning that the data were displayed and verified to draw conclusions.

This research utilized both primary and secondary data sources of a qualitative nature. According to (Sugiyono, n.d.), "Primary data are data sources that directly provide information to the data collector." Based on this definition, the researcher collected data directly from informants. Primary data

may consist of the individual or group opinions of subjects, as well as the results of observations on an object. In this study, primary data were obtained through direct observation focused on the learning style characteristics of students at SMAN 1 Palu. The data analysis technique used in this research was qualitative analysis, which consisted of data collection, data reduction, data display, and conclusion drawing and verification.

3. RESEARCH SETTING AND PERIOD

This study was conducted at SMAN 1 Palu, located in Central Sulawesi Province. The research was carried out over one month, in April 2024.

3.1. Data Sources

3.1.1. Primary Data

Primary data refers to information obtained directly by the researcher that is related to the variables and specific objectives of the study. In this research, primary data were collected through direct observation in accordance with the research focus, namely the learning style characteristics of students at SMAN 1 Palu. The data processing technique used was qualitative analysis, which involved data collection, data reduction, data display, and conclusion drawing and verification.

3.1.2. Secondary Data

Secondary data refers to data collected by the researcher to support the main research through relevant sources. In this study, secondary data consisted of references from various literature sources such as books, articles, and other supporting materials.

3.2. Analysis of Student Activity Data

Student activity data reflect students' engagement during classroom learning styles. consist of three types: visual, auditory, and kinesthetic.. This data is obtained from classroom. The steps for analyzing student activity data are adapted from Parta (Malvigie et al., 2023; Rosdiana et al., 2022)as follows.

1. Recap the class activity scores from all sessions.
2. Calculate the average score for each activity indicator across all sessions.
3. Calculate the overall average score for all activities.
4. Draw conclusions about the level of student activity.

The characteristics of learning styles used refer to (Labib et al., 2017; Mackay, 2007), while the critical thinking indicators refer to (Mestre, 2012; Williamson, 2018), which include analyzing, synthesizing, recognizing and solving problems, concluding, and evaluating. The scores obtained from expert validation will be processed based on the criteria listed in Table 1., Reliability values are tested using the criteria in Table 2, interpretation of the level of difficulty is in Table 3, Discriminatory power criteria in Table 4, practicality categories in Table 5.

Table 1: Expert Validity Student Activity Criteria(Sugiyono, 2017).

Score Interval	Category
$3.5 < A_r \leq 4.0$	Very Active
$2.5 < A_r \leq 3.5$	Active
$1.5 < A_r \leq 2.5$	Less Active
$1.0 < A_r \leq 1.5$	Not Active

Table 2. Reliability Criteria (Sumintono, B., & Widhiarso, W, 2014)

Mark	Criteria
<0.5	Bad
0.5 – 0.6	Bad
0.6 – 0.7	Enough
0.7 – 0.8	Good
>0.8	Very good

Table 3: Difficulty Level Interpretation Criteria (Kunandar, 2015).

Average interval of Difficulty Index	Difficulty Index Criteri
0.00 – 0.30	Difficult
0.31 – 0.70	Currently
0.71 – 1.00	Easy

Table 4: Distinguishing Power Criteria (Kunandar, 2015).

Average Interval of Discriminatory Power	Criteria
0.70 – 1.00	Very well
0.40 – 0.69	Good
0.20 – 0.39	Enough
0.00 – 0.19	Bad
Negative (-)	Thrown Away

The data analysis technique for the practicality test was carried out by calculating the percentage of the average practicality score for each indicator based on the percentage of the average score obtained and then interpreted based on the criteria in Table 5.

Table 5: Instrument Practicality Categories (Sudjana, N., 2009).

