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Mathematics Learning Style Instrument Developlemt in High School Students

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A B S T R A C T

This research aims to develop valid and reliable student learning style instruments to overcome diagnostic assessment problems, such as unclear learning styles, absence of standard instruments, low teachers' ability to compile instruments, and lack of documentation of assessment results. Development using the ADDIE model is through the stages of analysis, design, development (validation by three experts), implementation (trial), and evaluation. The validity test was conducted using the Pearson Product-Moment correlation, while the reliability was tested using Cronbach's Alpha at a significance level of 5%, with 612 test subjects from four schools. As a result, all 48 statements prepared based on 15 visual, auditory, and kinesthetic learning style indicators were declared valid and reliable, so that this instrument is suitable for widespread use to improve the effectiveness of diagnostic assessments.

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INTRODUCTION

One of the principles developed in the implementation of the Merdeka Curriculum is the Understanding by Design (UbD) principle, which emphasizes a curriculum focused on learning objectives, followed by the determination of assessments to measure learning achievements, and the design of instructional steps (Heni, 2023). Assessment is regarded as an integral part of the learning process, serving as a tool to understand students' progress, learning needs, and learning outcomes.

There are three types of assessment in the Merdeka Curriculum: (a) diagnostic assessment, which aims to diagnose students' strengths and weaknesses; (b) formative assessment, which measures and improves the learning process; and (c) summative assessment, which evaluates learning achievements (Baruta, 2023). Through diagnostic assessment, teachers can plan differentiated learning based on students' achievement levels (Tika et al., 2023). Learning style is a non-cognitive aspect of diagnostic assessment that must be measured and is highly important for teachers to understand.

Learning style is viewed as a cognitive, affective, and physiological aspect used as an indicator of how students comprehend, interact with, and respond to the learning environment (Garizábalo-Dávila et al., 2024; Costa et al., 2020). Furthermore, learning style refers to the method of gathering, processing, and managing information during the learning process (Goosen & Steenkamp, 2023; Deng et al., 2022). It is defined as a method preferred and prioritized by students in the learning process (Khamparia & Pandey, 2020).

Diagnosing students' learning styles is crucial to allow teachers to adapt and modify various teaching models or methods to support students' learning needs (Huang et al., 2018; Martínez Martínez et al., 2019); Learning becomes more effective when teachers align their teaching approaches with students' expected learning styles (Zrudlo, 2023; Papadatou-Pastou et al., 2021; Amponsah, 2020; Almasri, 2022). When students are taught according to their abilities, interests, and preferences, better and more effective learning outcomes can be achieved (Altun & Serin, 2019). Implementing a learning process that considers students' learning styles positively impacts their learning behavior, motivates students, and enhances time efficiency (Azzi et al., 2020).

Several learning style indicators have been established, including Kolb 1984: learning style indicator, Felder & Silverman, 1988: Index of learning styles (psychological), Gregorc, 1985: Gregorc style delineator (cognitive), and Fleming VAK model (meta-learning theory model) (Fleming, 2001). However, most focus on cognitive learning styles, particularly the visual, auditory, and kinesthetic (VAK) learning approach (Huang et al., 2018; Almasri, 2022).

The mandatory implementation of diagnostic assessments for students has raised several issues, including the lack of identification of students' learning styles, the absence of standardized instruments for measuring learning styles, teachers' limited ability to develop instruments, and the poor documentation of diagnostic assessment results. However, the available resources are highly supportive of learning style assessments through mobile applications, as most teachers and students already own Android smartphones, and schools are

equipped with laptops, computers, and Wi-Fi internet access. Therefore, a Student Learning Style Instrument will be developed, focusing on the research question: How is the quality of the developed learning style instrument evaluated in terms of validity.

LITERATURE REVIEW

This study focuses on addressing issues related to students' learning styles through the development of a Student Learning Style Instrument. The study aims to produce an instrument capable of effectively identifying students' learning styles, based on Barbe's (1979) VAK theory, and developed using the ADDIE model.

Several previous studies have developed learning style instruments, including Deng et al., (2022) in Cina; Alzain et al., (2017) in the United Kindom; Ferrer et al., (1991) in Malaysia; McKenna et al., (2018) in Australia; and in Indonesia, studies by Awaludin et al., (2019), and Mashurwati (2018). However, none of these studies specifically developed a learning style instrument for senior high school students.

