Exploring Pre-Service Teachers' Perceptions of Basic Physics Practicum: A Rasch Model Analysis

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Abstract. Practicum is a fundamental component of physics teacher education; however, various challenges continue to limit its effectiveness in developing students' practical and professional competencies. This study aimed to explore pre-service teachers' perceptions of basic physics practicum activities using Rasch model analysis. A quantitative survey design was employed involving 110 undergraduate physics education students who had completed basic physics practicum courses. Data were collected using a 20-item Likert-scale questionnaire covering practicum planning, instructions, implementation, and evaluation, and were analysed using the Rasch model with Winsteps software. The results demonstrated high internal consistency and measurement quality, with a Cronbach's alpha of 0.93 and item reliability of 0.94, indicating that the instrument was reliable and valid. Rasch analysis revealed that pre-laboratory activities were perceived as the most supportive aspect of practicum implementation, while insufficient time allocation emerged as the most challenging issue. In addition, the predominance of verification-based practicum models was found to constrain students' creativity in designing experimental activities. These findings suggest the need for redesigning physics practicum activities toward more inquiry-oriented approaches and optimising practicum time management to better support the development of pre-service teachers' 21st-century skills.

Keywords: Physics Practicum, Pre-Service Teachers' Perceptions, Physics Teacher Education, Rasch Model, Laboratory Learning.

1 Introduction

Physics practicum is a fundamental component of physics teacher education, as it provides pre-service teachers with opportunities to engage directly with physical phenomena and to translate abstract theoretical concepts into observable and measurable experiences [1, 2]. Through practicum activities, prospective physics teachers are expected to develop not only procedural laboratory skills but also scientific reasoning, data analysis abilities, and reflective thinking, which are essential for effective science instruction [3, 4].

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In teacher education programmes, physics practicum plays a particularly important role because it interacts dynamically with pre-service teachers' beliefs about how physics should be taught and learned. While practicum experiences can shape and refine these beliefs [5, 6], this relationship is increasingly recognised as bidirectional; pre-service teachers' prior beliefs and preconceptions also influence how they perceive, engage with, and interpret their experiences in the laboratory. Acknowledging this reciprocal dynamic is crucial for understanding how future teachers develop their pedagogical identities during practical training. Experiences gained during practicum courses often influence how future teachers perceive the value of laboratory activities and how confidently they later implement practicum in their own classrooms [5, 6]. Well-designed practicum experiences can support the development of professional competence and pedagogical confidence, whereas poorly structured practicum may limit students' engagement and reduce the perceived relevance of laboratory learning [1].

Practicum courses provide a structured environment that serves dual evaluative roles. Beyond acting as a site for the assessment of learning—where institutions evaluate whether intended learning outcomes related to scientific skills, laboratory competence, and professional readiness are being achieved—practicum also functions as a vital context for assessment for learning [7]. In this view, ongoing assessment processes, formative feedback, and reflective practices during laboratory activities actively support, scaffold, and enhance pre-service teachers' continuous professional development.

Despite its recognised importance, the implementation of physics practicum in teacher education programmes continues to face various challenges. Previous studies have reported constraints related to limited laboratory facilities, insufficient practicum time, rigid procedural guidelines, and difficulties in adopting inquiry-based approaches [8, 9]. In many higher education institutions, practicum activities remain predominantly verification-based, with students following predetermined instructions to obtain expected results [2]. While such approaches may support efficiency and procedural accuracy, they often limit opportunities for exploration, creativity, and deeper conceptual understanding [7].

These challenges may negatively affect students' motivation and engagement during practicum activities. For pre-service teachers, repeated exposure to time-constrained and highly structured practicum experiences may shape their perceptions of laboratory learning as routine and procedural rather than meaningful and inquiry-driven [5]. Such perceptions are particularly important, as they may influence future teachers' willingness to implement laboratory activities and inquiry-based learning approaches in school classrooms [6].

In addition to its pedagogical function, physics practicum also serves as an important evaluative component within teacher education programmes. Practicum courses provide a structured environment that serves dual evaluative roles. Beyond acting as a

site for the assessment of learning—where institutions evaluate whether intended learning outcomes related to scientific skills, laboratory competence, and professional readiness are being achieved [7]—practicum also functions as a vital context for assessment for learning. In this view, ongoing assessment processes, formative feedback, and reflective practices during the practicum actively support, scaffold, and enhance pre-service teachers' continuous professional development. As such, practicum implementation should be continuously monitored and evaluated to ensure alignment between curriculum objectives, instructional practices, and student learning experiences.

Evaluating practicum quality, however, presents several challenges. Laboratory learning involves complex interactions between preparation, instructional guidance, implementation, assessment, and available resources, which may be experienced differently by individual students [10]. Consequently, students' perceptions offer a valuable source of information for understanding how practicum activities are actually experienced in practice. Perception-based evaluation allows educators to identify aspects of practicum that are perceived as supportive, as well as those that are perceived as problematic, from the learners' perspective [5].