Average Score Interval	Category
3.50 – 4.00	Very Practical
3.00 – 3.49	Practical
2.00 – 2.99	Less practical
1.00 – 1.99	Not Practical

4. RESULT AND DISCUSSION

4.1. Cognitive Diagnostic Assessment results

The findings at SMAN 1 Palu showed that cognitive diagnostic assessment became an essential tool for teachers in adjusting the subject matter learning process to students' actual abilities. The profile of assessment results served as the basis for arranging instructional strategies by adjusting content, process, and learning products. For instance, students whose results were below the standard were provided with concept reinforcement

through repetition activities (remedial), while students with higher achievement were directed toward enrichment activities. In addition, teachers used observation results to understand students' difficulties, such as weak numeracy skills or limited comprehension of basic scientific concepts. Thus, cognitive diagnostic assessment functioned not only as a measurement tool but also as a strategy for designing adaptive and meaningful learning.

Cognitive diagnostic assessment was conducted for 1 month: at the beginning of learning, at the end, after the teacher finished explaining and discussing the topic, and at other times. Cognitive diagnostic tests could take the form of written tests and student observations. One of the written test instruments administered by the teacher at the beginning of learning in Grade X was as shown in Table 6.

Table 6: Cognitive Diagnostic Test in the History Subject for Grade X, Semester I.

Grade X A Material	Grade X B Material	Grade X C Material
1. History is a very important field of knowledge to study. Mention the scope of historical science.	1. What is the difference between history as an event and history as a science?	1. Explain the meaning of history according to your personal opinion.
2. Mention and explain the geological eras and archaeological eras along with their characteristics and each period.	2. What was the influence of ancient Egyptian civilization on science?	2. Write the development of historiography in Indonesia along with its characteristics.
3. Explain and mention the location, discoverer, and types of prehistoric humans that have been found in Indonesia.	3. Provide one example each to show that history has educational, inspirational, and integrative values.	3. Mention the system of government that existed in ancient China and its figures.
4. Explain why the Sangiran site was designated as a human heritage site by the International WHO.	4. Explain what is meant by internal criticism and external criticism when conducting verification in historical research.	4. History has four scopes. Mention them and provide the characteristics of each.
5. Explain and provide examples of synchronic and diachronic approaches.	5. Explain the differences in the lives of prehistoric humans in the Paleolithic era and the Neolithic era.	5. Explain why historical science is diachronic and synchronic.

4.2. Non-Cognitive Diagnostic Assessment

Non-cognitive diagnostic assessment at SMAN 1 Palu was conducted to map students' psychological and emotional conditions and learning preferences, as a basis for designing instruction that aligns with each student's characteristics. The main instrument used was a learning style test through interviews conducted by History subject teachers and Guidance and Counseling teachers. The interview aimed to explore students' learning habits, their preferences for learning and completing subject tasks (mapping competencies in individual and group work), and the methods they considered most helpful for understanding the learning material. Through this approach, the History teacher identified a picture obtained about the non-cognitive factors that influenced students' learning processes, such as motivation, self-confidence, and the ways students interacted with the learning environment.

4.3. Students' Learning Styles

In general, students' learning styles consist of three types: visual, auditory, and kinesthetic. These styles were described in detail by (Susilo & Sarkowi, 2018) as follows: 1) Visual: Remembers through images, prefers reading over being read to, needs a comprehensive picture and clear objectives, remembers what is seen, and maintains distance from others to have a clear view. 2) Auditory: Speaks in a rhythmic pattern, learns by listening, engages in both internal and external dialogues, stands close to others to hear clearly, and thinks in a chronological sequence. 3) Kinesthetic: Learns through practice, points to text while reading, responds physically, moves frequently, and prefers touch and sensory engagement with information.

A general classification of students' learning styles at SMAN 1 Palu for the academic year 2024/2025 is illustrated in Figure 1 below.

