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Research Article

Prospective teachers' perception of critical and reflective thinking skills on modern physics: Rasch Analysis

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Abstract

Related research on critical and reflective thinking skills has been interesting and conducted by many researchers, but they are still carried out separately. This study aims to determine the perception of prospective teachers towards critical and reflective thinking skills in modern physics lectures. This research includes quantitative research using the cross-sectional survey method. Ninety-seven prospective teachers participated in the study, with details of 15 men and 82 women with an age range of 19-21 years. Questionnaire critical and reflective thinking skills are used as instruments for collecting data. Each of them is a 20-item critical thinking skills questionnaire and 24 items of reflective thinking skills questionnaire. The collected data was analyzed using winsteps software version 4.6.1. which includes descriptive, individual conformity, gender, and bubble chart. The results of detailed data analysis show that for critical thinking skills, 17% of prospective teachers perceive low, 68% of prospective teachers perceive moderate, and 15% of prospective teachers perceive high. As for reflective thinking ability, 11% of prospective teachers perceive low, 78% of prospective teachers perceive moderate, and 11% of prospective teachers perceive high. However, there are many misfit persons, 66% for critical thinking skills and 67% for reflective thinking skills. This means prospective teachers do not have strong perception beliefs in both thinking skills. Therefore, it needs to be strengthened through treatment, training, or workshops to further train both skills.

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Introduction

Everyone is given the natural gift of the ability to think. The ability to think develops with age. The environment greatly influences the development of thinking ability. The provision of a supportive environment for the development of thinking skills is necessary. Thinking skills honed since childhood will largely determine the mindset of an adult. A person who often hones his thinking skills will have skills in thinking (Gómez and Suárez, 2020; Zhang, 2018). These thinking skills must be possessed in response to the demands of the 21st century.

The 21st century is an era of openness, requiring various skills (Mutohhari et al., 2021; Tijsma et al., 2020). This skill is often called a high-level thinking skill. Among the higher-order thinking skills are critical thinking, communication, creative thinking, and collaboration (Ichsan et al., 2019; Ismail et al., 2022). Critical thinking skills as a basis for the

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development of other thinking skills. Therefore, critical thinking skills must be developed as the main capital to develop the next potential of the individual Critical thinking skills can be seen from a person's ability to reflect in detail in the context of each activity (Teresa Fuertes-Camacho et al., 2021). The keyword critical thinking skills is the ability to reflect. Thus, critical, and reflective thinking skills are part of the higher-order thinking skills that everyone should have.

The Ministry of Education and Culture encourages the provision of critical and reflective thinking skills from an early age. The provision of critical and reflective thinking skills must be carried out on an ongoing basis at every level of education (Barton and Ryan, 2020; Jiménez-Gómez et al., 2019). Debriefing must be done consciously and conditionally to get maximum results. The education unit is expected to be able to manage learning to create an educational environment that supports the development of critical and reflective thinking skills. The content of developing critical and reflective thinking skills can be realized technically in each class through the distribution of subjects (Hidayati et al., 2020; Verawati et al., 2021; Wenno et al., 2022) Thus, the provision of critical and reflective thinking skills can be carried out by each teacher through content development with directed procedures. Before conducting a more in-depth study related to critical and reflective thinking skills. The first step that must be taken is to know the perceptions of prospective teachers regarding these two thinking skills. Perception is very important because it helps a person to interpret and understand the world around them (Han, 2023). Without perception, we cannot recognize, evaluate, or respond to our situations and environment effectively.

Prospective Teachers' Perception

These two types of thinking skills become urgent for everyone as they relate to the basic skills to develop other thinking skills. Educational institutions across the country are launching various learning programs, training, and workshops to develop thinking skills. Therefore, perceptions of various thinking skills, including critical and reflective thinking skills, must be studied more deeply to find real conditions in the field (Syahril et al., 2021). Perception is the internalization of values about an event that the senses acquire through inferring and interpreting messages. In other words, perception is the process of understanding a piece of information against a stimulus. Perception is an aspect that needs to be considered in complementing the ability of prospective teachers to plan, manage, and diversify practical tutoring (Batmang et al., 2021; Oral and Erkilic, 2022). Based on the perceptions of prospective teachers, program mapping can be done to help in achieving one specific goal.

Today, the learning process of modern physics still does not show a clear direction toward critical, creative, and innovative constructions among future teachers. Teaching experience is an important thing that can contribute to the success of the learning process (Ilkorucu et al., 2022). However, it is also necessary to pay attention to the initial conditions of the prospective teacher for the lesson before carrying out the learning process. Knowing the initial conditions of the future teacher is very important for three reasons. First, experience and knowledge influence understanding. The understanding of prospective teachers determines the practice in the learning process; the activities carried out are derived from the beliefs of the previously owned construction of knowledge (Changwong et al., 2018; Gómez and Suárez, 2020).