This study is crucial in responding to the urgent need for a valid instrument to identify students' learning styles. With a technology-based approach, the developed application can address various challenges. By providing a learning style instrument, this research contributes significantly to supporting the implementation of the Merdeka Curriculum and fostering a more inclusive, adaptive, and effective learning ecosystem.

METHODOLOGY

This study was a developmental research aimed at producing a valid and reliable learning style instrument using the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Brown & Green, 2019). The ADDIE model was chosen due to its systematic structure, which includes validation, testing, and refinement stages.

The expert validation analysis results were classified based on the following criteria:

Table 1. Expert Validation Test Classification

No	Interval	Criteria
1	1.00 - 1.75	Not Valid
2	1.76 - 2.50	Less Valid
3	2.51 - 3.25	Fairly Valid
4	3.26 - 4.00	Highly Valid

The validity test was conducted using Pearson's Product-Moment formula, where an instrument item is considered valid if the rxy value is greater than the r-table at a 5% significance level. Meanwhile, reliability was measured using Cronbach's Alpha formula, and an instrument item was considered consistent if the calculated r-value exceeds the r-table at the same significance level.

RESEARCH RESULT

This study followed the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model, which is elaborated as follows.

Analysis

At the analysis stage, learning needs are identified, and various factors influencing the success of the learning program are analyzed with the aim of understanding the main issues to be addressed, defining specific learning objectives, and identifying the characteristics of the audience or learners, such as prior knowledge, interests, and learning styles.

Design

This stage involved designing a systematic structure for the learning style instrument, beginning with an exploration of the following theories:

a) VARK Learning Style Theory: The VARK learning style theory, introduced by Neil D. Fleming in 1987, is an extension of the previous VAK model, with the addition of the Read/Write (R) category to distinguish between visual and textual preferences. The VARK model classifies individual learning styles into four main categories: Visual, Auditory, Read/Write, and Kinesthetic. Understanding these categories can help educators and learners optimize the learning process.
b) Visual Learning Style (V): Individuals with a visual learning style comprehend information more easily through graphical representations such as diagrams, images, charts, and maps. They tend to rely on vision for processing information and often have a strong visual memory. The use of visual aids in learning can enhance understanding and information retention for this type of learner.
c) Auditory Learning Style (A): Auditory learners rely on hearing as their primary mode of processing information. They understand material more easily through verbal explanations, discussions, and listening to lectures. Teaching methods such as group discussions, lectures, and audio recordings can be highly effective for individuals with an auditory preference.
d) Read/Write Learning Style (R): Individuals with a read/write preference prefer information presented in text format. They tend to learn effectively through reading books, articles, and writing notes. Strategies such as providing comprehensive reading materials and encouraging summarization or essay writing can support their learning process.
e) Kinesthetic Learning Style (K): Kinesthetic learners learn best through direct experiences and physical activities. They grasp concepts more effectively by practicing, experimenting, or simulating real-life scenarios. Learning approaches that involve physical activities, such as laboratory experiments, fieldwork, or role-playing, can enhance comprehension for individuals with this learning style. Fleming, N. D., & Mills, C. (1992); Widharyanto, B., & Pd, M. (2017); Robertson, L., Smellie, T., Wilson, P., & Cox, L. (2011).

Design

The development stage was begun with the construction of the learning style instrument. This process included adapting the original learning style instrument developed by Laila (2021). The instrument was then translated and adjusted to the mathematics learning context in senior high schools (SMA). The learning style instrument developed in this study is presented in the following tables.

Table 2. Visual Learning Style Instrument

No	Indicator	Statement
1	Neat and organized	1) In learning, I take complete and neat notes on lesson materials. 2) I study with books and other stationery scattered around me. 3) When presenting in front of the class, I do not tidy up my uniform beforehand. 4) I only complete assignments a day before the submission deadline. 5) I pay attention to my appearance to look neat and presentable.
2	Prefers Reading Over Listening	6) I enjoy learning by reading textbooks myself rather than listening to the teacher's explanations
3	Good Long-Term Planning	7) Before exams, I prepare myself several days in advance. 8) When solving math problems, I sometimes make calculation mistakes
4	Attention to Detail	9) When working on math problems, I strive to write calculations and symbols correctly. 10) After completing assignments, I review my work before submitting it to the teacher. 11) I submit my math test answers immediately without reviewing them first
5	Remembers What is Seen Rather than Heard	12) I easily understand and remember materials written by the teacher rather than those explained verbally. 13) I only take notes from the teacher's presentation because I do not remember the explanations. 14) I understand mathematics better when the teacher explains it using diagrams or concept maps. 15) I ask others to repeat the teacher's instructions for me. 16) I struggle to understand mathematics lessons when taught using images

Table 3. Auditory Learning Style Instrument

No	Indicator	Statement
1	Easily Distracted by Noise	1) I prefer studying at night when it is quiet. 2) I cannot concentrate if my surroundings are noisy. 3) I can study even when people around me are chatting. 4) I study while listening to music.