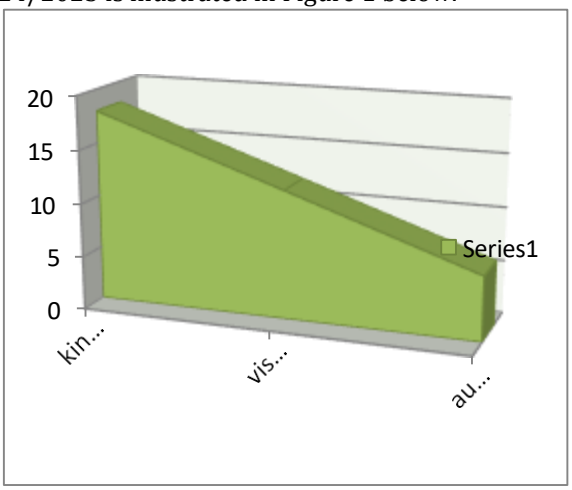
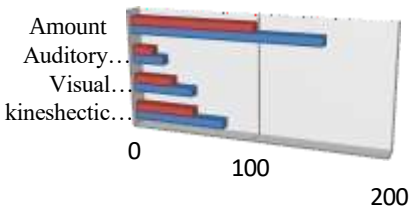


Fig 1: General Classification of Students' Learning Styles at SMAN 1 Palu.
Source: Processed Data, 2025.

4.4. Non-Cognitive Assessment Results on Students' Learning Styles

The non-cognitive diagnostic assessment conducted on students who served as research samples yielded the following results:



	kinesthetic learning Style	Visual learning Style	Auditory learning Style	Amount
Persentase	50	33	17	100
Study Amount	75	50	26	151

***Figure 2: Non-Cognitive Diagnostic Assessment Results on Students' Learning Styles at SMAN 1 Palu.* Source: Processed Data, 2025.**

The questionnaire distributed to students included statements with response options related to the auditory learning style (such as learning by listening to explanations or recordings, using loud verbal repetition during study, and learning through spoken explanations), and this was selected by 75 students. Statements associated with the visual learning style (such as learning through pictures or diagrams, using concept maps or mind maps, and easily recognizing colors, shapes, or page layouts in books) were chosen by 50 students. Meanwhile, statements related to the kinesthetic learning style (such as learning through hands-on practice, studying while moving, rewriting notes, and preferring experiments over reading theories) were selected by 26 students. Total 151 students.

The percentage breakdown for each learning style is presented in the following figure:

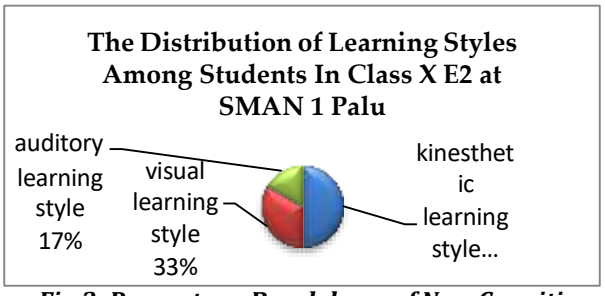


Fig 3: Percentage Breakdown of Non-Cognitive Diagnostic Assessment on Students' Learning Styles at SMAN 1 Palu
Source: Processed Data, 2025.

The chart above illustrates that Grade X students at SMAN 1 Palu were categorized into different learning styles. The blue segment in the chart represents students with a kinesthetic learning style, characterized by learning through practice, pointing at text while reading, responding physically, frequent movement, and a preference for touch and sensory engagement. This group accounted for fifty percent (50.00%) of the total. The red segment represents students with a visual learning style, characterized by remembering through images, preferring reading over being read to, requiring complete visualizations and objectives, remembering what is seen, and maintaining distance from others for a clear view. This group made up thirty-three percent (33.00%). The green segment represents students with an auditory learning style, who prefer to learn by listening, such as through being read to rather than reading on their own. This group constituted seventeen percent (17.00%). These percentages were based on responses from 468 Grade X students at SMAN 1 Palu.

Table 6: Non-Cognitive Diagnostic Assessment Results on Students at SMAN 1 Palu.

NO	Student Learning Style	Statement	Persentase (%)	Category
1	Kinestheic	understand the lesson material when they do physical activities, such as hands-on practice, simulations, or using approaches that involve movement.	50,00	Very good
2	Visual	understand material through visual media such as pictures, diagrams, concept maps, videos, and presentations.	33,00	Good
		listen to		

3	Auditory	explanations verbally, either through teacher lectures, group discussions, or audio recordings.	17,00	Enough

Source: Processed Data, 2025.

