RESEARCH ARTICLE

Diagnostic assessment to identify learning styles and critical thinking in independent learning

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Abstract: Diagnostic assessment is a crucial step in the differentiated learning process as an implementation of the Merdeka curriculum. This study aimed to develop a diagnostic assessment instrument that can identify students' learning styles and critical thinking skills, especially in the Cell and Bioprocess material, in the context of implementing the Independent Curriculum. This study uses the Research and Development (R&D) method with the Borg and Gall development model. The subjects of the study were 35 grade X students of SMA Negeri 8 Pekanbaru who were selected randomly. Data analysis was carried out using the Rasch model with Winstep. The results of the study showed that the critical thinking diagnostic instrument had high validity and good reliability, while the learning style instrument had low reliability and needed further improvement. Several learning style assessment items were considered invalid and had to be adjusted or discarded. This diagnostic assessment instrument is expected to help teachers develop more effective learning strategies that are in accordance with the individual needs of students, so that it can improve the quality of learning, especially in understanding the Cell and Bioprocess material.

Keywords: cells and bioprocesses; critical thinking; diagnostic assessment; learning styles

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Introduction

Education in Indonesia continues to develop with various efforts to improve the quality of the curriculum to meet the demands of the 21st century. One of the latest policies is the Independent Curriculum, which emphasizes the 21st century skills (4C). The curriculum allows teachers to choose the appropriate format, experience, and important materials to achieve learning objective (Purnawanto, 2023). The Independent Curriculum, which is a new breakthrough in curriculum change, of course has many challenges that must be faced, such as the readiness of educators, the availability of learning resources, and adjustments to school infrastructure.

Differentiated learning is one of the main challenges for teachers in implementing the Independent Curriculum, because the teaching approach, content, and evaluation must be adjusted to the needs of each student. According to the Krisnawati, (2024) this approach aims to ensure that each student develops according to their potential. The teaching module provides flexibility for teachers in designing relevant learning strategies, by mapping student needs using diagnostic assessments. This allows teachers to design more personal and effective learning steps according to student needs.

Diagnostic assessment plays an important role in identifying students' competencies, strengths, and weaknesses, so that teachers can design learning strategies that suit the needs of each student (Natasari et al., 2023). This assessment is divided into two types, namely cognitive and non-cognitive. Non-cognitive assessment helps diagnose psychological aspects, such as students' motivation, interests, and learning styles, while cognitive assessment aims to assess students' initial abilities before starting new material. By combining these two types of assessments, teachers can design more targeted and effective learning according to students' conditions.

Based on a survey conducted on MGMP Biology teachers, the results showed that 80% of teachers still need an understanding related to the development of diagnostic assessment instruments. There are 40% of teachers still using examples of instruments from the internet. Furthermore, the material that is considered difficult for students to understand in biology learning is in the Cell and Bioprocess material in Phase F. This is because the material is abstract and complex, which means it cannot be learned contextually.

Understanding a concept requires high-level thinking skills, critical thinking is a skill that must be possessed according to the needs of Phase F. Critical thinking skills are also one of the factors that can improve students' conceptual understanding (Permana et al., 2019; Alsaleh, 2021; Hasnunidah et al., 2020). Critical thinking consists of Analyzing, Synthesizing, Recognizing and Solving problems, Concluding and Evaluating (Angelo, 1995;Yustina & Apiyandi, 2022). The improvement of students' critical thinking needs to be evaluated periodically so that the needs required in the learning process can be identified.

Learning style is one of the factors that influence the learning process. Learning style is a key to success in the learning process (El-Sabagh, 2021; Indirwan et al., 2023). Learning style has a very strong relationship with learning outcomes, because learning methods that are in accordance with individual preferences can improve understanding of the material (Asrianingsi, 2020; Aprilia et al., 2022; Zebua & Harefa, 2023). So, it is important for educators to know the learning styles of students in order to determine the right learning strategy.

This article discusses the results of the development of a diagnostic assessment instrument which aims to offer a more holistic approach by integrating cognitive and non-cognitive aspects in one learning material, namely measuring students' learning styles and critical thinking. So that it can provide a significant contribution in advancing more personal, effective and specific learning practices according to cell and bioprocess materials. In addition, the results of this study are not only relevant in the context of implementing the Independent Curriculum, but also provide information in the form of data to teachers to develop teaching modules based on the results of diagnostic assessments that have been carried out so that learning can be adjusted to the needs and learning styles of each student and can be a reference for teachers in constructing diagnostic assessments on other materials.