Second, understanding prospective teachers has significant feedback to develop professionalism affects what will be learned and how to apply that knowledge in learning practice. Knowing this understanding is essential to developing training designs that can improve the ability of prospective teachers to operate critical and reflective thinking skills. Third, learning the initial knowledge of prospective teachers on issues related to previous critical and reflective thinking skills can be assessed for reflection to create a more appropriate training program (Chee Choy et al., 2019; Jarvis and Baloyi, 2020; Öztürk, 2020). Related research on critical and reflective thinking skills has been interesting and conducted by many researchers, but they are still carried out separately. The research that houses these two types of skills is still not widely carried out. Therefore, research related to these two types of skills in one study will be more interesting. In addition to obtaining information regarding the two types of skills, the slices of the two types of skills can also be known to each other.

Critical Thinking Skills

Critical thinking skills are a process of deep thinking by expressing goals complemented by compelling reasoning about a belief and the activities carried out (Ennis, 1985; Feldman, 2002; Su and Shum, 2019; Tsai, 2019). Critical thinking focuses on the ability and tendency to collect, evaluate, and use information effectively. Sometimes critical thinking is called critical-creative thinking (Latorre-Cosculluela et al., 2020; Toheri et al., 2020; Tsai, 2019). A person is said to be able to think critically if he gives simple explanations, builds basic skills, concludes, and provides further explanations, strategies, and tactics (Boa et al., 2018; Braun et al., 2020; Nitko and Brookhart, 2014). The achievement of critical thinking indicators can be measured through various instruments, one of which was developed by Nitko and Brookhart (Nitko and Brookhart, 2014)

Critical thinking skills today are increasingly emphasized in the education system. Developing critical thinking skills increases higher-order thinking capacity and confidence and great authority to carry out more effective guidance. Critical thinking skills are discussed as important in society and class. The basic concept of critical thinking skills is emphasized as a 21st-century skills center in education, work atmosphere, and social life. However, evidence suggests that critical thinking skills are one of the tricky variables to promote in tutoring (Kriswantoro et al., 2021; Makhene, 2019). This can be understood because critical thinking skills must be achieved further than ordinary academic skills. More technically, applying critical thinking skills is interpreted and operationalized according to the subject's characteristics (Damayanti and Kuswanto, 2021; Purwanto et al., 2022; Syahril et al., 2021). Thus, each subject can establish critical skills as general abilities and fundamentals as minimal competencies that must be met.

Fostering critical thinking skills is an important educational process. These process stages can form effective communication skills, develop logic and working capacity, and actively participate in modern society. The low ability of prospective teachers in this aspect can be a bad record in developing future performance in the capacity of a teacher (Alpaydın and Demirli, 2022; Marco-Fondevila et al., 2022) . Therefore, every prospective teacher needs to be involved in providing critical thinking skills in various subjects. Each subject is designed to practice critical thinking skills and conduct deliberate evaluations to produce the character of original thinking skills that can reason, formulate, analyze, and find solutions to each problem faced.

Reflective Thinking Skills

So are reflective thinking skills, reflective thinking skills are a learning style that provides an important rearrangement as a reflective observation by teachers who review the final state of many individuals and make objective judgments (Aydoğmuş and Kurnaz, 2022; Guo et al., 2022; Zach and Ophir, 2020). A person is said to have reflective thinking skills if he meets at least four indicators: habitual action, comprehension, reflection, and critical reflection. To measure the achievement of reflective thinking skills can use instruments developed by Kember (2000). A person's reflective thinking skills can be a benchmark for problem-solving success. An important thing related to critical thinking skills is reflective thinking skills. Reflective thinking skills are imaginative abilities to form opinions from historical events or events as an anticipatory action against failure. It is a way of thinking and acting on a new understanding.

Developing reflective thinking skills in prospective teachers can accelerate understanding, support abstract change, and encourage critical evaluation and knowledge transfer. Reflective thinking skills to integrate acquired understanding into one's experience to allow better choices or behaviors in the future and improve one's overall effectiveness. Reflective thinking skills can be described in four situations, the first two situations, habitual action, and understanding, are considered reflexive, while reflection and critical reflection are reflective. The act of habit and understanding refers to conditioning without being significant or with little awareness (Kember et al., 1999, 2000; Tseng and Hill, 2020). It is characterized when a person follows the procedure without involving serious thoughts in it. Meanwhile, in the position of reflection and critical reflection, one not only achieves an accurate understanding but can also reflect on experiences for future activities (Antonio, 2020; Barton and Ryan, 2020). Finally, as the highest position of reflective thinking, the position of critical reflection implies a metamorphosis of one's perspective on beliefs about the understanding of conception. The flow of thinking in this research can be seen in Figure 1.