No	Indicator	Statement
2	Learns by Listening and Remembering Discussions Rather than Seeing	5) I focus on listening to the teacher's explanation first, then take notes after understanding it. 6) I find it difficult to understand mathematics if I only listen to the teacher's explanation. 7) I quickly get bored when listening to too much explanation from the teacher
3	Enjoys Reading Aloud	8) I read books aloud as if explaining them. 9) I memorize things better when I say them out loud. 10) When reading, I move my lips. 11) I read silently without making a sound.
4	Likes Discussions and Explaining in Detail	12) I prefer studying in groups rather than alone. 13) If I have difficulty, I discuss it with my friends. 14) I enjoy explaining things in detail to classmates who need help
5	Struggles with Writing but Excels in Speaking	15) I prefer expressing ideas verbally rather than writing them down. 16) I struggle to articulate my ideas verbally

Table 4. Kinesthetic Learning Style Instrument

No	Indicator	Statement
1	Learns Through Practice	1) I prefer math books that have more exercises rather than explanations. 2) I enjoy practicing math problems even if not assigned by the teacher. 3) I do not like books with too many practice exercises. 4) When I see an example problem in a math book, I only read it without attempting to solve it.
2	Physically Oriented and Active	5) When the teacher asks a question and I do not know the answer, I shake my head. 6) I struggle to sit still for long periods while listening to lessons. 7) I often play with my pen, fingers, or feet while listening to the teacher. 8) I use my fingers or pen to guide my reading. 9) I do not like physical activities such as sports
3	Speaks Slowly	10) When the teacher asks me to explain something, I speak slowly. 11) When asked to explain something, I speak quickly
4	Prefers Hands-on Learning	12) I summarize while reading books. 13) I memorize lessons by reading notes while walking. 14) I do not take notes during discussions
5	Enjoys Interactive Learning	15) I enjoy learning through games that involve physical activities. 16) I do not like learning through games involving physical activities

Table 5. Expert Validation Test Results

No	Evaluation Indicator	Score	Category
A. Instrument Construction			
1	Statements align with research objectives	3,67	Highly Valid
2	Statements are logically and systematically structured	3,67	Highly Valid
3	Statements comprehensively cover various dimensions of learning styles	4,00	Highly Valid
B. Language			
4	Language is clear and easily understood by students	3,67	Highly Valid
5	No ambiguous or difficult words	3,33	Highly Valid
C. Content (Content Validity)			
6	Each item is relevant to learning style indicators	4,00	Highly Valid
7	Learning style indicators are fully covered	4,00	Highly Valid
D. Relevance and Suitability			
8	Items reflect the aspects intended to be measured	3,67	Highly Valid
9	Answer format is appropriate for measurement needs	4,00	Highly Valid
10	Average Score	3,78	Highly Valid

Implementation

The implementation stage involved testing the learning style instrument that had been designed and developed. The instrument was administered to 612 students across four senior high schools (SMA) in Gowa Regency and Makassar City. The results from the trial phase were then subjected to validity and reliability testing, with the results presented below.

Table 6. Instrument Validity Test Results

No	Item	Pearson Value	Sig	Status
Visual				
1	V.1	0.340	<0,001	Valid
2	V.2	0.217	<0,001	Valid
3	V.3	0.483	<0,001	Valid
4	V.4	0.387	<0,001	Valid
5	V.5	0.241	<0,001	Valid
6	V.6	0.232	<0,001	Valid
7	V.7	0.415	<0,001	Valid
8	V.8	0.531	<0,001	Valid
9	V.9	0.361	<0,001	Valid
10	V.10	0.468	<0,001	Valid
11	V.11	0.566	<0,001	Valid