Method

This study uses the R&D (Research and Development) model developed by Borg and Gall (2016) modified by Sugiyono (2016). This model consists of five stages, namely: (1) Identification of potential and needs; (2) Information collection; (3) Product design; (4) Product validation; and (5) Product evaluation. The subjects of the study were 105 class X students of SMA Negeri 8 Pekanbaru. A total of 35 students were taken randomly in this study. Data analysis was carried out through expert validation and analysis using the Rasch Model with the Winstep application, based on research parameters including the validity and reliability of the learning style questionnaire and question analysis (validity, reliability, unidimensionality, level of difficulty, discriminatory power, distractor function, and item-person map) on the critical thinking test on cell and bioprocess material. The characteristics of learning styles used refer to Deporter & Hernacki (2016), while the critical thinking indicators refer to Angelo (1995), 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. For the Rasch Model analysis, the validity of the instrument is determined through the MNSQ, ZSTD, and Corr values, which are presented in Table 2, Reliability values are tested using the criteria in Table 3, interpretation of the level of difficulty is in Table 4, Discriminatory power criteria in Table 5, practicality categories in Table 6.

Table 1. Expert Validity Criteria (Sugiyono, 2015)

Average Interval	Category Score
$3.25 \leq x < 4$	Very valid
$2.5 \leq x < 3.25$	Valid
$1.75 \leq x < 2.5$	Less Valid
$1 \leq x < 1.75$	Invalid

Data analysis techniques for testing instrument validity with the Rasch model can be seen in the following Table 2.

Table 2. Validity Criteria for MNSQ, ZSTD and Corr values (Sumintono & Widhiarso, 2014)

Variables	Score
MNSQ	0.5 – 1.5
ZSTD	(-2) – 2
Corr	0.4-0.85

Table 3. Reliability Criteria (Sumintono & Widhiarso, 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 4. Difficulty Level Interpretation Criteria (Kunandar, 2015)

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

Table 5. 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 8.

Table 6. Instrument Practicality Categories (Sudjana, 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

Results and Discussion

Stages and Results of the Development of Diagnostic Assessment of Learning Styles and Critical Thinking on Cells and Bioprocesses material in grade XI of Senior High School were carried out through the stages of Expert Validity Test, Practicality Test and Validity Test (Rasch Model) to identify students' learning styles and critical thinking using the Borg & Gall development model modified by (Sugiyono, 2016).

Identification of Potential and Problems

The results of the initial needs analysis identified a gap in teacher competency in designing and implementing diagnostic assessments that are in accordance with the demands of the Independent Curriculum. The lack of references in building diagnostic assessments can have a significant impact on the quality of assessment and learning (Natasari et al., 2023). This is because constructing assessment instruments must be based on the Learning Outcomes that have been set, especially on the material on cells and their bioprocesses because it is a relatively difficult material. Because the material is abstract, students have difficulty understanding the concepts (Utami & Susanti, 2020; Firdaus et al., 2024). So, it is necessary to identify student needs so that Learning Objectives (TP) can be achieved as they should.

Information Collection

The information gathering stage is crucial in the process of making a diagnostic assessment. The information collected will be the basis for compiling a valid and reliable assessment instrument. Here are some aspects of information gathering that are relevant to making a diagnostic assessment:

Curriculum Analysis

The curriculum analysis on the Cell and Bioprocess material that focuses on Table 7 aims to ensure the suitability between the designed learning objectives and the Phase F Learning Outcomes (CP). With this alignment, learning becomes more focused, efficient, and directed.

Table 7. Development of Learning Objectives for Cells and Bioprocesses

Learning Outcomes (CP)
Students have the ability to describe the structure and components of cells, as well as the bioprocesses that occur such as membrane transport and cell division.
Learning Objectives (TP)
Students are able to identify the structure and components of prokaryotic and eukaryotic cells (Bacteria, Animals and Plants) Students are able to identify the cell structure (cell walls) of plants and animals through practical work. Students are able to compare passive and active membrane transport processes. Students are able to conclude the results of the membrane transport practicum (diffusion and osmosis) Students can create learning media related to the processes of mitosis and meiosis.

Material Analysis

The activities carried out at the material analysis stage are creating a concept map by mapping the main concepts of the Cell and Bioprocess material. This aims to determine prerequisite material as an important point in designing a diagnostic assessment. Prerequisite material as basic knowledge or skills that must be mastered first before studying more complex material (Asrianengsi, 2020). The results of the concept map of Cell and Bioprocess material in Indonesia can be shown in Figure 1.