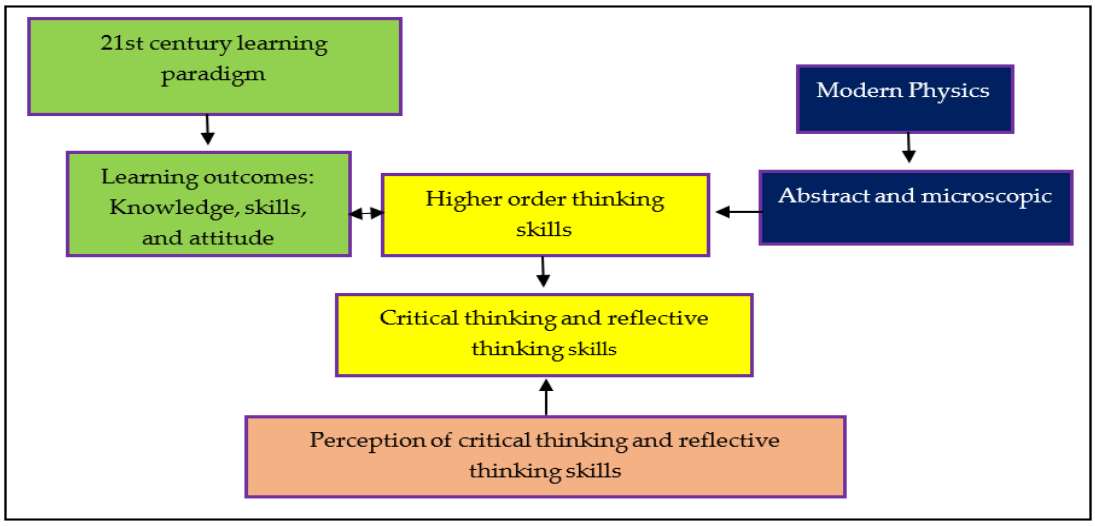


Figure 1. Conceptual frameworks perception of critical thinking and reflective thinking skills

This research was conducted at a modern physics lecture, the content of modern physics concepts belongs to the abstract and microscopic categories (Hermann, 2020; Arabatzis, 2017), which can be felt but cannot be seen. Since the beginning of the 20th-century modern physics has experienced very rapid development, until now the development of modern physics content continues to be enriched through research such as Compton scattering, electron scattering and electron momentum (Xu et al., 2019); Talmantaite et al., 2019), wave packet scattering (Khomitsky and Kulakov, 2020); electron diffraction (Kulygin et al., 2020); electron temperature and bremsstrahlung Zeemen effect (Al et al., 2020); and the nonlinear Schrodinger equation (Rashkovskiy, 2019). However, most of this research is carried out by scientists in developing physics. Given the content of abstract and microscopic modern physics, it is very necessary to know prospective teacher perceptions regarding the learning process of modern physics. This study aims to analyze the perception of prospective teachers towards the ability to think critically and reflectively in modern physics.

Method

Research Design

This research includes quantitative research using the cross-sectional survey method. The cross-sectional survey method is suitable for knowing and examining current beliefs, attitudes, and perceptions/opinions or practices (Creswell & Creswell, 2018). Questionnaires have been used to collect data from participants who have taken modern physics in several regions in Indonesia. The focus of this study is to obtain information about prospective teachers' perceptions of critical and reflective thinking skills. Based on the research objectives, the cross-sectional survey method is very suitable for collecting data based on current phenomena.

Participants

Students who have studied modern physics participated in this research. The questionnaire is distributed openly through Google Forms, making it possible to reach a large area with many respondents. After the data was collected, it was recorded that ninety-seven participants filled out a questionnaire. Table 1 shows a description of the demographic characteristics of participants.

Table 1. Description of the demographic characteristics of participants

Demographic		Frequency	%
Gender	Male	15	15
	Female	82	85
	2018	8	8
	2019	48	50
	2020	41	42
University area	*Nusa Tenggara Barat*	57	59
	Jambi	2	2
	Kalimantan	4	4
	Sulawesi	12	12
	Jawa Barat	22	23

The vast territory of Indonesia with a very large population, of course, the distribution of areas that are the source of participants does not adequately reflect regional representation. But as an initial illustration of student perceptions related to critical and reflective thinking skills in modern physics lectures are considered quite representative. Participants from their respective provinces reflected on the conditions experienced during modern physics lectures. The questionnaire was packaged in a Google Form and distributed through the researcher's network of colleagues at several universities in Indonesia. The respondents were prospective physics teachers who voluntarily completed the questionnaire after taking a modern physics course. Based on the collected data, there were 97 respondents who filled out the questionnaire and agreed to participate in this research. As an illustration of the distribution of participants in each province in this study, it can be seen in Figure 2 below.

