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Rasch Model Analysis of a Learning Autonomy Instrument in Digital Higher Education

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ABSTRACT
This study examined the measurement and calibration of learning independence among PGSD students in digital learning using the Rasch Model. Motivated by the need for validated tools that capture readiness for autonomous learning in higher education, a survey of 40 students from the 2023 and 2024 cohorts employed a Learning Independence Test. Rasch analysis estimated item difficulty and person ability and assessed reliability and model fit. Most items showed acceptable fit and internal consistency. Item and person distributions indicated generally moderate to high independence, with meaningful individual variation. These findings suggest the instrument functions adequately and can yield actionable diagnostics for curriculum design and targeted supports that strengthen autonomy in digital environments. Psychometrically sound measurement is therefore valuable for understanding learner characteristics and informing teacher preparation, since prospective teachers must foster independence in their future pupils. The small sample limits generalization. Future research should use larger and more diverse samples and adopt longitudinal designs to track changes in learning independence over time.

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Introduction

The rapid advancement of information and communication technology has given rise to the era of digital learning, in which digital devices and internet connectivity serve as the primary means of teaching and learning. Globally, digital learning is regarded as a key strategy for expanding access, flexibility, and quality in education, particularly using learning management systems (LMS), e-learning platforms, and online conferencing applications that enable interaction between lecturers and students across distances (Firman & Rahman, 2020). This shift is not merely a change in medium but represents a paradigm transformation from teacher-centered instruction to student-centered learning. Within this framework, students are expected to become more active agents in managing their learning process, from planning strategies and allocating time to maintaining motivation and achieving academic goals.

Learning independence, often referred to as self-regulated learning, has therefore become a central competency in ensuring success in digital education. According to Sumarmo (2013), learning independence involves the ability to organize, monitor, and evaluate one's learning process without excessive reliance on external guidance. Similarly, Zimmerman (2000) emphasized that students with higher levels of self-regulation can set goals, selecting appropriate learning strategies, monitoring progress, and reflecting critically on their outcomes. In the context of digital learning, such independence becomes increasingly vital as students must navigate abundant online resources that demand both technological literacy and self-discipline.

In Indonesia, the implementation of digital learning has expanded significantly, particularly since the COVID-19 pandemic accelerated the adoption of educational technologies in higher education. However, existing studies indicate that success in digital learning is uneven. Marhayani (2020) reported that not all students possess sufficient learning independence to participate effectively in online classes. Furthermore, infrastructure disparities, such as limited internet access in certain regions, create inequities in learning opportunities (Purwanto et al., 2020). Some students also face difficulties adjusting to the culture of online learning, particularly in time management, concentration, and self-evaluation.

Studies focusing on PGSD students suggest that levels of learning independence vary considerably. Akmal et al. (2022) found that while many students exhibit high or very high levels of independence, a proportion still fall into the lower categories. High levels of independence are often supported by conducive learning environments, intrinsic motivation, and help-seeking strategies, whereas challenges remain in maintaining motivation and managing time effectively. Although these findings point to generally promising conditions, they also highlight persistent gaps that warrant deeper investigation.

Moreover, prior research on learning independence in the Indonesian context has largely remained descriptive, focusing on category distributions rather than employing robust psychometric evaluations of the instruments used. The accuracy of research outcomes is heavily dependent on the validity and reliability of measurement tools, yet relatively few studies have applied rigorous approaches such as Rasch analysis. The Rasch Model offers significant advantages, including the evaluation of item fit, estimation of respondent ability, and assessment of overall instrument reliability. By using Rasch analysis, researchers can obtain more precise results and generate a clearer map of students' competencies across the continuum of learning independence.

This research therefore addresses the gap by systematically calibrating and validating a learning independence instrument for PGSD students using Rasch analysis, while also examining its relevance to digital learning effectiveness. The study aims to provide both methodological contributions, through psychometric validation, and practical insights, by informing strategies to enhance learner independence among future educators. The findings suggest that while PGSD students generally display moderate to high levels of independence, continued efforts are required to strengthen self-directed learning skills, particularly in digital contexts where autonomy is a critical determinant of success.