In teacher education, the use of students' perceptions as evaluative data is particularly important because practicum experiences play a formative role in shaping future teaching practices. Pre-service teachers often draw on their own learning experiences when designing instructional activities in their later professional careers [11]. If practicum experiences are perceived as meaningful, well-organised, and supportive of inquiry, future teachers may be more inclined to adopt similar approaches in their classrooms. Conversely, negative practicum experiences may discourage the use of laboratory activities or reinforce procedural and teacher-centred practices [12, 13].

Previous research exploring practicum perceptions has commonly employed qualitative or mixed-methods approaches, such as interviews, focus group discussions, and questionnaire surveys [10]. While these approaches provide valuable descriptive insights, quantitative analyses often rely on classical test theory, which has limitations in terms of measurement precision and item-level diagnostics [14]. Classical approaches tend to focus on total scores and may overlook how individual questionnaire items function across different levels of respondent perception.

To address these limitations, more robust measurement approaches are needed. The Rasch measurement model offers a powerful framework for analysing perception data by converting ordinal questionnaire responses into interval-level measurements, enabling more accurate and objective assessment of respondents' perceptions [15]. In addition, Rasch analysis provides diagnostic information at the item level, making it particularly useful for identifying problematic items and evaluating the quality of measurement instruments [16, 17].

Although the Rasch model has been widely applied in educational measurement, its use in analysing pre-service teachers' perceptions of physics practicum activities remains limited [18, 19]. Existing studies on practicum perceptions rarely employ Rasch-based analysis to examine how different aspects of practicum are perceived and how well questionnaire items function in measuring these perceptions. This indicates a gap in the literature regarding the application of Rasch modelling for practicum evaluation in physics teacher education.

Therefore, this study aims to examine pre-service teachers' perceptions of basic physics practicum activities using the Rasch measurement model. Specifically, the study seeks to evaluate the quality of the measurement instrument and to identify practicum aspects that are perceived as supportive or challenging by students, including preparation, implementation, time allocation, and evaluation processes. By applying Rasch analysis, this study is expected to provide more precise and nuanced insights into students' practicum experiences.

The findings of this study are expected to contribute both theoretically and practically to physics teacher education. Theoretically, the study demonstrates the usefulness of Rasch modelling in analysing perception data related to practicum implementation. Practically, the results offer evidence-based insights that may inform the redesign of physics practicum courses, particularly in terms of strengthening pre-laboratory activities, optimising practicum time management, and promoting more inquiry-oriented laboratory learning [2, 8]. Through these contributions, the study seeks to support ongoing efforts to improve the quality of physics practicum and the preparation of future physics teachers.

2 Methodology

2.1 Research Design

This study adopted a quantitative descriptive survey design to examine pre-service teachers' perceptions of basic physics practicum activities. A quantitative approach was selected because it allows for systematic measurement of perceptions and supports objective statistical analysis [20]. Given the focus on evaluating the quality of practicum experiences from the students' perspective, a survey design was considered appropriate for capturing a broad range of responses and identifying general patterns within the population.

Furthermore, this study employed the Rasch measurement model as the primary analytical framework. Unlike classical test theory, which relies heavily on total scores and sample-dependent statistics, the Rasch model provides item- and person-level measures that are sample-independent. This feature enables more precise interpretation of students' perceptions and ensures that the measurement instrument functions consistently across different respondent groups.

2.2 Participants

The population of this study consisted of undergraduate students enrolled in the Physics Education Study Program at Universitas Lambung Mangkurat, Indonesia. These students were prospective physics teachers who had completed at least one cycle of basic physics practicum, which typically includes experiments related to mechanics, thermodynamics, electricity, and magnetism.

A total of 110 pre-service teachers participated in the study. A saturated sampling technique was employed, whereby all students who met the inclusion criteria were included as research participants. The inclusion criterion required that participants had completed the basic physics practicum course, ensuring that all respondents possessed direct and relevant experience with the practicum activities being evaluated. This approach minimised sampling bias and increased the representativeness of the findings within the studied context.

While the use of a saturated sampling technique ensures a high representation of the target population at this institution, it is important to acknowledge that the study population is limited to undergraduate students in the Physics Education Study Program at Universitas Lambung Mangkurat, Indonesia. Consequently, the findings are highly context-specific. Caution should be exercised when generalising these results to broader populations or other institutional contexts with different curricular structures. However, the insights into common challenges—such as time constraints and verification-based designs—may reflect broader systemic issues in physics teacher education.

2.3 Instrument

Data were collected using a self-administered questionnaire developed to measure students' perceptions of basic physics practicum activities. The questionnaire consisted of 20 Likert-scale items distributed across four dimensions, practicum planning, practicum instructions, practicum implementation, and practicum evaluation. The complete questionnaire is provided in the Appendix.

Each questionnaire item was rated using a four-point Likert scale, with response options ranging from 1 (strongly disagree) to 4 (strongly agree). The decision to use a four-point scale was intentional. By excluding a neutral midpoint, respondents were encouraged to express a clear stance regarding each statement, thereby reducing response ambiguity [21].

From a Rasch measurement perspective, forced-choice response formats are often recommended because they improve category functioning and enhance measurement precision. A four-category scale is also considered optimal for perception studies, as it balances response sensitivity with respondent cognitive load. The suitability of the

response categories was later evaluated through Rasch category probability curves to ensure that each category functioned as intended.