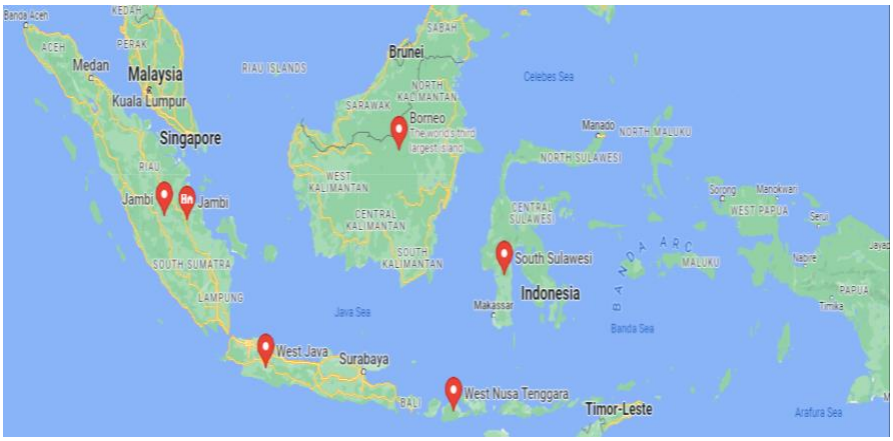


Figure 2. Distribution area of research participants

Data Collection

Data on critical and reflective thinking skills were collected using developed questionnaires. A total of 20 questionnaire items were to measure critical thinking skills that concern five aspects. The five aspects are providing simple explanations, building basic skills, inferring, providing further explanations, and strategies and tactics (Nitko and Brookhart, 2014). As for reflective thinking skills, there were 24 questionnaire items with four indicators. The four indicators are habitual action, understanding, reflection, and critical reflection (Kember et al., 2000). Both questionnaires use a four-point Likert-type scale: strongly agree, agree, disagree, and strongly disagree. With the gradation of each category, that is, strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1.

Data Analysis

After the data is collected, then proceed with data analysis. Before the data is analyzed, coding is first done with the help of Microsoft Excel. Data coding aims to classify data according to the desired characteristics so that it is easily read by analysis tools. For example, gender, institutional origin, and so on. After the coding process is complete, the data is analyzed using the Rasch model.

Results and Discussion

Based on the results of data analysis of perceptions of critical and reflective thinking skills using the WINSTEPS 4.6.1 program. The average value of person measurements for the perception of critical thinking skills is +2.32. This suggests that respondents were more likely to approve of the questionnaire provided. A standard deviation (SD) value of 2.09 logit indicates that the spread of person capabilities is quite wide on the logit value continuum. The average item value of 0.00 logit is the ideal item condition. The standard deviation of the item (SD) of the item is 0.67, and this suggests that it is not very broad across the logit scale regarding the problem's difficulty.

For reflective thinking skills, the average value of person measurements is +1.62. This suggests that respondents were more likely to approve of the questionnaire provided. A standard deviation (SD) value of 1.37 logit indicates that the spread of person capabilities is quite wide on the logit value continuum. At the same time, an average item measuring the value of 0.00 logs is the ideal item condition. The item's standard deviation (SD) is 1.04, which indicates quite widely across the logit scale regarding the difficulty of the question. If the average logit person is positive (far exceeding the average logit item), then it is said that the person has a good mentality toward the item (Wicaksono, 2021). For SD logit, the greater the value, the better the measurement dissemination data (Wei et al., 2020; Widhiarso and Sumintono, 2016). Table 2 shows the data on the perception of critical and reflective thinking skills of prospective physics teachers.

Table 2. Summary (logit) value of person and item for the perception of critical and reflective thinking skills

	Critical thinking skill		Reflective thinking skill	
	Person	**Item**	**Person**	**Item**
N	97	20	97	24
Measures				
Mean	2.32	0.00	1.62	0.00
SD	2.09	0.67	1.37	1.04

The results of data analysis of these two types of thinking skills are shown in Table 2. The average score of persons for critical and reflective thinking skills looks different. The greater the average value of a variable indicates the total number of scores a large person has. In this regard, it is said that the perception of the prospective teacher toward critical thinking skills is stronger than that of the prospective teacher towards reflective thinking skills. Likewise, if you look at the standard deviation (SD). A larger SD value indicates a wider distribution of persons within the existing continuum range is broader than the distribution of prospective teachers to the perception of reflective thinking skills. However, this is different from SD items. SD reflective thinking skill items are larger than SD critical thinking skill items. This suggests that the distribution of reflective thinking skill items is broader than critical thinking skill items for detecting the diversity of people. However, regardless of the difference between the two variables, the average and SD values. Empirical facts show that the average value of the two variables is greater than the average value of the item. Therefore, it can be said that the respondents can understand the points of both instruments (Adams et al., 2022; Ling Lee et al., 2021).