Methods

This study employed a quantitative approach with a survey design to investigate the measurement and calibration of learning independence among Primary School Teacher Education (PGSD) students in the context of digital learning. The target population consisted of all PGSD students enrolled at University X in the 2023 and 2024 cohorts. From this population, a sample of 40 students was selected using simple random sampling. Although the sample size is relatively small, it meets the minimum threshold for Rasch analysis, which is generally recommended at 30 respondents, and thus provides an adequate basis for exploratory psychometric evaluation.

The primary instrument used in this research was a Learning Independence Questionnaire consisting of 30 items distributed across five domains: planning, time management, motivation, learning strategies, and self-evaluation. Each item was rated on a four-point Likert scale, ranging from "strongly disagree" to "strongly agree." Content validity was established through expert judgment, while construct validity and reliability were tested using Rasch analysis with the Rating Scale Model. Data were processed with the Winsteps software package, which allowed for comprehensive evaluation of item and person reliability, separation indices, fit statistics (acceptable range of infit/outfit mean square values = 0.5–1.5), category functioning (threshold ordering), and Differential Item Functioning (DIF) across cohort and gender groups.

In addition to measuring learning independence, the study also assessed the effectiveness of digital learning using a 10-item subscale that evaluated student engagement, perceived usefulness, and overall satisfaction with digital learning. To examine the empirical relationship between the two constructs, simple linear regression analysis was conducted, using Rasch-derived logit scores of learning independence as the predictor variable and digital learning effectiveness as the outcome variable. Through this design, the study not only provided validation evidence for the learning independence instrument but also tested its predictive relevance for understanding the effectiveness of digital learning among PGSD students.

Results and Discussion

The Rasch Model analysis provided a comprehensive overview of the psychometric quality of the learning independence instrument as well as the distribution of students' ability levels. The instrument statistics are presented in Table 1. Overall, the infit and outfit mean square statistics for all items ranged between 0.95 and 1.12, which falls well within the acceptable threshold range of 0.5–1.5, indicating that all items exhibited good fit to the Rasch model. Despite this acceptable fit, two items were identified as relatively more difficult, namely "expressing opinions in online forums" (measure = 0.65 logit) and "presenting without hesitation in online classes" (measure = 0.72 logit). Conversely, the easiest items for students were "submitting assignments on time" (measure = –0.40 logit) and "searching for supplementary materials beyond online lectures" (measure = –0.35 logit). This variation suggests that the instrument successfully incorporated a diverse range of item difficulties.

Table 1. Instrument Statistics Based on Rasch Analysis

Indicator/Item	Measure (Logit)	SE	Outfit MNSQ	Infit MNSQ	Difficulty Category
Seeking additional materials beyond online classes	–0.35	0.12	0.98	1.02	Easy
Actively asking questions to lecturers/peers	0.12	0.11	1.05	0.99	Medium
Finding solutions independently when facing difficulties	0.25	0.13	0.96	1.01	Medium
Completing assignments on time	–0.40	0.10	1.00	0.97	Easy
Expressing opinions confidently in online forums	0.65	0.15	1.08	1.10	Difficult
Presenting online without hesitation	0.72	0.16	1.12	1.05	Difficult
Learning driven by intrinsic awareness	–0.20	0.12	0.95	0.98	Easy

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Reliability and Separation Summary

- Person reliability = 0.82; separation = 2.25
- Item reliability = 0.85; separation = 2.50

The person reliability value of 0.82 with a separation index of 2.25 indicated that the instrument could distinguish respondents into at least two levels of ability. Similarly, item reliability was 0.85 with a separation index of 2.50, confirming that the items demonstrated strong internal consistency and stability for replication in future samples. Therefore, the learning independence instrument used in this study can be considered sufficiently valid and reliable.