The research instrument was a self-administered questionnaire designed to measure students' perceptions of basic physics practicum activities. Instrument development followed a systematic, multi-stage process to ensure both theoretical relevance and measurement quality.

First, an extensive review of the literature on physics practicum, laboratory learning, and teacher education was conducted to identify key components of effective practicum implementation. Based on this review, four core dimensions were identified: practicum planning, practicum instructions, practicum implementation, and practicum evaluation. These dimensions reflect the main stages and supporting elements of laboratory-based learning in physics education.

Second, an initial pool of questionnaire items was generated for each dimension. The items were formulated to capture students' direct experiences during practicum activities, focusing on aspects such as clarity of objectives, adequacy of preparation, guidance during experimentation, availability of resources, and transparency of assessment. Care was taken to ensure that each item addressed a single idea to meet the unidimensionality requirement of Rasch analysis.

Third, the initial instrument underwent expert validation involving specialists in physics education and educational measurement. Experts evaluated the items in terms of relevance, clarity, and alignment with the intended constructs. Feedback from this process was used to revise item wording, eliminate ambiguous statements, and ensure content validity. After revision, the final instrument consisted of 20 items representing the four practicum dimensions.

2.4 Data Collection Procedure

Data collection was conducted after the completion of the basic physics practicum course. Prior to administering the questionnaire, participants were informed about the purpose of the study and assured that their responses would be treated confidentially and used solely for research purposes. Participation was voluntary, and informed consent was obtained from all respondents.

The questionnaire was administered in a paper-based and/or online format, depending on class conditions. Completed questionnaires were checked for completeness to ensure data quality. Responses were then coded and tabulated using Microsoft Excel as a preliminary step before Rasch analysis.

2.5 Data Analysis

Data analysis was performed using the Rasch measurement model, specifically employing the Andrich Rating Scale Model (RSM) with Winsteps version 5.3.4

software. The RSM was selected as it is highly appropriate for instruments utilizing a fixed Likert response scale across all items (in this case, a uniform 4-point scale). Although the questionnaire conceptually covers four structural dimensions of the practicum (planning, instructions, implementation, and evaluation), to ensure content representative richness , the psychometric analysis treats the instrument as a single unidimensional latent construct representing 'pre-service teachers' overall perception of basic physics practicum'. To empirically justify this unidimensional approach, a Principal Component Analysis (PCA) of residuals was conducted. The criteria for unidimensionality were met, as the empirical variance explained by the primary dimension was substantially high (>40%) and the eigenvalue of the first unresolved residual was less than 2.0, confirming that no secondary dimension distorted the measurement of the intended construct.

First, data were screened to identify misfitting responses, which may indicate inconsistent answering patterns or guessing behaviour. Misfitting respondents were identified based on outfit and infit statistics and were examined carefully before exclusion.

Second, person and item reliability indices were calculated to assess the consistency of responses and the stability of item difficulty estimates. Separation indices were also examined to determine the instrument's ability to distinguish between different levels of respondent perception and item difficulty.

Third, item fit statistics, including Infit and Outfit Mean Square (MNSQ) values and Z-standardised fit (ZSTD)scores, were evaluated. Acceptable fit criteria were defined as MNSQ values between 0.5 and 1.5 and ZSTD values between −2.0 and +2.0. Point-measure correlations were also analysed to examine the alignment between individual items and the overall construct [22].

Fourth, Wright maps were generated to visualise the distribution of respondents' perception levels and item difficulties on the same logit scale. This visual representation enabled direct comparison between respondent ability and item difficulty, facilitating the identification of practicum aspects perceived as particularly supportive or challenging.

Through these procedures, the Rasch analysis provided a comprehensive evaluation of both measurement quality and substantive findings related to students' perceptions of basic physics practicum activities.

3 Results and Discussion

3.1 Rasch Model Analysis Results

Prior to conducting further analysis, the data were screened to identify misfitting responses, which may indicate inconsistent answering patterns or random guessing.

Rasch analysis enables the detection of such responses to ensure that the measurement results accurately reflect respondents' true perceptions. From the initial dataset of 110 respondents, one respondent was identified as a misfit and excluded from subsequent analyses. The final analysis was therefore conducted with data from 109 respondents.

Table 1 presents the summary statistics for both persons and items after data cleaning. The results indicate that the measurement instrument demonstrated excellent psychometric properties. The Cronbach's alpha value of 0.93 reflects high internal consistency, indicating that the items reliably measure a single underlying construct. Furthermore, the item reliability value of 0.94 suggests that the instrument items are stable and capable of consistently differentiating respondents' perceptions.