Perception of Critical and Reflective Thinking Skills

The perception of critical and reflective thinking skills is categorized into three parts: low, moderate, and high, as shown in Table 3. The division into three categories is based on a separation person value of 2.91. This categorization is intended to determine the level of perception of prospective physics teachers towards modern physics courses. Regarding critical thinking ability, 16 persons or 17% of respondents have a low perception, 66 persons or 68% have a moderate perception, and 15 persons or 15% have a high perception. As for the perception of reflective thinking skills, 11 persons or 11% of respondents had low perception, 75 persons on 78% had moderate perception, and 11 persons or 11% had high perception; categorization is shown in Table 3. The categorization of perceptions is determined based on the value of the person's Logit (LVP) (Adams et al., 2022; Planinic et al., 2019; Widhiarso & Sumintono, 2016). Categorization is performed on the average logit person combined with standard deviation (SD).

Table 3. Categories of perception of critical and reflective thinking skill based on the logit value of the person (LVP)

Thinking skills	Low LVP ≤ +0.23	Moderate +0.23 < LVP <+4.41	High LVP ≥ +4.41
Critical	16	66	15
	Low LVP ≤ +0.25	Moderate +0.25 < LVP <+2.99	Hight LVP ≥ +2.99
Reflective	11	75	11

The analysis results show that the largest percentage is in the "moderate" category, above 50%, on the perception of critical and reflective thinking skills. That is, the prospective teacher does not yet have too strong self-confidence to have critical and reflective thinking skills. The diversity of prospective teachers' perceptions towards critical and reflective thinking skills is inseparable from the conditions of modern physics lectures experienced in each place. The availability of infrastructure and learning environment also impacts the perception of prospective teachers (Lu et al., 2021; Wästberg et al., 2019) . An individual's life experiences and knowledge greatly influence their perception of a situation (Reeder et al., 2024). Additionally, emotions, motivation, and interests also influence how a person perceives something (Perera and Abeysekera, 2022). Thus, other factors that cause differences in perception include experience and knowledge, emotions, motivation, and interests.

Individual Conformity

The ideal response given by the respondent is largely determined by his ability. The higher the respondent's ability, the higher the response indicates high approval. But sometimes, the opposite is true. In this case, the Rasch Model can detect inappropriate individual response patterns, i.e., differences in answers based on respondents' abilities compared to the ideal model (Wei et al., 2020). Data analysis found that a person's misfit or a person's response patterns did not match the questionnaire on critical thinking skills and reflective thinking skills. About 64 persons had unique or inappropriate response patterns in the critical thinking skills questionnaire: an example of a response can be seen in Figure 4 (a). The reflective thinking skills of 53-persons misfit showed the questionnaire in the questionnaire, and the response pattern can be seen in Figure 4 (b). Details of a person's incompatibility with critical and reflective thinking skills can be seen in Table 4.

Table 4. Misfit person of critical and reflective thinking skills based on the person statistic: misfit order

Demographic		Thinking skills	
		Critical	Reflective
Gender	Male	16	12
	Female	48	41
University area	*Nusa Tenggara Barat*	36	31
	Jambi	2	2
	Kalimantan	2	2
	Sulawesi	5	8
	Jawa Barat	19	10
	Total	64	53

The respondents were classified as misfits for providing responses that did not fit the model. For example, respondents with codes 59M7, 12F2, and 27M3 to the critical thinking skills questionnaire. Respondents with the code 59M7 have the same response for all items. This suggests that respondents likely did not read the questionnaire seriously or did not even read the statement at all. Likewise, respondents with codes 12F2 and 27M3 had the same response pattern. Based on the responses provided, respondents with codes 12F2 and 27M3 were classified as less observant. Because it scores three lower on the easiest items compared to scores on harder items. The left-to-right order of items indicates a low level of approval to a high level of consent or, in other languages, indicates the item's difficulty.