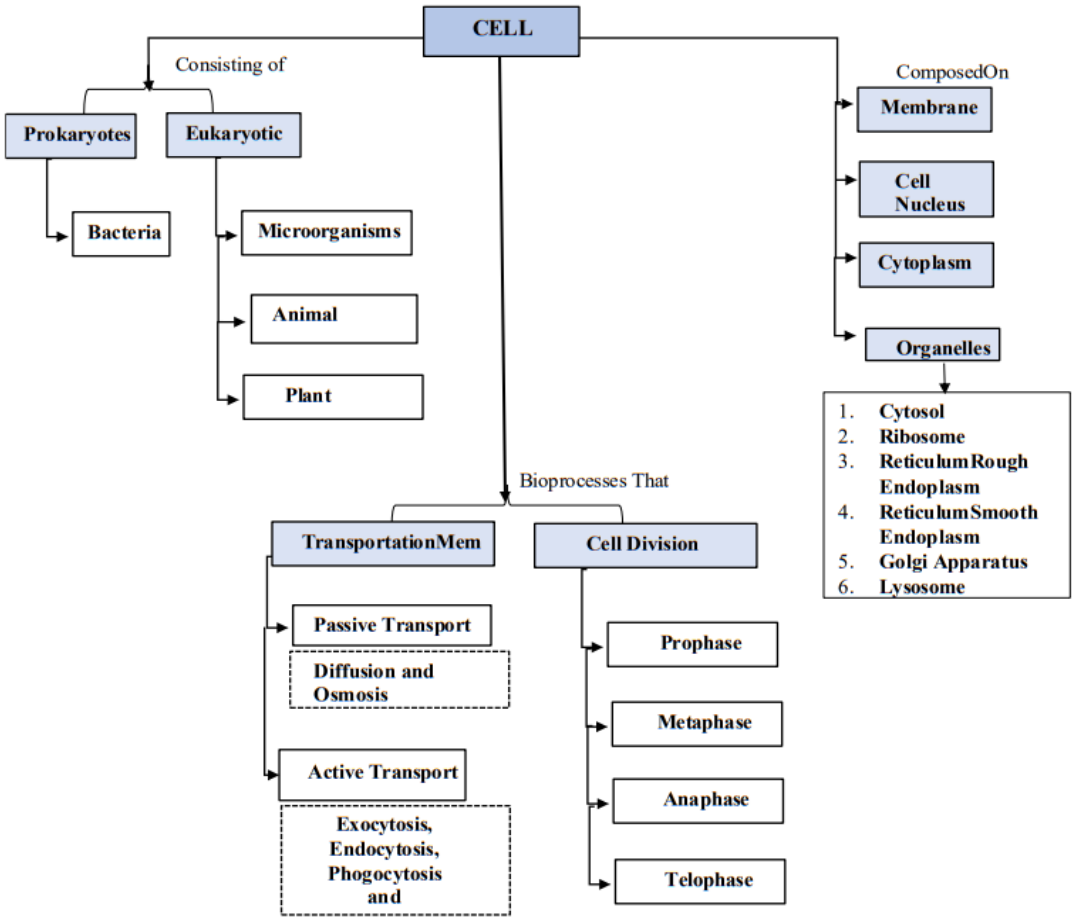


Figure 1. Concept Map of Cell Material and Its Bioprocesses

Based on the concept map presented, it is clear that there is a close relationship between the material on cell division, types of prokaryotic and eukaryotic cells, and the core material, namely Cells and their Bioprocesses. The material on cell division studied in grade IX is the foundation for students' understanding of how organisms grow and develop. Furthermore, knowledge about the differences between prokaryotic and eukaryotic cells obtained in grade X provides an initial picture of the diversity of cells as basic units of life. These two prerequisite materials then become a strong foundation for studying the material on Cells and Bioprocesses in more depth in grade XI. By understanding the process of cell division and the differences in cell types, students will find it easier to understand cell structure, organelle functions, and various biological processes that occur in cells (Nisak, 2021).

Learning Style Aspect Analysis

Identification of learning styles that are appropriate to the material to be studied has a positive impact by helping teachers to map groups based on students' learning styles. This is because the more specific the instrument used, the more accurate and relevant the results obtained tend to be to the objectives that have been set (Azrai et al., 2018; Devi et al., 2022; Hidayat et al., 2023). The aspects of learning styles identified by teachers use 3 aspects, namely Visual, Auditory and Kinesthetic.