Table 1. Summary statistics of students and item

	Person	Item
N	110	20
Mean Measure	2.53	0.00
Mean	64.3	353.7
SD	1.83	0.89
SE	1.75	0.86
Mean outfit MNSQ	0.97	0.97
Mean infit MNSQ	1.00	0.98
Separation	3.16	4.07
Reliability	0.91	0.94
Croncbach's alpha	0.93	

The person reliability value of 0.91 indicates that respondents provided consistent responses across items, while the item separation index of 4.07 suggests that the items can be classified into multiple levels of difficulty. According to Linacre (2005), separation values above 2.0 indicate good measurement quality, as they reflect the instrument's ability to distinguish between different levels of the measured construct. The person separation index of 3.16 further indicates that respondents can be categorised into several distinct perception levels, demonstrating the instrument's effectiveness in differentiating students based on their perceptions of practicum activities.

In terms of fit statistics, both Infit and Outfit Mean Square (MNSQ) values were close to the ideal value of 1.00, indicating good model–data fit. These results confirm that the observed data were consistent with the expectations of the Rasch model, supporting the validity of the measurement instrument used in this study. Key diagnostics for the Rasch model were systematically evaluated. The category functioning and threshold ordering analysis confirmed that the 4-point response categories functioned properly without any threshold disordering, meaning respondents could clearly distinguish between the options. In terms of individual fit, item measures fell within the acceptable Infit and Outfit MNSQ ranges of 0.5 to 1.5. Furthermore, preliminary screening for Differential Item Functioning (DIF) indicated no significant item bias across different respondent demographics (e.g., gender or semester cohort).

3.2 Distribution of Respondents' Ability and Item Difficulty

Figure 1 illustrates the distribution of respondents' perception levels and item difficulty along the same logit scale. The majority of respondents were clustered within the logit range of 0 to 2, indicating that most students demonstrated moderate to positive perceptions of basic physics practicum activities.

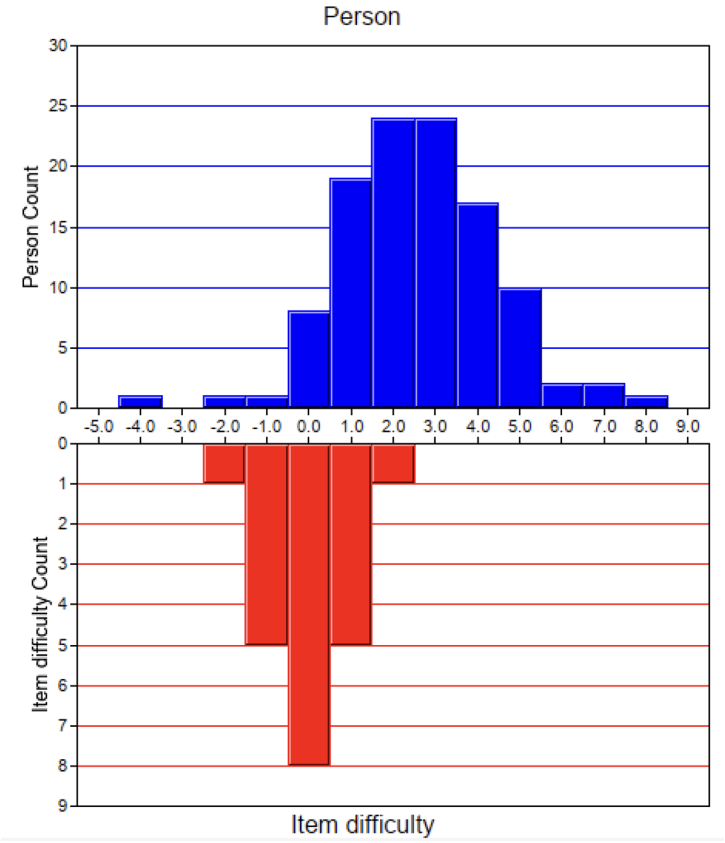


Fig. 1. Distribution of respondents' ability

The distribution of item difficulty shows that most items were centred around the mean logit value of 0.00, indicating a balanced range of item difficulties. Figures 1 and 2 illustrate the distribution of respondents' perception levels and item difficulty along the same logit scale. As summarized in Table 1, the mean person measure is 2.53 logits, whereas the mean item difficulty is fixed at 0.00 logits. This significant gap indicates a noticeable mistargeting (off-targeting) within the measurement setup, where the pre-service teachers' baseline perception levels are substantially higher than the difficulty thresholds of the questionnaire items. Consequently, the items were relatively easy for this specific cohort to endorse, representing highly positive overall attitudes but causing a minor ceiling effect. While the questionnaire remains valid for identifying general

trends and capturing specific operational pain points—such as Item 11 regarding time constraints—future revisions of this instrument must incorporate more stringent or 'harder-to-endorse' items that represent more demanding criteria for laboratory quality to improve targeting accuracy and better differentiate respondents with exceptionally high perception levels. Nevertheless, the presence of items at the extreme ends of the difficulty spectrum indicates that certain aspects of the practicum were perceived as uniquely supportive or challenging, warranting further qualitative examination.

3.3 Key Findings from the Wright Map Analysis

The Wright map presented in Figure 2 provides a visual representation of respondents' perception levels and item difficulty on the same measurement scale. One notable finding is that Item 11 ("The time allocated for physics practicum is sufficient") was identified as the most difficult item. This indicates that many students perceived practicum time allocation as insufficient, highlighting time constraints as a significant challenge in practicum implementation.