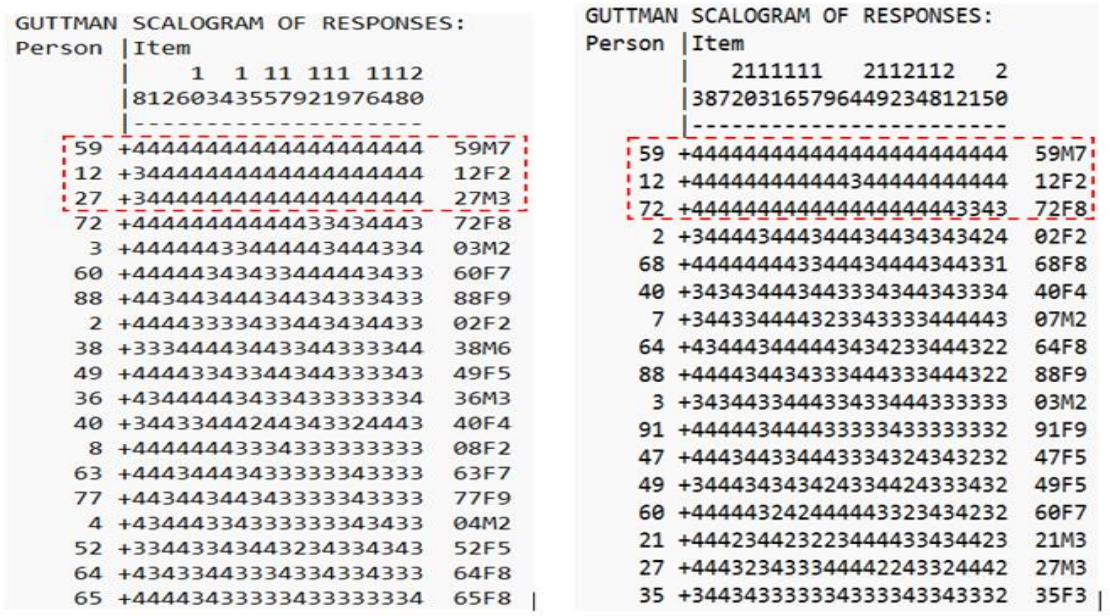


Figure 3. (a) Scalogram of critical thinking skills, (b) Scalogram of reflective thinking skills

The same character is seen in Figure 3 shows most people are in the overfit area. This indicates that most scores produced by high people are even too high, so it is suspected that these scores do not reflect the real condition of the person. Therefore, it can be said that there are problems experienced by prospective teachers in perceiving critical and reflective thinking skills. In another form, it can be shown in Figure 4.

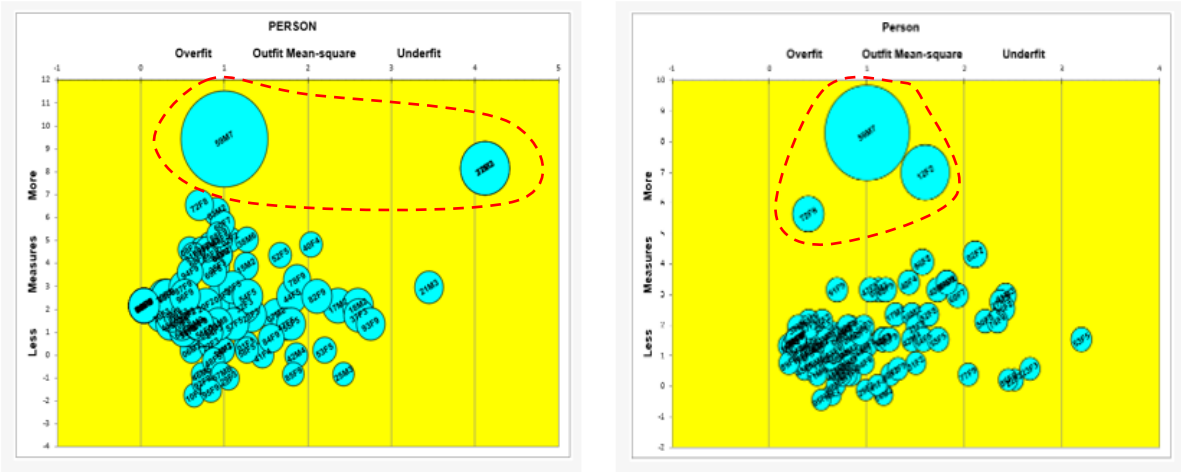
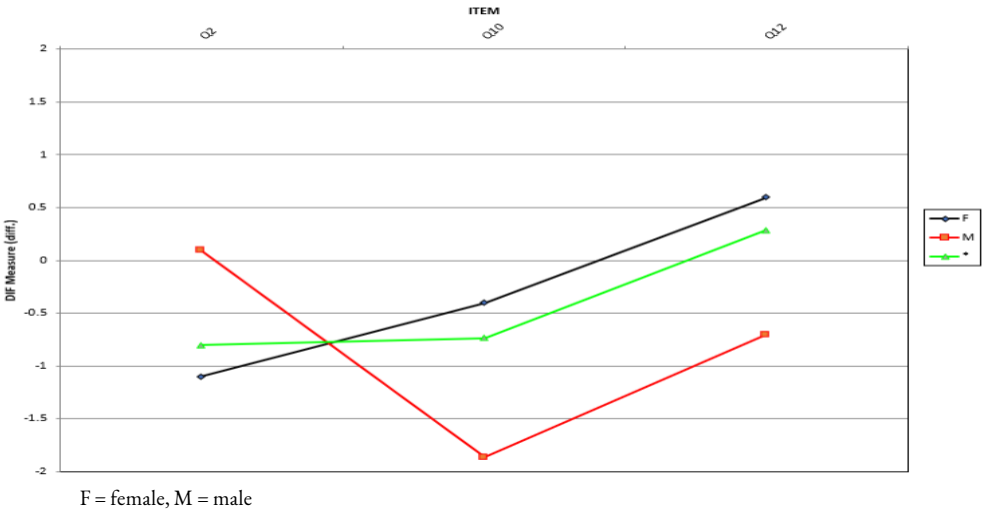