Product Design: Creating a Learning Objective Flow

The designed Learning Objective Flow (ATP) combines the Problem Based Learning (PBL), Inquiry Learning, and Teaching at The Right Level (TaRL) approaches to create an active and meaningful learning experience for students in learning Cells and Bioprocesses material. Starting with an authentic problem, students are encouraged to explore, analyze, and synthesize information independently or in groups (Putri et al., 2024; Rahmi et al., 2024). The TaRL approach ensures that each student can learn according to their abilities, while the group discussion and practicum methods provide opportunities for students to interact directly with the learning materials. Through this process, it is hoped that students will not only understand the basic concepts of cells and bioprocesses, but also be able to apply this knowledge in the context of everyday life.

Designing Grids and Making Assessments

In the cognitive diagnostic assessment (Critical Thinking), Create a Critical Thinking Question Grid and Create Critical Thinking Indicator Questions with indicators from Angelo (1995) namely Analyze, Synthesize, Recognize and solve problems, Conclude, Evaluate and Assess. The questions created amount to 30 multiple choice questions, adjusted to the Learning Objectives (SPL) based on Learning Outcomes (PK) at Stage F.

As for the non-cognitive diagnostic assessment, Create a questionnaire grid based on the characteristics of learning styles from Deporter & Hernacki (2016). Each learning style (Visual, Auditory and Kinesthetic) has 10 characteristics. Each characteristic is represented by one question item. The questionnaire made amounted to 30 questionnaire items with a polytomous scale, namely a Likert scale of 1 to 4 based on the grid, the questions in the questionnaire adjust to the Learning Objectives (TP) of cell material and its bioprocesses so that the questions related to the activities in the ATP made.

Design Validation

Expert validation was conducted by providing assessment sheets to three validators who evaluated the aspects of Material, Construction, and Language. The validators noted that several questions did not meet the criteria for eligibility, so the researcher needed to make improvements according to the suggestions given. However, the validation results showed that the diagnostic assessment instrument for learning styles and critical thinking of grade X students as a whole was categorized as very valid, with details of the validity aspects listed in Table 8.

Table 8. Average Validity of the Learning Style and Critical Thinking Diagnostic Assessment Instrument

No	Aspect Evaluation	Average Score						Average		Category Validity
		V.1		V.2		V.3				
		GB	BK	GB	BK	GB	BK	GB	BK	
1	Material	3.80	3.75	4.00	3.75	3.60	3.50	3.80	3.67	Very Valid
2	Construction	3.67	3.50	3.50	3.67	3.67	3.50	3.61	3.56	Very Valid
3	Language	3.67	3.80	3.67	3.80	3.67	3.60	3.67	3.73	Very Valid

Information:
V.1: Validator 1, V.2: Validator 2, V.3: Validator 3, GB: Learning Style, BK: Critical Thinking

Based on Table 8, the validation results of the learning style and critical thinking instruments show that both instruments have met the criteria for good validity, seen from the average of each aspect which is included in the very valid category. This is reflected in the suitability of the questions to the material, level, and learning objectives, as well as the use of standard and clear language. Good questions have standards that are in accordance with the material based on the curriculum standards currently being used (Afandi et al., 2019; Islamiyati et al., 2021). In addition, the alternative answers to the questions designed have reflected a proper understanding of the material. Alternative answers that are in accordance with the questions can reflect the correct answers (Biezma & Rawlins,2015; Drake, 2020). In addition, the instrument follows the writing rules of the Great Dictionary of the Indonesian Language (KBBI) which can increase clarity and reduce ambiguity (Yanti et al., 2024). The writing errors in the instrument are also minimal so that there is no misconception when reading the question instructions. Accuracy and appropriateness in writing instructions can reduce students' ambiguity in understanding the questions (Harmoko et al., 2022). Thus, the instrument developed can be relied on to measure the learning styles and critical thinking skills of grade X students in the Cell and Bioprocess material.

Product Trial

The product trial aims to analyze the validity of the instrument developed using the Rasch model with valid indications on the learning style instrument seen from the validity and reliability, while the critical thinking instrument is seen based on validity, reliability, unidimensionality, level of difficulty, distractor function, discriminatory power and person item map. The following are the results of the analysis using the Rasch model. Validity Instrument validity was carried out using the Rasch model test using Winstep, as can be seen in Table 9.