Based on the results of the non-cognitive diagnostic assessment conducted on students at SMAN 1 Palu, it was found that the majority of students exhibited a kinesthetic learning style, accounting for 50% of the total. This result indicates that most students tend to understand learning materials more effectively when engaging in physical activities, such as hands-on practice, simulations, or movement-based approaches. Therefore, teachers are encouraged to implement more interactive instructional strategies, such as role-playing, experiments, or practice-based projects, to enhance the learning experience for students with a kinesthetic preference.

In addition, 33% of students indicated a visual learning style, suggesting that they comprehend material more easily through visual media such as images, diagrams, concept maps, videos, and presentations. Students with this learning style tend to grasp information more quickly when it is presented in visually engaging formats rather than through verbal instruction. As a result, instructional approaches that utilize multimedia, infographics, or visual presentations can significantly support their ability to absorb information effectively.

Meanwhile, only 17% of students indicated an auditory learning style, indicating that they comprehend learning material more effectively by listening to verbal explanations, whether through teacher lectures, group discussions, or audio recordings. To support students with this learning preference, teachers may optimize methods such as question-and-answer sessions, group discussions, and the use of sound-based media such as podcasts or recorded lessons.

These strategies can enhance students' understanding of the material being taught. Based on this analysis, educators need to implement diverse and adaptive learning approaches to meet the needs of all students.

These results highlight the important role that non-cognitive diagnostic assessment plays in identifying students' learning styles, thereby enabling teachers to design instructional strategies that better align with students' individual needs(Campos et al., 2022; Valiente, 2008) understanding students' learning tendencies, teachers can create a more inclusive and effective learning environment in which each student can achieve optimal understanding according to their preferred learning style. Furthermore, the assessment results also assist in developing more varied teaching methods, such as a combination of kinesthetic, visual, and auditory approaches, ensuring that all students are given equal opportunities to grow. Therefore, non-cognitive diagnostic assessment functions not only as an evaluation tool but also as a guide for educators in creating more meaningful and comprehensive learning experiences for every student.

- **Students' Abilities**

As previously mentioned, non-cognitive diagnostic assessment not only helps identify students' learning styles but also has an impact on their abilities. Interview results with students from Class X A revealed the following statement: "After participating in the non-cognitive diagnostic assessment, I gained a better understanding of myself, especially regarding how I learn. I have now realized that I feel more comfortable and can understand lessons more quickly through practical methods such as conducting experiments or hands-on practice."

A student from Class X B stated: "After participating in the non-cognitive diagnostic assessment, I realized that I have a strength in learning History, but I tend to feel stressed when studying Mathematics. However, after receiving positive feedback and tips from my teacher, I started to feel better and found learning more enjoyable."

Interview results from several teachers who taught Class X students also supported these observations. A History teacher stated: "Following the implementation of the non-cognitive diagnostic assessment, we not only obtained a clearer picture of each student's learning style but also noticed positive behavioral changes, particularly in terms of increased self-confidence. Some students who were initially reluctant to speak up began asking questions and sharing their thoughts when I taught Class X C. I observed that the feedback they received from the assessment made them feel appreciated and more willing to participate in class." Another teacher, an English teacher from Class X D, stated: "Through the diagnostic assessment, I was able to adjust my teaching methods to accommodate students' learning styles. Those who previously felt pressured by conventional teaching approaches became more comfortable and confident in the learning environment."

5. CONCLUSION

Based on the results of this study, non-cognitive diagnostic assessment played a significant role in identifying students' learning styles at SMAN 1 Palu. The results indicated that the majority of students indicated a kinesthetic learning style (50.00%), followed by visual (33.00%) and auditory (17.00%) learning styles. These results suggest that each student has a different learning preference, and thus, instructional approaches used in the classroom should be aligned with the individual characteristics of each learner. By understanding students' learning style tendencies, teachers can design more varied and adaptive instructional strategies, such as combining kinesthetic, visual, and auditory methods. Approaches that are tailored to students' characteristics are expected to enhance learning effectiveness, improve student motivation, and support better comprehension and application of learning materials. In addition, non-cognitive diagnostic assessment also had a significant positive impact on fostering students' self-confidence, self-motivation, and sense of responsibility. Through a deeper understanding of their own strengths and weaknesses, students felt more valued and were given greater opportunities to grow according to their individual potential.