Figure 4. Bubble chart for critical and reflective thinking skills

In Figure 5 for critical thinking skills (left image) people with codes 59M7, 12F2, and 27M3 are far apart from their group and have a larger round than others. The distant position and the circle are larger than the others indicating that the person has different characteristics (Juandi et al., 2023; Planinic et al., 2019; Purnami et al., 2021; Rusland et al., 2020) Person code 59M7 is in the overfit area while person codes 12F2 and 27M3 are in the underfit area. Likewise, for reflective thinking skills (right image), people with codes 59M7, 12F2, and 72F8 are far apart from their group and have larger roundabouts than others. This indicates that these people are abnormal or problematic.

Differential Item Functioning (DIF)

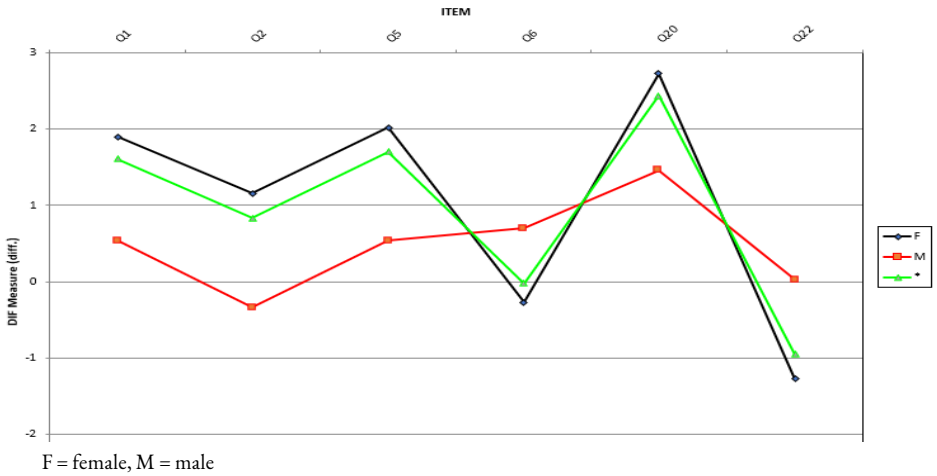
In this section, we will describe the demographic differences of respondents between the sexes with a questionnaire on critical thinking and reflective skills. These data have been analyzed using differential item functioning (DIF), this analysis shows respondents from separate subgroups respond differently to some items (Andrich and Marais, 2019; Boone and Staver, 2020). The DIF gender with critical thinking skills can be seen in Figure 5.



F = female, M = male

Figure 5. Person DIF plot based on gender for critical thinking skill on gender

Figure 6 shows only 3 items detected by DIF out of 20 questionnaire items for critical thinking skills, i.e., items with codes Q2, Q10, and Q12. This means that men are more able to ask questions that fit the arguments of friends/lecturers about modern physics concepts (Q10), are more able to define problems, formulate solutions, see the total problem then take action and evaluate those actions (Q12) than women. On the other hand, women feel more given the opportunity to assess the credibility of modern physics sources derived from books, the internet, or others (Q2) than men. Then DIF for reflective thinking skills detected 6 items out of 24 questionnaire items, DIF visualization of these items is shown in Figure 6.



F = female, M = male

Figure 6. Person DIF plot based on gender for reflective thinking skill on gender

Based on Figure 6, men are more prepared to take time to repeat learning that has been done on campus for deeper understanding (Q6), and more aware that understanding learning content while studying can do tasks well (Q22) than women. But women are more accustomed to doing modern physics problems without having to think long (Q1), are more observant in finding misconceptions that were previously believed to be true (Q2), more confident in giving the right answer to a problem so that there is no need to think again (Q5), more sufficient to focus on learning so that there is no need to look for additional information (Q20) than men.