Table 9. Validity of the Results of the Learning Style Instrument Trial

Variables	Range	Information	Number of Questions	
			Learning Styles	Critical thinking
MNSQ	0.5 - 1.5	Valid	29	23
	>1.5	Invalid	1	7
	<0.5	Invalid	0	0
ZSTD	-2.0 - 2.0	Valid	24	26
	> 2.0	Invalid	1	4
	<-2.0	Invalid	4	0
Corr	0.4 –0.85	Valid	28	24
	> 0.85	Invalid	0	0
	< 0.4	Invalid	2	6

Based on the analysis in Table 10, the validity of the questions in the Diagnostic Assessment is assessed using Outfit Mean Square (MNSQ), Outfit Z-Standard (ZSTD), and Point Measure Correlation (Pt Mean Corr), with a minimum of two categories must meet the specified limits (Sumintono & Widhiarso, 2014). In the learning style instrument, out of 30 questions, 28 items are valid, while 2 questions in numbers 22 and 23 are invalid. Question item number 22 shows an MNSQ value of -2.43 and Corr -0.8, which indicates a mismatch between the student's response and the model. This can be influenced by the unclear instructions and alternative answers given (Akmal & Festiyed, 2023), as well as the inability of the questions to measure kinesthetic learning styles. Meanwhile, question number 23 has an MNSQ value of 1.53; however, the ZSTD value of 2.37 shows a significant deviation increase, thus indicating that this question also fails to accurately assess students' kinesthetic learning styles.
In critical thinking questions, out of 30 questions, there are seven invalid questions. Some factors that cause invalid questions are unclear and convoluted question formulations, illogical answer choices or having more than one correct answer, to errors in the material and the use of non-standard language (Fikri et al., 2022; Prawiki & Helendra, 2021). Questions 8 and 15 have MNSQ values above 1.5, indicating inappropriate difficulty to measure student understanding, while Corr values below 0.4 indicate a weak relationship with the overall score, indicating irrelevance. For questions 16, 19, 26, and 30, the same MNSQ values and ZSTD above 2.00 indicate problems in the level of difficulty and consistency of results. Low Corr values indicate that these questions are not effective in assessment. This leads to the possibility of inappropriate question design and incompatibility with teaching materials, which requires further analysis and revision to improve the validity of the assessment (Yasir et al., 2020).

Reliability

The results of the reliability analysis for the learning style and critical thinking instruments are detailed in Table 10, which presents a comprehensive overview of the statistical measures used to assess their consistency and dependability. This analysis highlights the key metrics, such as Cronbach's alpha and inter-item correlations, that contribute to understanding the robustness of these instruments in evaluating

students' learning preferences and critical thinking abilities

Table 10. Reliability of the Results of the Learning Style Instrument Trial

Variables	StyleStudy		ThinkCritical	
	Measure	Category	Measure	Category
Respondent Reliability	1.00	Special	0.77	Good
Item Reliability	-1.00	Weak	0.79	Very good
Cronbach's Alpha	0.21	Not Reliable	0.82	Reliable

The results of the reliability test of the learning style instrument showed a Cronbach's alpha value of 0.21, which is very low and indicates an error in instrument development.Factors such as misunderstanding of instructions, lack of motivation, and random answer patterns also influence these results (Putriani et al., 2020; Dewi et al., 2020). In this case, it indicates that the learning style questionnaire instrument cannot be used as a basis for drawing valid conclusions about students' learning styles.

On the other hand, the Cronbach's alpha value of 0.82 with a very good category, on the critical thinking instrument shows a very high level of reliability. This indicates that the items in the instrument consistently measure the same critical thinking dimensions. This high reliability indicates that the instrument can be relied on to measure the level of critical thinking and the research results obtained using this instrument can be trusted (Setiawan et al., 2020).Thus, this instrument can be used well in further research.

Unidimensionality

The Rasch analysis conducted showed that the multiple-choice test instrument developed in this study had met the unidimensionality criteria. This means that the instrument measures one construct of student ability consistently. The raw variance value of 32.5% obtained from the residual principal component analysis exceeds the minimum threshold of 20% (Yuhanna et al., 2021), indicating that this instrument is valid and reliable for measuring student abilities.Thus, the measurement results using this instrument can be trusted to evaluate learning, place students, or develop a more effective curriculum.

Difficulty Level

The results of the proportion and percentage of the level of difficulty of the questions can be seen in Table 11. Proportion and Percentage of the Level of Difficulty of Students' Critical Thinking Questions on the Material of Cells and Bioprocesses.