REFERENCES

Awaludin, A. A. R., Wulan, R., Sarwandianto, A., & Alamsyah, N. (2019). A Development of Assessment Instruments Analysis Learning Style and Creativity of Elementary School Based on Forward Chaining Method. Journal of Physics: Conference Series, 1338(1), 012046. https://doi.org/10.1088/1742-6596/1338/1/012046

Bobbi DePorter, Mark Reardon, dan Sarah Singer-Nourie,. (2007). Quantum Teaching (Mempraktekkan Quantum Learning Di Ruang-Ruang Kelas) (Cet. Ke XIX,). Mizan Pustaka.

Cahyadi, W., Aswita, D., & Ningsih, T. Z. (2022). Analysis of The Development of Non-Cognitive Assessment Instrument to Support Online History Learning in Jambi City High School. AL-ISHLAH: Jurnal Pendidikan, 14(3), 3265–3274. https://doi.org/10.35445/alishlah.v14i3.2044

Campos, D. G., Alvarenga, M. R. M., Morais, S. C. R. V., Gonçalves, N., Silva, T. B. C., Jarvill, M., & Oliveira Kumakura, A. R. S. (2022). A multi-centre study of learning styles of new nursing students. Journal of Clinical Nursing, 31(1–2), 111–120. https://doi.org/10.1111/jocn.15888

Cardino, J. M., & Ortega-Dela Cruz, R. A. (2020). Understanding of learning styles and teaching strategies towards improving the teaching and learning of mathematics. LUMAT: International Journal on Math, Science and Technology Education, 8(1). https://doi.org/10.31129/lumat.8.1.1348

Cheng, G., & Chau, J. (2016). Exploring the relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course. British Journal of Educational Technology, 47(2), 257–278. https://doi.org/10.1111/bjet.12243

Chetty, N. D. S., Handayani, L., Binti Sahabudin, N. A., Ali, Z., Hamzah, N., & Kasim, S. (2019). Learning styles and teaching styles determine students' academic performances. International Journal of Evaluation and Research in Education (IJERE), 8(4), 610. https://doi.org/10.11591/ijere.v8i4.20345

Dewantara, A. H., Setiawati, F. A., & Saraswati, S. (2023). Towards numeracy literacy development: A single-case study on the use of the living book homeschooling model. Infinity Journal, 12(2), 225–242. https://doi.org/10.22460/infinity.v12i2.p225-242

Djayadin, C., & Mubarakah, W. W. (2021). ANALISIS HASIL ASESMEN DIAGNOSTIK PADA KONSENTRASI MAHASISWA DALAM PROSES PEMBELAJARAN DARING DI PERGURUAN TINGGI KEAGAMAAN ISLAM NEGERI (PTKIN). Perspektif Ilmu Pendidikan, 35(1), 1–8. https://doi.org/10.21009/pip.351.1

Dyah Kusuma, E., Gunarhadi, G., & Riyadi, R. (2018). The Development of Problem-Based Quantum Learning Model in Elementary Schoolin. International Journal of Educational Research Review, 3(3), 9–16. https://doi.org/10.24331/ijere.412267

Ermiyanto, E., B.S, I. A., & Ilyas, A. (2023). Asesmen Diagnostik Gaya Belajar Siswa Kelas VII di SMPN 4 Padang Panjang. MANAZHIM, 5(1), 166–177. https://doi.org/10.36088/manazhim.v5i1.2845

Ilman, E. N., Putri, A., Julita, N. H., Ristanto, R. H., & Isfaeni, H. (2024). Development of a Learning Style Diagnostic Assessment Instrument Based on Experiential Learning Theory. International Journal of Biology Education Towards Sustainable Development, 4(2), 83–100. https://doi.org/10.53889/ijbetsd.v4i2.542