No	Item	Pearson Value	Sig	Status
12	V.12	0.516	<0,001	Valid
13	V.13	0.541	<0,001	Valid
14	V.14	0.403	<0,001	Valid
15	V.15	0.562	<0,001	Valid
16	V.16	0.508	<0,001	Valid
Auditory				
1	A.1	0.398	<0,001	Valid
2	A.2	0.307	<0,001	Valid
3	A.3	0.434	<0,001	Valid
4	A.4	0.512	<0,001	Valid
5	A.5	0.501	<0,001	Valid
6	A.6	0.501	<0,001	Valid
7	A.7	0.470	<0,001	Valid
8	A.8	0.485	<0,001	Valid
9	A.9	0.479	<0,001	Valid
10	A.10	0.499	<0,001	Valid
11	A.11	0.404	<0,001	Valid
12	A.12	0.471	<0,001	Valid
13	A.13	0.480	<0,001	Valid
14	A.14	0.388	<0,001	Valid
15	A.15	0.244	<0,001	Valid
16	A.16	0.366	<0,001	Valid
Kinesthetic				
1	A.1	0.564	<0,001	Valid
2	A.2	0.481	<0,001	Valid
3	A.3	0.504	<0,001	Valid
4	A.4	0.562	<0,001	Valid
5	A.5	0.454	<0,001	Valid
6	A.6	0.487	<0,001	Valid
7	A.7	0.405	<0,001	Valid
8	A.8	0.446	<0,001	Valid
9	A.9	0.535	<0,001	Valid
10	A.10	0.356	<0,001	Valid
11	A.11	0.464	<0,001	Valid
12	A.12	0.480	<0,001	Valid
13	A.13	0.543	<0,001	Valid
14	A.14	0.496	<0,001	Valid
15	A.15	0.492	<0,001	Valid
16	A.16	0.535	<0,001	Valid

Table 6. Instrument Reliability Test Results

No	Item	Cronbach's Alpha Value	Status
1	Visual	0.708	Reliable

No	Item	Cronbach's Alpha Value	Status
2	Auditory	0.708	Reliable
3	Kinesthetic	0.727	Reliable

Evaluation

Based on the limited trial results, it is found that out of the 48 statement items developed from 15 learning style indicators (Visual, Auditory, and Kinesthetic), all items are valid and reliable. Therefore, the instrument can be widely applied by educational stakeholders to enhance learning assessment processes.

DISCUSSION

This study developed 48 statement items based on three primary learning styles—visual, auditory, and kinesthetic—to assess the effectiveness of the learning style measurement instrument for students. Of the total items developed, 15 sub-indicators covering various aspects of visual, auditory, and kinesthetic learning styles are successfully validated and tested for reliability. The results of this study indicate that all statement items are found to be valid and reliable, suggesting that the developed instrument can be effectively used to measure students' learning styles.

Visual, auditory, and kinesthetic learning styles are widely recognized approaches to understanding how students process information. According to Dunn dan Dunn (1992), each learning style reflects an individual's preference for receiving information—visual learners rely more on sight, auditory learners depend on hearing, and kinesthetic learners emphasize physical engagement in the learning process. This study supports this theory by confirming that the instrument designed to match these learning styles can be measured with high validity and reliability (Dunn & Dunn, 1978).

The validity of the statement items was tested through expert analysis, involving educational psychology experts to ensure that each item was relevant and accurately targeted in measuring the intended learning styles. These validity results support the development of an instrument that not only measures the intended construct but also avoids bias or measurement errors. This validity aligns with studies emphasizing the importance of validity in psychological measurement tools to produce accurate assessments (Thissen & Steinberg, 2009).

On the other hand, the instrument's reliability was assessed using Cronbach's Alpha coefficient, which provides a measure of internal consistency among the developed items. The high reliability scores indicate that this instrument produces stable and dependable results when used in different situations. These findings align with the research of George and Mallery which highlights the importance of high reliability in ensuring that an instrument can be used consistently and repeatedly in assessment (George & Mallery, 2019).

Additionally, this study contributes significantly to the understanding of the importance of aligning measurement instruments with individual learning styles, as proposed by Felder and Silverman (1988). The application of this valid

and reliable instrument can serve as a foundation for developing more personalized and effective teaching approaches while providing insights into the impact of learning styles on students' academic performance. Furthermore, this research reinforces the idea that learning-style-based instruments can be used to identify individual strengths and weaknesses in learning, ultimately helping to design more suitable learning strategies.