Table 11. Proportion and Percentage of Results of Trial of Difficulty Level of Critical Thinking Questions

No	Category	Indicator	Amount	Percentage
1.	Easy	Analyze	0	7.00%
		Synthesize	0	
		Recognizing and Solving Problems	0	
		Conclude	0	
		Evaluate and Assess	2	
2.	Currently	Analyze	6	80.00%
		Synthesize	7	
		Recognizing and Solving Problems	3	
		Conclude	4	
		Evaluate and Assess	4	
3.	Difficult	Analyze	1	13.00%
		Synthesize	0	
		Recognizing and Solving Problems	0	
		Conclude	3	
		Evaluate and Assess	0	

Analysis of the difficulty level of the questions shows a fairly good distribution, with the majority of questions (80%) in the medium category. This indicates that the instrument has been well designed to differentiate students' critical thinking skills. Questions that are too difficult, such as numbers 8, 15, 16, 26, and 30,tend to have complex material or ambiguous delivery, making it difficult for students to answer (Subari et al., 2021). On the other hand, questions that are too easy, such as numbers 2 and 17,usually has simple, easy-to-understand material and clear delivery (Prasetya & Pratama, 2023). Ideally, good questions are those with a moderate level of difficulty, because they can differentiate students with different abilities without burdening them too much. Thus, questions number 1, 2, 3, 4, 5, 6, 7, 9, 10, 11,

12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28, and 29 are considered more appropriate for measuring students' critical thinking skills accurately and reliably.

Distinguishing Power

The results of the proportion and percentage of the question's discriminating power which show the effectiveness of each item in differentiating student abilities can be seen in Table 12.

Table 12. Proportion and Percentage of Distinguishing Power of Critical Thinking Instrument Question Items on Cell and Bioprocess Materials

No	Category	Indicator	Amount	Percentage
1.	Very well	Analyze	6	84.00%
		Synthesize	7	
		Recognizing and Solving Problems	4	
		Conclude	4	
		Evaluate and Assess	5	
2.	Good	Analyze	0	3.00%
		Synthesize	0	
		Recognizing and Solving Problems	0	
		Conclude	0	
		Evaluate and Assess	1	
3.	Enough	Analyze	0	10.00%
		Synthesize	1	
		Recognizing and Solving Problems	0	
		Conclude	0	
		Evaluate and Assess	2	
4.	Bad	Analyze	0	0.00%
		Synthesize	0	
		Recognizing and Solving Problems	0	
		Conclude	0	
		Evaluate and Assess	0	
5.	Thrown Away	Analyze	0	3.00%
		Synthesize	0	
		Recognizing and Solving Problems	0	
		Conclude	0	
		Evaluate and Assess	1	

Based on Table 12, there is one question with negative discriminatory power (rejected) in number 19. Question number 19 was rejected because it had a discriminatory power of -0.2. The critical thinking indicator tested was "Comparing animal and plant cells" at the cognitive level C5.The trial results showed that negative questions indicated that lower class participants answered more correctly than upper class participants (Akmal & Festiyed, 2023).The discrimination power of questions reflects the ability of questions to differentiate between high and low ability participants (Nurhalimah et al., 2022).Therefore, questions with good discriminating power are very important to measure student learning achievement accurately and objectively. However, on the other hand, questions become irrelevant if they have low discriminating power.

Distraction Function

The total results of the distractor function in critical thinking questions show that although most of the questions are effective, some distractors, such as in questions 8, 15, 16, 17, 18, 19, 23, 26, and 30, do not function properly, can be seen in Figure 2. In question 18, the correct answer is D, but the dominant choices are A and E. In the analysis of multiple-choice questions, distractors should be chosen evenly by test participants to show good question quality (Arikunto, 2013). Distractors are considered ineffective if the Mean value does not increase, such as in question 18, which shows the inability to distinguish participant understanding. Meanwhile, in question 15, the correct answer is C, but distractor A is chosen by more than 20% of students. A good distractor is if each answer alternative is chosen by more than 5% of respondents (Kunandar, 2015; Rahmadani et al, 2022).

The effectiveness of the distractor function is seen based on the ability of the question to distinguish students who understand and do not understand the concept of a material. If the distractor has great appeal, then it can be said to be effective (Fikri, 2022). In other words, if a distractor is widely chosen by test participants, then the distractor is said to be functioning. Likewise, a distractor that is not good or bad is one that is rarely chosen by students. By ensuring that the designed distractors are relevant and