The Wright Map provided further insight into the relationship between students' ability distribution and item difficulty. The map revealed that the majority of students clustered at medium-to-high ability levels, while the more challenging items—such as "expressing opinions in online forums" and "presenting online without hesitation"—were positioned above the average ability of most respondents. This small gap suggests that the instrument may benefit from including additional items with varying levels of difficulty to optimize targeting in future applications.

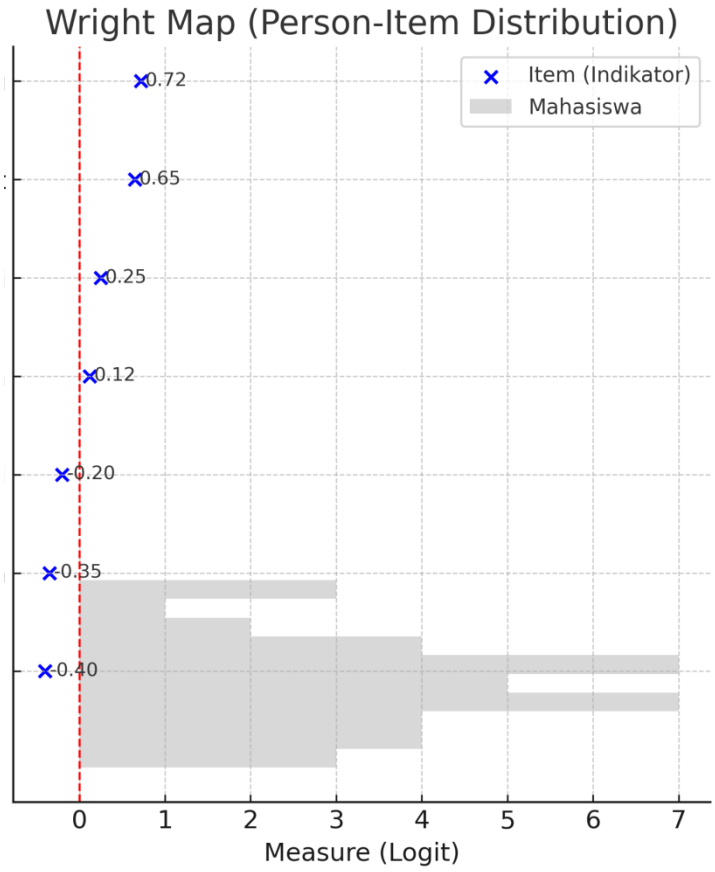

Figure 1. Wright Map

To further explore group differences, descriptive statistics of learning independence scores were examined across the two cohorts. As shown in Table 2, students from the 2023 cohort achieved a mean score of 48.5 (SD = 5.2), categorized as medium-to-high, while the 2024 cohort achieved a slightly higher mean score of 50.2 (SD = 4.8), also categorized as medium-to-high. The combined sample produced an overall mean of 49.4 (SD = 5.0). Independent t-tests on Rasch person measures revealed no statistically significant differences between the cohorts ($p > 0.05$). However, effect size analysis (Hedges' $g = 0.25$) suggested a small trend indicating that students in the 2024 cohort may possess slightly higher learning independence than their 2023 counterparts.

Table 2. Descriptive Statistics of Student Learning Independence

Cohort	N	Min Score	Max Score	Mean (M)	SD	Dominant Category
2023	20	38	58	48.5	5.2	Moderate–High
2024	20	40	60	50.2	4.8	Moderate–High
Total	40	38	60	49.4	5.0	Moderate–High

Finally, regression analysis was conducted to assess the effect of learning independence on the effectiveness of digital learning. Results demonstrated a significant positive relationship ($\beta = 0.42$, $p < 0.05$, $R^2 = 0.18$), indicating that higher levels of learning independence predicted more effective engagement in digital learning activities. This finding reinforces the theoretical framework of self-regulated learning, highlighting that students who can seek additional resources, manage their time effectively, and participate actively in discussions tend to adapt better to digital learning environments.