Iskak, K. N. N., A.G Thamrin, & Budi Tri Cahyono. (2023). The IMPLEMENTATION OF DIAGNOSTIC ASSESSMENT AS ONE OF THE STEPS TO IMPROVE LEARNING IN THE IMPLEMENTATION OF

THE INDEPENDENT CURRICULUM. JISAE: Journal of Indonesian Student Assessment and Evaluation, 9(1), 15–25. https://doi.org/10.21009/jisae.v9i1.32714

Ivinson, A. J. (2001). Society's Stake in XenotransplantationXeno: The Promise of Transplanting Animal Organs into Humans. David K. C. Cooper, Robert P. Lanza. The Quarterly Review of Biology, 76(3), 331–332. https://doi.org/10.1086/393991

Joebagio, H. (2017). Tantangan Pembelajaran Sejarah di Era Globalisasi. ISTORIA: Jurnal Pendidikan Dan Ilmu Sejarah, 13(1). https://doi.org/10.21831/istoria.v13i1.17617

Jumardi, J. (2014). Pengaruh Pendekatan Pembelajaran dan Gaya Belajar Terhadap Hasil Belajar Sejarah Siswa. Jurnal Pendidikan Sejarah, 3(1), 1. https://doi.org/10.21009/jps.031.01

Khoeron, I. R., Sumarna, N., & Permana, T. (2016). PENGARUH GAYA BELAJAR TERHADAP PRESTASI BELAJAR PESERTA DIDIK PADA MATA PELAJARAN PRODUKTIF. Journal of Mechanical Engineering Education, 1(2), 291. https://doi.org/10.17509/jmee.v1i2.3816

Kolb's Learning Styles. (2012). In A. Kolb & D. A. Kolb, Encyclopedia of the Sciences of Learning (pp. 1698–1703). Springer US. https://doi.org/10.1007/978-1-4419-1428-6_228

Kunandar. (2015). Penilaian autentik (penilaian hasil belajar siswa berdasarkan kurikulum 2013) pendekatan praktis disertai contoh. (Revised Edition 4th Printing.). Rajawali Pers. https://www.sciepub.com/reference/95479

Labib, A. E., Canós, J. H., & Penadés, M. C. (2017). On the way to learning style models integration: A Learner's Characteristics Ontology. Computers in Human Behavior, 73, 433–445. https://doi.org/10.1016/j.chb.2017.03.054

Lenny, Z., Firman, F., & Desyandri, D. (2018). The effect of using quantum teaching and motivation in learning toward students achievement. Jurnal Aplikasi IPTEK Indonesia, 2(3). https://doi.org/10.24036/4.32143

Li, C., Yang, Y., & Jing, Y. (2022). Formulation of teaching strategies for graduation internship based on the experiential learning styles of nursing undergraduates: A non-randomized controlled trial. BMC Medical Education, 22(1). https://doi.org/10.1186/s12909-022-03221-0

Mackay, A. (2007). Individual Learning Styles. In Motivation, Ability and Confidence Building in People (pp. 188–210). Elsevier. https://doi.org/10.1016/B978-0-7506-6500-1.50016-1

Magdalena, S. M. (2015). The Relationship of Learning Styles, Learning Behaviour and Learning Outcomes at the Romanian Students. Procedia - Social and Behavioral Sciences, 180, 1667–1672. https://doi.org/10.1016/j.sbspro.2015.05.062

Malvigie, C., Novianto, V., & Marzuki, S. Z. S. (2023). Visual Auditory and Kinesthetic Learning Model to Improve Students' Motivation, Creativity, and Learning Outcomes. Research and Innovation in Social Science Education Journal (RISSEJ), 1(2), 63–69. https://doi.org/10.30595/rissej.v1i2.128

Martika, W., & Hermayawati, H. (2016). Improving Students' Reading Skill By Using Quantum Learning. JELE (Journal of English Language and Education), 2(2), 118. https://doi.org/10.26486/jele.v2i2.227