Based on the study results, it can be concluded that all 48 items developed, derived from 15 sub-indicators of visual, auditory, and kinesthetic learning styles, were successfully validated and tested for reliability. The findings indicate that all statement items are valid and reliable, confirming that the instrument can be effectively used to assess students' learning styles.

For further development, it is recommended to test the use of this instrument across different educational levels to ensure its effectiveness in various contexts. Additionally, incorporating student feedback is essential for refining the instrument. This instrument can also be utilized to develop more suitable learning methods based on students' learning styles and be applied to a broader population, including students with special needs. Further research can explore the relationship between learning styles and other factors affecting student achievement to enhance overall education quality..

CONCLUSIONS AND RECOMMENDATIONS

Based on the research findings, it can be concluded that out of the total 48 items developed, 15 derived indicators covering various aspects of visual, auditory, and kinesthetic learning styles have been successfully validated and tested for reliability. The results indicate that all statement items are valid and reliable, suggesting that the developed instrument can be effectively used to measure students' learning styles.

For further development, it is recommended to test the use of this instrument across various educational levels to ensure its effectiveness in different contexts. Additionally, it is essential to involve student feedback for the refinement of the instrument. This instrument can also be utilized to develop teaching methods that are more aligned with students' learning styles and can be applied to a broader population, including students with special needs. Future research may explore the relationship between learning styles and other factors influencing student achievement, with the aim of improving the overall quality of education.

ADVANCED RESEARCH

Based on the conclusions of this study, it is recommended that future researchers test the instrument across various educational levels to ensure its effectiveness, as well as gather student feedback for further refinement. The instrument should also be adapted for students with special needs and tested in diverse cultural contexts. Future research could explore the relationship between learning styles and academic performance, as well as conduct longitudinal studies to assess long-term impact. Additionally, integrating technology into the instrument could enhance the learning experience and improve personalized teaching.

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REFERENCES

Almasri, F. (2022). Simulations to Teach Science Subjects: Connections Among Students' Engagement, Self-Confidence, Satisfaction, and Learning Styles. *Education and Information Technologies*, *27*(5), 7161–7181. https://doi.org/10.1007/s10639-022-10940-w

Altun, H., & Serin, O. (2019). Determination of Learning Styles and Achievements of Talented Students in the Fields of Science and Mathematics. *Cypriot Journal of Educational Sciences*, *14*(1), 80–89.

Alzain, A. M., Ireson, G., Clark, S., & Jwaid, A. (2017). Learning style instruments: Implications of content. *International Journal of Sustainable Energy*, *6*(1), 18.

Amponsah, S. (2020). Exploring the dominant learning styles of adult learners in higher education. *International Review of Education*, *66*(4), 531–550. https://doi.org/10.1007/s11159-020-09845-y

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://iopscience.iop.org/article/10.1088/1742-6596/1338/1/012046/meta

Azzi, I., Jeghal, A., Radouane, A., Yahyaouy, A., & Tairi, H. (2020). A robust classification to predict learning styles in adaptive E-learning systems. *Education and Information Technologies*, *25*(1), 437–448. https://doi.org/10.1007/s10639-019-09956-6

Baruta, Y. (2023). *Asesmen pembelajaran pada kurikulum merdeka: Pendidikan anak usia dini, pendidikan dasar, dan pendidikan menengah*. Penerbit P4I.

https://books.google.com/books?hl=id&lr=&id=QQLJEAAAQBAJ&oi=fnd&pg=PA9&dq=Y.+Baruta,+Asesmen+pembelajaran+pada+kurikulum+merdeka:+Pendidikan+anak+usia+dini,+pendidikan+dasar,+dan+pendidikan+menengah.+Penerbit+P4I,+2023.+Accessed:+Mar.+14,+2024.&ots=XIeeKoTyzy&sig=TfxSLPZ-zmBw1rV0lsyD8pag4AM

Brown, A. H., & Green, T. D. (2019). *The essentials of instructional design: Connecting fundamental principles with process and practice*. Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9780429439698/essentials-instructional-design-abbie-brown-timothy-green

Costa, R. D., Souza, G. F., Valentim, R. A., & Castro, T. B. (2020). The theory of learning styles applied to distance learning. *Cognitive Systems Research*, *64*, 134–145.