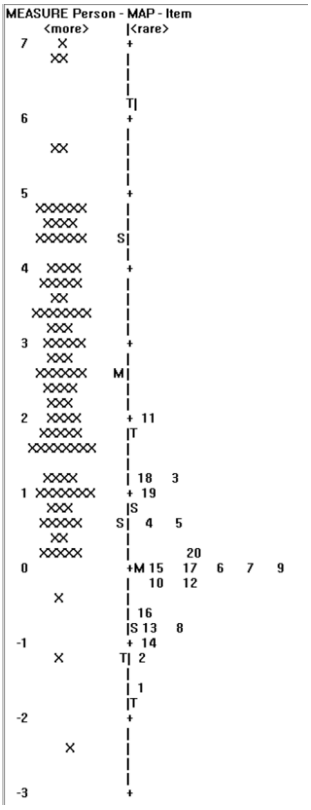


Fig. 2. Wright Map of Distribution of Persons and Items on the Same Logit Scale

Conversely, Item 1 ("Pre-laboratory activities help me understand the concepts and theories related to the practicum") emerged as the easiest item, suggesting that pre-laboratory activities were perceived as highly supportive. This finding indicates that pre-lab preparation effectively equips students with conceptual understanding prior to engaging in laboratory work, thereby enhancing practicum readiness.

Items related to practicum evaluation and assessment transparency were located around the middle of the logit scale, reflecting variability in students' perceptions. This suggests that while some students felt confident about assessment procedures, others perceived room for improvement in clarity and objectivity.

3.4 Item Characteristic Curves and Response Patterns

The Item Characteristic Curves (ICC) shown in Figure 3 illustrate the probability of respondents selecting each response category based on their perception level. For Item 1, the response categories demonstrated clear separation, indicating that the item effectively distinguished between respondents with different levels of perception. Higher-perception respondents were more likely to select agreement categories, confirming the positive role of pre-laboratory activities.

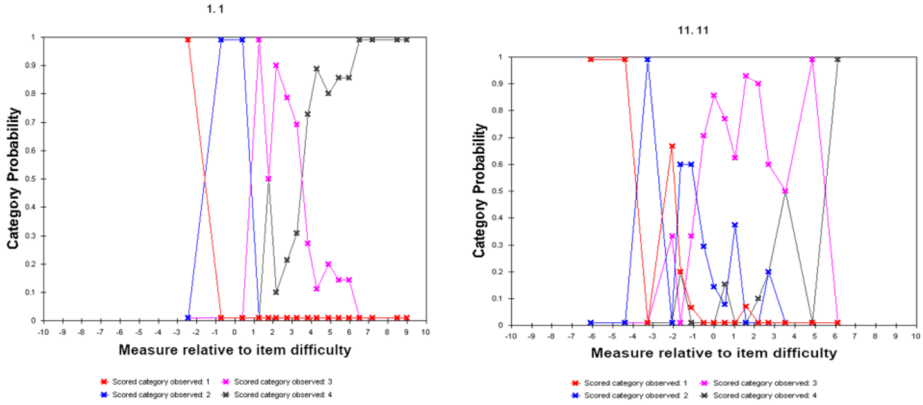


Figure 3. Item Characteristic Curves

In contrast, the ICC for Item 11 revealed overlapping response categories, particularly between "disagree" and "agree". This overlap suggests ambiguity in respondents' perceptions regarding practicum time adequacy, especially among those with moderate perception levels. Such findings indicate that practicum time allocation may not be uniformly suited to students' learning needs and may require further adjustment.

Further examination of the Rasch analysis results reveals distinct response patterns across the different dimensions of basic physics practicum activities. Items related to practicum planning and pre-laboratory preparation were generally located at lower logit values, indicating that these aspects were more easily endorsed by respondents.

This suggests that most pre-service teachers perceived practicum planning activities, such as pre-laboratory instructions and conceptual preparation, as supportive components of the practicum experience.

In contrast, several items associated with practicum implementation, particularly those related to time allocation and flexibility during experimental activities, were positioned at higher logit values. This indicates that these items were more difficult for respondents to endorse, reflecting greater variability in students' perceptions. The spread of item difficulties within this dimension suggests that students experienced practicum implementation differently, possibly due to variations in experimental complexity, laboratory conditions, or individual preparedness.

Items related to practicum evaluation and assessment tended to cluster around the middle of the logit scale. This distribution indicates moderate endorsement levels and suggests that students held mixed perceptions regarding assessment clarity and objectivity. While some respondents perceived practicum evaluation procedures as transparent and fair, others expressed uncertainty, as reflected in the variability of item locations within this dimension.

Analysis of person measures further supports these findings. The majority of respondents were located above the mean item difficulty, indicating generally positive perceptions of practicum activities. However, the presence of respondents at lower logit levels highlights that not all students experienced practicum in the same way. This variability underscores the importance of examining item-level information rather than relying solely on overall perception scores.

Overall, the distribution of item difficulties and person measures demonstrates that the instrument was well-targeted to the respondent population. The alignment between respondent ability and item difficulty suggests that the questionnaire effectively captured variations in students' perceptions across different practicum dimensions, providing a comprehensive picture of practicum implementation from the learners' perspective.