More details for each of the second categories of perception thinking skills are in Table 3. Prospective teachers' perceptions of critical thinking skills show 17% from the low category, 68% from the moderate category, and 15% from the high category. If you pay attention, the percentage of low and high categories has a very wide range against the medium category. That is, the number of prospective teachers who have a "low" and "high" perception of critical thinking skills is very small compared to prospective teachers who have a "moderate" perception. However, if this is confirmed by the results of the person fit order analysis, it is found that the number of misfit persons is very large, reaching 64 or 66% of the total respondents. This indicates that it is likely that prospective teachers who fall into the

"moderate" category and even the "high" category are among the unworthy persons. A large number of misfit persons means that most respondents, in this case, prospective teachers, do not reflect the ideal model of score results (Wicaksono, 2021). Therefore, the perception of each prospective teacher in a "moderate" and even "high" position deserves further study.

Table 3 also provides detailed information on the categorization of the perception of prospective teachers toward reflective thinking skills. 11% look low, 78% look medium, and 11% respond high. There is a very long range between the "low" and "high" categories against the "medium" categories. This shows that the number of prospective teachers in both categories is quite small compared to the "moderate" category. However, if confirmed by the analysis of the order fit person, there is a large percentage of misfit persons, 53 or 67% of the total respondents. This means that prospective teachers in the category of "moderate" or even "high" reflective thinking tend to be indicated as inappropriate. So, conducting a more in-depth study is necessary to ascertain the truth of these allegations.

After a more in-depth study of the data of non-conforming persons on both thinking skills. Found a misfit of 50 persons in the moderate category and a misfit of 6 persons in the high category for critical thinking skills. As for reflective thinking skills, 43 persons were found in the medium category, and six misfit persons in the high category. These findings confirm that most of the data in the "moderate" category indicate a person's incompatibility. Even the "high" category data also has some misfit persons. Thus, it can be presumed that prospective teachers' critical and reflective thinking skills are still low. Therefore, it is necessary to strengthen in the form of treatment, training, or workshops to instill the confidence of prospective teachers to have strong critical and reflective thinking skills.

Learning interactions should refer to the development of technology and science and the needs of the present and the future. Technology information continues to develop and update educational applications (Prieto et al., 2019; Tang and Hai, 2021; Tseng and Hill, 2020). Students feel comfortable using digital technology and adopt new technologies easily and quickly. The rapid development of technology and science requires teaching staff to have high 21st-century literacy skills (Damaianti et al., 2020; Mutohhari et al., 2021). There are many obstacles to developing literacy skills, especially reading literacy and developing high-level thinking tests (Damaianti et al., 2020; Nelson-Hurwitz and Buchthal, 2019). So sometimes, teaching staff are not familiar with the literacy of higher order thinking skills, making it difficult to apply in learning. Educators' knowledge of higher-order thinking skills and literacy creates a learning atmosphere that can accommodate 21st-century skills.

In today's digital era, learning *outcomes* must refer to the competencies needed in the 21st century. Such competencies, such as critical thinking skills, problem-solving skills, collaboration skills, and communication skills, are known as higher-order thinking skills (Bao and Koenig, 2019; Su and Shum, 2019; Tijsma et al., 2020). So far, the provision of higher-order thinking skills has not been carried out massively in educational institutions and units, causing teaching staff to be unfamiliar with higher-order thinking skills tests (Pham et al., 2020; 2019; Wale and Bishaw, 2020). So, the evaluation of learning often carried out is limited to checking low-thinking skills, given the lack of provision of critical and reflective thinking skills. There is a low perception of these two skills. More intense training, workshops, and education for educators and aspiring educators should be needed. Many life skills are needed in the 21st century, including critical and reflective thinking skills.

Conclusion

The results of the data analysis show that prospective teachers' perceptions of critical and reflective thinking skills are mostly in the moderate category. In detail, 17% of prospective teachers perceive low critical thinking skills, 68% moderate perception, and 15% high perception. As for reflective thinking skills, 11% of prospective teachers have a low perception, 78% of prospective teachers have a medium perception, and 11% of prospective teachers have a high perception. However, there are many misfit persons, 66% for critical thinking skills and 67% for reflective thinking skills. This means prospective teachers do not have strong perception beliefs in both thinking skills. Therefore, it needs to be strengthened through treatment, training, or workshops to further train both skills.

Recommendations

Based on the results of data analysis, it is known that the perceptions of prospective teachers on critical and reflective thinking skills vary. Most perceptions of prospective teachers are in the moderate category, but given the number of people who are misfits, this category is suspected to contain doubts. Therefore, it is necessary to do further research to obtain more convincing results.

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