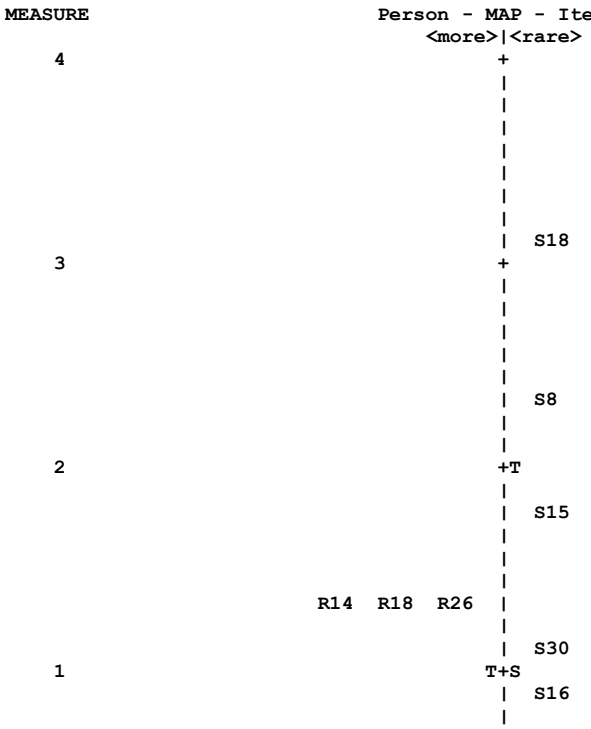
effective so that they can distinguish students who really understand the material from students who are still hesitant.

ENTRY NUMBER	DATA CODE	SCORE VALUE	DATA COUNT	%	ABILITY MEAN	P.SD	S.E. MEAN	INFT MNSQ	OUTF MNSQ	PTMA CORR.	Item
18	b	0	7	20	-1.48	.60	.24	.2	.4	-.29	S18
	c	0	7	20	-1.43	.30	.12	.1	.4	-.26	
	a	0	9	26	-.56	.83	.29	1.1	1.3	.23	
	e	0	11	31	-.52	1.18	.37	1.4	1.8	.29	
	d	1	1	3	-1.62*	.00		9.5	3.4	-.12	
8	e	0	1	3	-1.86	.00		.1	.2	-.17	S8
	b	0	10	29	-1.53	.31	.10	.2	.4	-.40	
	a	0	19	54	-.63	.92	.22	1.2	1.4	.36	
	c	0	3	9	-.23	1.45	1.03	1.9	2.7	.23	
	d	1	2	6	-1.52*	.11	.11	7.1	2.9	-.15	
15	e	0	7	20	-1.67	.25	.10	.2	.3	-.38	S15
	a	0	12	34	-1.14	.72	.22	.5	.7	-.15	
	b	0	4	11	-.27	1.15	.67	1.8	2.4	.25	
	d	0	9	26	-.25	.99	.35	1.7	2.2	.42	
	c	1	3	9	-1.37*	.36	.26	4.8	2.5	-.14	
30	d	0	3	9	-1.65	.31	.22	.2	.4	-.23	S30
	e	0	5	14	-1.09	.67	.33	.6	.8	-.07	
	a	0	4	11	-1.06	.66	.38	.5	.8	-.05	
	c	0	18	51	-.56	1.07	.26	1.8	2.0	.41	
	b	1	5	14	-1.63*	.20	.10	4.7	2.8	-.30	

Figure 2. Distractor Function in Questions

Person Item Map

The person-item map analysis in Figure 3 shows the suitability between student abilities and the level of difficulty of the questions. Students with high ability successfully answered the difficult questions, while students with low ability struggled with them. Questions 18, 8, and 15 were too difficult, while question 2 was too easy. In this case, questions that are too difficult and too easy are not used because they will provide an inaccurate picture of students' abilities. This is because these questions can produce unreliable data and are difficult to compare with data from other questions (Fitriani, 2021).