3.5 Discussion

The findings of this study indicate that pre-service teachers generally hold positive perceptions of basic physics practicum activities, as reflected by the strong person measures and favourable item responses identified through Rasch analysis. The high reliability indices and good model–data fit further confirm that students' responses were consistent and that the instrument effectively captured their perceptions [14]. These results reinforce the view that well-structured practicum activities remain a central pillar of physics teacher education, particularly in supporting the development of conceptual understanding and practical competence [1,2].

One of the most prominent findings of this study is the strong endorsement of pre-laboratory activities. The Rasch analysis revealed that items related to pre-laboratory preparation were among the easiest for respondents to endorse, indicating widespread agreement regarding their usefulness. This suggests that pre-lab activities play a critical role in helping students connect theoretical concepts with experimental procedures before entering the laboratory. Such preparation can reduce cognitive load during practicum implementation and enable students to focus more effectively on data collection, observation, and interpretation. This finding aligns with previous research emphasising that structured pre-laboratory activities enhance students' readiness and improve the overall effectiveness of laboratory learning [2, 3].

From a pedagogical perspective, effective pre-laboratory preparation is particularly important for pre-service teachers, as it models good instructional practice that they may later adopt in their own teaching [1, 2]. By experiencing the benefits of clear objectives, conceptual scaffolding, and procedural clarity during practicum, pre-service teachers can develop a deeper appreciation of how laboratory learning should be designed and facilitated [3]. This supports the development of professional competence and reflective teaching practices, which are essential components of teacher education programmes [5, 6].

In contrast, insufficient time allocation emerged as the most challenging aspect of practicum implementation. Item 11, which addressed the adequacy of practicum time, was identified as the most difficult item on the Wright map, indicating that many students perceived the available time as inadequate. This finding is consistent with previous studies reporting time constraints as a major barrier to effective practicum implementation in physics education [8, 9]. Limited time may restrict students' opportunities to engage deeply with experimental processes, repeat measurements, troubleshoot errors, and reflect on results—activities that are crucial for meaningful learning.

For pre-service teachers, time constraints may have additional implications beyond immediate learning outcomes. Practicum experiences shape future teachers' beliefs about laboratory instruction and influence how they will later design and manage practicum activities in school settings [1, 5]. If practicum is consistently experienced as rushed or procedural, pre-service teachers may be less inclined to implement inquiry-based laboratory activities in their future classrooms [8, 9]. Therefore, addressing time allocation issues is not only a matter of improving current practicum experiences but also of supporting long-term improvements in physics teaching practices [2].

Another important finding of this study relates to the predominance of verification-based practicum models. Although such models can support the acquisition of basic procedural skills, they often limit opportunities for creativity, critical thinking, and experimental design. The Rasch analysis results, particularly the response patterns observed in the Item Characteristic Curves, suggest variability in students' perceptions of practicum implementation, reflecting differing levels of engagement and

satisfaction. These findings support earlier research indicating that verification-oriented laboratory activities may constrain students' creative engagement and inquiry skills [2].

In the context of 21st-century education, this limitation is particularly significant. Contemporary science education emphasises the development of higher-order skills, such as problem-solving, collaboration, and creativity, which are best fostered through inquiry-oriented and student-centred learning approaches. For pre-service teachers, experiencing inquiry-based practicum activities is essential for developing the pedagogical knowledge and confidence required to implement such approaches in their future teaching. Transitioning from verification-based models to more inquiry-oriented practicum designs may therefore enhance both learning outcomes and professional preparation.

The findings related to practicum evaluation and assessment also warrant attention. Items addressing assessment clarity and objectivity were located around the middle of the logit scale, indicating variability in students' perceptions. This suggests that while some students perceived practicum assessment as transparent and fair, others experienced uncertainty regarding evaluation criteria or feedback. Transparent and objective assessment is a critical component of effective practicum design, as it supports students' understanding of learning expectations and encourages reflective practice. Previous research has highlighted the importance of clear assessment criteria in promoting student engagement and learning during practicum [5].

Beyond substantive findings, this study demonstrates the methodological value of applying the Rasch measurement model to the evaluation of practicum experiences. Rasch analysis enabled the identification of specific strengths and weaknesses at the item level, providing detailed diagnostic information that would be difficult to obtain using classical test theory alone. For example, the identification of time allocation as the most challenging aspect of practicum implementation was supported by both Wright map analysis and Item Characteristic Curves.

The use of Rasch analysis also contributes to the development of more robust measurement instruments in physics education research. By ensuring that questionnaire items function as intended and accurately represent underlying constructs, Rasch modelling supports the generation of reliable and valid data for educational decision-making [15, 16]. This methodological contribution strengthens the overall quality of the study and highlights the potential of Rasch analysis for future research on practicum evaluation and teacher education.

The results of this study have important implications for physics teacher education programmes, particularly in relation to how practicum courses are designed and implemented. The generally positive perceptions expressed by pre-service teachers suggest that practicum activities continue to play a vital role in supporting conceptual understanding and professional preparation [8]. However, the identified challenges

indicate that further refinement is needed to maximise the pedagogical value of practicum experiences.