The findings of this study demonstrate that the learning independence instrument applied to PGSD students exhibited sound psychometric properties when analyzed through the Rasch Model. All items fell within acceptable fit indices, thereby ensuring construct validity and reliability. These results support prior research emphasizing the Rasch Model as a rigorous tool for educational assessment (Bond & Fox, 2015). The presence of both relatively easy and more difficult items confirms that the instrument is capable of differentiating students across a spectrum of learning independence, which is essential for diagnostic and evaluative purposes.

The Wright Map analysis provides important insights into student ability distribution. The observation that most students were positioned at medium-to-high independence levels suggests that PGSD students are reasonably prepared for digital learning contexts. Nevertheless, items such as "expressing opinions in online forums" and "presenting without hesitation online" being more difficult indicate persistent challenges in digital communication and self-expression. These findings align with previous studies (Broadbent & Poon, 2015) showing that while students often excel in task management and resource-seeking, they may struggle with confidence in digital participation.

In terms of group differences, although no statistically significant disparities were observed between the 2023 and 2024 cohorts, the small effect size implies that newer cohorts may gradually adapt better to digital learning. This echoes observations from Marhayani (2020), who noted generational differences in readiness for online education. The relatively stable means across cohorts further suggest that institutional factors, such as consistent curriculum design and exposure to digital platforms, may have contributed to a uniform development of learning independence.

The regression analysis confirmed that learning independence significantly predicted digital learning effectiveness. This is consistent with Zimmerman's (2002) self-regulated learning theory, which emphasizes that learners who can plan, monitor, and reflect on their learning processes perform better in less structured environments. It also reinforces empirical findings that autonomy and self-regulation are critical determinants of success in e-learning (Artino & Stephens, 2009). However, the modest R^2 value of 0.18 suggests that while learning independence is important, other factors—such as digital literacy, peer support, and infrastructure—also play significant roles in determining digital learning outcomes.

Taken together, these results highlight the importance of fostering independent learning skills among PGSD students as they transition into professional teaching roles. Since future teachers are expected to integrate technology into classroom practice, their own independence in digital learning can shape how effectively they guide their students in similar environments.

Conclusion

This study demonstrated that the level of learning independence among PGSD students from the 2023 and 2024 cohorts fell within the moderate to high category, with an average score of 49.4. The Rasch analysis produced a person reliability of 0.82 (separation = 2.25) and an item reliability of 0.85 (separation = 2.50), confirming that the instrument is psychometrically sound and suitable for measuring learning independence in higher education. Regression analysis further revealed that learning independence had a significant positive effect on the effectiveness of digital learning ($\beta = 0.42$, $p < 0.05$, $R^2 = 0.18$). Comparisons between cohorts showed that the 2024 students scored slightly higher in learning independence than their 2023 counterparts (Hedges' $g = 0.25$), although this difference was not statistically significant.

From a theoretical perspective, the findings provide empirical support for the self-regulated learning (SRL) framework, which emphasizes self-management, resource-seeking, and proactive learning strategies in digital environments. From a practical standpoint, the results highlight the importance of designing digital learning experiences that promote independence through project-based assignments, sustained feedback, and a facilitative role for lecturers. Methodologically, the use of the Rasch Model proved

effective in producing detailed diagnostic information on item fit, reliability, and ability distribution, offering a solid foundation for evaluating and refining instruments of learning independence in future studies.

Despite these contributions, the study has limitations, including the relatively small sample size (N = 40), the focus on a single program at one institution, and the cross-sectional design, which limits the ability to capture developmental changes in student independence over time. Therefore, further research is recommended to expand the sample size and diversity, include multiple institutions, and adopt longitudinal or experimental designs to provide stronger evidence of causal relationships between learning independence and digital learning effectiveness.

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