Deng, R., Benckendorff, P., & Gao, Y. (2022). Limited usefulness of learning style instruments in advancing teaching and learning. *The International Journal of Management Education*, *20*(3), 100686.

Dunn, R., & Dunn, K. J. (1978). *Teaching students through their individual learning styles: A practical approach*. Reston,.

Ferrer, L. M., Pak, L. Y., & Hill, D. (1991). Developing a Learning Style Instrument for Use in Upper Primary Schools. *Research in Science & Technological Education*, *9*(2), 181–191. https://doi.org/10.1080/0263514910090206

Garizábalo-Dávila, C., Ospino-Mendoza, E., Marin-Hamburger, Y., Arrieta-Reales, N., Díaz-Arroyo, E., & Marina-Rueda, A. (2024). An Empirical Analysis of Learning Styles and Generic Competencies in University Students: Case of Health Services Administration Students in the City of Barranquilla, Colombia. *Procedia Computer Science*, *231*, 623–628.

George, D., & Mallery, P. (2019). *IBM SPSS statistics 26 step by step: A simple guide and reference*. Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9780429056765/ibm-spss-statistics-26-step-step-darren-george-paul-mallery

Goosen, R., & Steenkamp, G. (2023). Activating accounting students' decision-making skills through a reflective self-assessment workshop on learning styles. *The International Journal of Management Education*, *21*(3), 100858.

Heni, L. (2023). *Modul Prinsip Pengajaran Dan Asesmen I | PDF | Bisnis*. https://id.scribd.com/document/683689241/2023-Inti-Modul-Prinsip-Pengajaran-Dan-Asesmen-I. https://id.scribd.com/document/683689241/2023-Inti-Modul-Prinsip-Pengajaran-Dan-Asesmen-I

Huang, F., Hoi, C. K. W., & Teo, T. (2018). The Influence of Learning Style on English Learning Achievement Among Undergraduates in Mainland China. *Journal of Psycholinguistic Research*, *47*(5), 1069–1084. https://doi.org/10.1007/s10936-018-9578-3

Khamparia, A., & Pandey, B. (2020). Association of learning styles with different e-learning problems: A systematic review and classification. *Education and Information Technologies*, *25*(2), 1303–1331. https://doi.org/10.1007/s10639-019-10028-y

Laila, N. (2021). *Analisis Kemampuan Komunikasi Matematis Pada Materi Segiempat Ditinjau Dari Gaya Belajar Siswa Kelas VII SMP Negeri 2 Bangkalan Tahun Ajaran 2020/2021*. https://digilib.uns.ac.id/dokumen/detail/85218

Martínez Martínez, I., Renés Arellano, P., & Martínez Geijo, P. (2019). *Los estilos de aprendizaje y de enseñanza: Análisis y diagnóstico en educación superior de Centro Internacional de Estudios Superiores del Español, CIESE-Comillas, España*. https://repositorio.unican.es/xmlui/handle/10902/18650

Mashurwati, Y. (2018). Penerapan inventory tes gaya belajar remaja dengan aplikasi google form, media sosial serta pengembangan program layanan bimbingan dan konseling terkait. *Jurnal EDUCATIO: Jurnal Pendidikan Indonesia*, *4*(1), 1–6.

McKenna, L., Copnell, B., Butler, A. E., & Lau, R. (2018). Learning style preferences of Australian accelerated postgraduate pre-registration nursing students: A cross-sectional survey. *Nurse Education in Practice*, *28*, 280–284.

Papadatou-Pastou, M., Touloumakos, A. K., Koutouveli, C., & Barrable, A. (2021). The learning styles neuromyth: When the same term means different things to different teachers. *European Journal of Psychology of Education*, *36*(2), 511–531. https://doi.org/10.1007/s10212-020-00485-2

Thissen, D., & Steinberg, L. (2009). Item response theory. *The Sage Handbook of Quantitative Methods in Psychology*, 148–177.

Tika, P. N., Jariah, Y. A., Melina, M. M., Ristanto, R. H., & Isfaeni, H. (2023). Pengembangan Instrumen Tes Diagnostik Three-Tier Pada Pembelajaran Sistem Ekskresi Berdiferensiasi. *Bio-Lectura: Jurnal Pendidikan Biologi*, *10*(2), 167–182.

Zrudlo, I. (2023). Why the learning styles myth appeals and how to persuade believers otherwise. *Teaching and Teacher Education*, *132*, 104266.