The strong contribution of pre-laboratory activities highlights the importance of structured preparation in laboratory learning. For physics teacher education, this finding suggests that pre-lab components should be systematically integrated into practicum curricula, rather than treated as supplementary or optional activities. Clear learning objectives, conceptual scaffolding, and guided questions can help pre-service teachers develop a deeper understanding of experimental purposes and expected outcomes. Such practices align with recommendations from previous studies emphasising the role of preparatory activities in enhancing laboratory effectiveness [2, 3].

In addition, pre-laboratory activities can serve as a pedagogical model for future teaching practice. By experiencing well-designed pre-lab instruction, pre-service teachers may be more likely to adopt similar approaches in their own classrooms [23]. This is particularly relevant in the context of secondary school physics education, where laboratory activities are often constrained by limited time and resources [24]. Effective preparation can help teachers manage these constraints while maintaining meaningful learning experiences.

The perception of insufficient time allocation raises important questions about the structure and scheduling of practicum courses. Time constraints may limit students' ability to engage in deeper inquiry processes, such as formulating hypotheses, refining experimental procedures, or reflecting critically on results. This issue has been consistently reported in previous studies, indicating that it is not unique to the context of this study but represents a broader challenge in physics practicum implementation [9].

For pre-service teachers, limited practicum time may also influence their perceptions of laboratory teaching as a rigid and time-pressured activity. Such perceptions could discourage the adoption of inquiry-based approaches in future teaching practice, reinforcing reliance on verification-based experiments [25]. Addressing time allocation issues may therefore require not only extending practicum duration but also reconsidering how time is used within laboratory sessions. Strategies such as integrating pre-lab simulations, streamlining procedural steps, or distributing practicum activities across multiple sessions could help optimise learning within existing time constraints.

The predominance of verification-based practicum models identified in this study reflects a common trend in physics education, where laboratory activities are often designed to confirm established theories rather than encourage exploration and inquiry. While verification-based experiments can support basic procedural understanding, they offer limited opportunities for students to develop higher-order thinking skills, such as problem-solving, creativity, and scientific reasoning [10].

Previous research has emphasised the importance of inquiry-oriented laboratory learning in fostering deeper engagement and conceptual understanding [2, 8]. For pre-service teachers, experiencing inquiry-based practicum activities is particularly important, as it shapes their beliefs about effective laboratory instruction and influences future teaching practices. Transitioning towards more inquiry-oriented practicum designs may therefore contribute to the development of reflective and innovative physics teachers who are better prepared to meet the demands of contemporary science education.

4 Conclusion

This study examined pre-service teachers' perceptions of basic physics practicum activities using the Rasch measurement model. The results indicate that students generally perceive the practicum positively, particularly the role of pre-laboratory activities in supporting conceptual understanding and preparation for laboratory work. Rasch analysis confirmed that the measurement instrument demonstrated good reliability and model–data fit, indicating its suitability for assessing students' perceptions.

However, insufficient time allocation was identified as the most challenging aspect of practicum implementation. In addition, the predominance of verification-based practicum models was found to limit opportunities for creativity and inquiry. These findings suggest the need to optimise practicum time management and to gradually adopt more inquiry-oriented laboratory designs in physics teacher education.

Overall, this study provides empirical evidence on the strengths and limitations of basic physics practicum implementation and demonstrates the usefulness of the Rasch model for evaluating practicum experiences. The findings offer practical insights for improving practicum design to better support the development of future physics teachers.