Mestre, L. S. (2012). The intersection of culture and learning styles. In Designing Effective Library Tutorials (pp. 33–53). Elsevier. https://doi.org/10.1016/B978-1-84334-688-3.50003-2

Rodrigues, F., & Oliveira, P. (2014). A system for formative assessment and monitoring of students' progress. Computers & Education, 76, 30–41. https://doi.org/10.1016/j.compedu.2014.03.001

Rosdiana, M. P. M., Muslimin, M., & Firmansyah, F. (2022). The use of visual, auditory, kinesthetic (VAK) learning to increase student learning outcomes. Inornatus: Biology Education Journal, 2(2), 85–93. https://doi.org/10.30862/inornatus.v2i2.343

Samsuri, T., Adnyana, P. B., Ariawan, I. P. W., & Wesnawa, I. G. A. (2024). The Development of the Kolb Learning Style Inventory (KLSI): Evolution, Validity, Flexibility and Its Application in Education. Path of Science, 10(11), 3070. https://doi.org/10.22178/pos.111-16

Sari, R. T., & Jusar, I. R. (2018). Analysis of Science Learning Process by Using Learning Module of Character Education Oriented through Quantum Learning Approach. Jurnal Penelitian Dan Pembelajaran IPA, 4(1), 14. https://doi.org/10.30870/jppi.v4i1.2252

Sibarani, B. E. (2021). Analysis of the Effect of the Implementation of the Quantum Teaching Method on Accounting Learning in Class XI IPS SMA N 1 Laguboti. Aptisi Transactions on Technopreneurship (ATT), 3(1), 1–12. https://doi.org/10.34306/att.v3i1.129

Sofhiya, E. N., Ivo, D. P. A., Setyowati, D. R., Febrianti, N., & Altawil, A. N. (2023). Identifying senior high school students' learning styles at a diagnostic assessment. International Journal on Education Insight,

4(2), 57–64. https://doi.org/10.12928/ijei.v4i2.10296

Sudjana, N. (2009). Penilaian hasil belajar mengajar. Pt.Remaja Rosdakarya. https://scholar.google.co.id/scholar?q=Sudjana,+N.+(2009).+Penilaian+hasil+belajar+mengajar.+PT.Remaja+Rosdakarya.&hl=id&as_sdt=0&as_vis=1&oi=scholart

Sugiyono. (2017). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung : Alfabeta, CV.

Sugiyono. (n.d.). Metode Penelitian Pendidikan Pendekatan Kuantitatif Kualitatif, dan R&D. Alfabeta.

Sumintono, B., & Widhiarso, W. (2014). Aplikasi model Rasch untuk penelitian ilmu-ilmu sosial ((edisi revisi).). Trim Komunikata. https://scholar.google.com/citations?view_op=view_citation&hl=id&user=P8Odq4QAAAAJ&citation_for_view=P8Odq4QAAAAJ:Zph67rFs4hoC

Susilo, A., & Sarkowi, S. (2018). Peran Guru Sejarah Abad 21 dalam Menghadapi Tantangan Arus Globalisasi. Historia: Jurnal Pendidik Dan Peneliti Sejarah, 2(1), 43. https://doi.org/10.17509/historia.v2i1.11206

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating Instruction in Response to Student Readiness, Interest, and Learning Profile in Academically Diverse Classrooms: A Review of Literature. Journal for the Education of the Gifted, 27(2–3), 119–145. https://doi.org/10.1177/016235320302700203

Valiente, C. (2008). Are students using the "wrong" style of learning?: A multicultural scrutiny for helping teachers to appreciate differences. Active Learning in Higher Education, 9(1), 73–91. https://doi.org/10.1177/1469787407086746

Williamson, J. M. (2018). Personality Traits and Learning Styles of Librarians, Scientists, and Engineers. In Teaching to Individual Differences in Science and Engineering Librarianship (pp. 41–55). Elsevier. https://doi.org/10.1016/B978-0-08-101881-1.00004-2

Yotta, E. G. (2023). Accommodating students' learning styles differences in English language classroom. Heliyon, 9(6), e17497. https://doi.org/10.1016/j.heliyon.2023.e17497