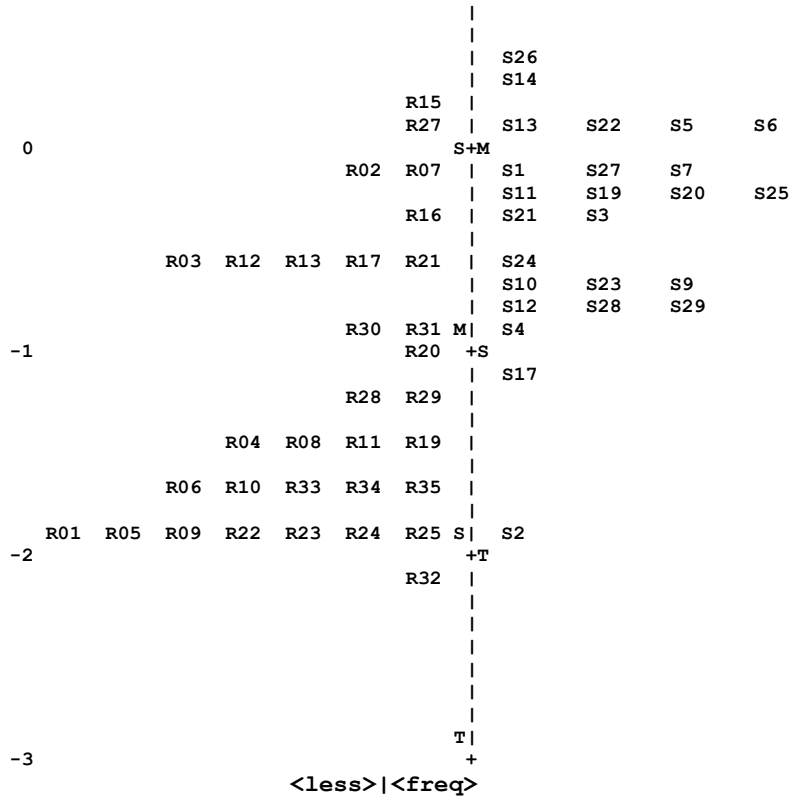


Figure 3. Person-Item Map

Based on the description of the results of the product trial data analysis, there is a valid level in the construct of the developed test item instrument so as to obtain a level of conformity between student responses and the test instrument. The results of the analysis at the trial stage can be seen in Table 13 and Table 14.

Table 13. Results of the Trial Learning Style Questionnaire Analysis

No	Criteria	Results
1.	Validity	Item no 22 and 23 are invalid
2.	Reliability	0.21

Table 14. Results of Critical Thinking Test Item Analysis

No	Criteria	Results
1.	Validity	Item No. 8,15,16,19,26 and 30 are invalid
2.	Reliability	0.82
3.	Unidimensionality	32.5%
3.	Difficulty Level	The difficult question is in item =8,15,16,19,26 and 30 The easy questions are in items = 2 and 17
4.	Distinguishing Power	Range = -0.26– 1.4
5.	Distraction Function	Not working properly = Items 8,15,16,19,23,26 and 30
6.	Person-item Map	Range = -3 – 3

The results of the diagnostic assessment instrument trial analysis (Tables 14 and Table 15) show that the developed instrument has generally met the eligibility standards, but there are still several questions that need to be improved, especially in the learning style assessment instrument. This indicates that the instrument is not yet fully capable of measuring variations in students' learning styles accurately and consistently.In compiling a questionnaire, it is important to pay attention to clear instructions, relevant answer alternatives, and measurement scales according to the indicators used (Maryuningsih et al., 2020; Ramadhan et al., 2024).Significant improvements to learning style instruments are necessary to increase the reliability and validity of the measurements.
In the critical thinking assessment instrument shows better potential, but still needs improvement on

invalid questions to maintain the overall quality of the instrument. This finding underlines the importance of a continuous instrument development process, where regular evaluation and improvement are the keys to producing accurate and relevant instruments in measuring student competencies (Yasir, 2020).

Practicality Test

Based on the results of the trial, a practicality test was conducted by distributing response questionnaires to teachers and students. The practicality questionnaire for this study can be seen in Table 15.

Table 15. Practical Results by Teachers and Students

No	Assessment Aspects	Teacher		Student	
		Average	Category	Average	Category
1	Ease of Use	3.33	Practical	3.86	Very Practical
2	Time Effectiveness	3.57	Very Practical	4.00	Very Practical
3	Benefit	3.60	Very Practical	3.50	Very Practical
	Amount	3.50	Very Practical	3.79	Very Practical

Source: Modification from Bago (2018).

The results of Table 14 and Table 15 show an overall average of 3.50 and Table 4.19 with a score of 3.79, both in the very practical category. The use of Google Form as an instrument platform offers ease of distribution and efficiency of data collection, thus facilitating the assessment process (Indirwan et al., 2023). The positive response of students with high average scores shows their comfort in working on the questions, which is supported by a clear display and appropriate time. No participants asked or requested additional time during the trial, indicating that the developed Diagnostic Assessment is practical and can be used effectively.

Conclusion

Based on the results of the study, it can be concluded that the development of diagnostic assessment instruments to identify learning styles cannot be used properly because the reliability value is weak, while the instrument to identify students' critical thinking skills in the Cell and Bioprocess material has shown good validity and reliability so that it can be used for mapping. The practicality of using the instrument is considered practical by teachers and students. The use of this instrument is effective in helping to map students' critical thinking skills, as well as facilitating learning that is more in accordance with the needs of individual students.

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Conflict Of Interest

The Author Team declares that there is no conflict of interest regarding the publication of this paper

Author Contributions

E. Sari: writing original draft preparation and analysis data; **E. Suryawati**: corresponding author, prepares work plans and coordinates the production of research articles; **I. Mahadi**: interpretation data, review and editing.

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