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References

1. Bada, A. A., & Jita, L. C. Teaching practice: Experiences of pre-service physics teachers. Eurasia Journal of Mathematics, Science and Technology Education, 19(6) (2023).
2. Jeličić, K., Geyer, M., Ivanjek, L., Klein, P., Küchemann, S., Dahlkemper, M., … & Sušac, A. Lab courses for prospective physics teachers: what could we learn from the first covid-19 lockdown?. European Journal of Physics, 43(5) (2022).
3. Voitkiv, H., & Lishchynskyy, I. Practical Works In Primary School Physics Course. Scientific Journal of Polonia University, 55(6), 109–115 (2023).
4. Rashidov, D. Developing Practical Skills in Physics Students at Technical Universities. International Journal of Research Publication and Reviews, 5(5), 9172–9174 (2024).
5. Ahmed, T., Mughal, S. H., & Memon, S. Attitude of prospective teachers towards the practicum in teachers' training institutes of sukkur and khairpur districts. *Journal of Development and Social Sciences*, *4*(4), 353-361 (2023).
6. Bibi, S., & Aziz, S. Navigation of Teaching Practicum Challenges: An Emerging Perspective of Pre-Service Teachers. *Academy of Education and Social Sciences Review*, *4*(2), 184-196 (2024).
7. Salnyk, I. Approaches To The Organization Of Laboratory Practicum In Physics Teacher Training During Distance Education. Scientific Bulletin of Flight Academy. Section: Pedagogical Sciences, 12, 108–116, (2022).
8. O'Neill, D., & McLoughlin, E. What Do Novice Physics Teachers Identify as Their Problems of Practice?. In *Physics Teacher Education: What Matters?* (pp. 137-147). Cham: Springer International Publishing, (2022).
9. Ramayani, N., & Amalia, L. The Analysis of Barriers to the Use of Physics Practicum Applications. *International Journal of Education and Teaching Zone*, *1*(1), 34-43 (2022).
10. Beshir, S., Dagnaw Kelkay, A., & Melesse, T. Perceptions of practicum actors in the primary teacher education practicum program. *Cogent Education*, *10*(1), 2206628, (2023).
11. Kaya, F. Identity (re)construction of turkish pre-service language teachers during the practicum. International E-Journal of Educational Studies, 7(14), 243-256 (2023).
12. Han, T. and Tulgar, A. Analysis of the pre-service teachers' teaching anxiety and coping strategies: a turkish elementary school context. Gist Education and Learning Research Journal, (19), 49-83 (2019).
13. Gustine, G. "how do you work out this zoom classroom?": pre-service english teachers challenges and expectations during transition to online teaching practicum. Research and Innovation in Language Learning, 4(1), 68 (2021).
14. Holster, T. A., & Lake, J. Guessing and the Rasch model. *Language Assessment Quarterly*, *13*(2), 124-141. 14, (2016).
15. Tennant, A., & Küçükdeveci, A. A. Application of the Rasch measurement model in rehabilitation research and practice: early developments, current practice, and future challenges. *Frontiers in Rehabilitation Sciences*, *4*, 1208670, (2023).
16. Hope, D., Kluth, D., Homer, M., Dewar, A., Goddard-Fuller, R., Jaap, A., & Cameron, H. Exploring the use of Rasch modelling in "common content" items for multi-site and multi-year assessment. *Advances in Health Sciences Education*, 1-12, (2024).
17. Tesio, L., Caronni, A., Simone, A., Kumbhare, D., & Scarano, S. Interpreting results from Rasch analysis 2. Advanced model applications and the data-model fit assessment. *Disability and rehabilitation*, *46*(3), 604-617 (2024).
18. Al Ali, R., & Shehab, R. T. Psychometric Properties of Social Perception of Mathematics: Rasch Model Analysis. *International Education Studies*, *13*(12), 102-110 (2020).

19. Villalonga-Olives, E., Kawachi, I., & Rodríguez, A. M. Rasch model of the bridging social capital questionnaire. *SSM-population Health*, *14*, 100791 (2021).
20. Creswell, J. W., & Creswell, J. D. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, (2017).
21. Boone, H. N. J., & Boone, DA , Analyzing likert data. Journal of Extension, 50(2), 1-5 (2012).
22. Bond, T. G., & Fox, C. M. Applying the Rasch model: Fundamental measurement in the human sciences. Psychology Press. (2013).
23. Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. W. Teaching practice: A cross-professional perspective. Teachers college record, 111(9), 2055-2100 (2009).
24. Hofstein, A., & Lunetta, V. N. The laboratory in science education: Foundations for the twenty-first century. Science education, 88(1), 28-54 (2004).
25. Loughran, J. Pedagogical reasoning: The foundation of the professional knowledge of teaching. Teachers and Teaching, 25(5), 523-535 (2019).

Appendix: Questionnaire Items for Pre-Service Teachers' Perceptions of Basic Physics Practicum

No	Questionnaire Statement	SD	D	A	SA
1	Pre-laboratory activities help me understand the concepts and theories related to the practicum.				
2	Pre-laboratory activities provide opportunities for me to plan and prepare for the practicum effectively.				
3	The schedule for implementing the practicum topics aligns well with the lecture material.				
4	The number of members within each practicum group is ideal.				
5	The practicum manual provides comprehensive and clear step-by-step procedures for the experiment.				
6	The practicum manual provides illustrations that help me understand the practicum concepts.				
7	The physics practicum activities conducted are related to the application of physics concepts in solving everyday life problems.				
8	The verification-based practicum model used is appropriate for implementation at the university level.				
9	The verification-based practicum model used provides a variety of creative activities and experiments.				
10	The verification-based practicum model used allows me to connect physics concepts with real-world phenomena.				
11	The time allocated for the physics practicum is sufficient.				
12	The physics practicum conducted is relevant to the topics taught in the related course.				
13	Practicing in the physics laboratory helps me better understand the physics concepts taught in the related course.				
14	Explanations provided by the lecturer or lab assistants during the physics practicum help me execute the experiments.				
15	The physics practicum helps me develop my character.				
16	The physics practicum design used helps me work collaboratively with fellow students.				
17	The physics practicum design used encourages me to develop creativity in conducting experiments.				
18	I am well aware of the evaluation components used for the physics practicum grading.				
19	The evaluation and assessment of the physics practicum results are conducted objectively and transparently.				

No	Questionnaire Statement	SD	D	A	SA
20	I am satisfied with the completeness and novelty of the facilities and equipment available in the physics laboratory.				

SD (*Strongly Disagree*) ; D (*Disagree*); A (*Agree*); SA (*Strongly Agree*)

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