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Assessing Digital Competence in Indonesian students: demographic and Internet usage factors through the Rasch Model

Wibowo Heru Prasetiyo[a,1], Beti Indah Sari[b], Rizky Novia Saputri[a], Noor Banu Mahadir Naidu[c], Triyanto[d], Jagad Aditya Dewantara[e]

[a]*Universitas Muhammadiyah Surakarta, Dept. of Civic Education – Surakarta (Indonesia)*

[b]*Universitas Negeri Surabaya, Dept. of Pancasila and Civic Education – Surabaya (Indonesia)*

[c]*University Pendidikan Sultan Idris, Dept. of Moral, Civics, and Character Building Studies – Tanjong Malim (Malaysia)*

[d]*Universitas Sebelas Maret, Dept. of Civic Education – Surakarta (Indonesia)*

[e]*Universitas Tanjungpura, Dept. of Civic Education – Surakarta (Indonesia)*

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Abstract

In today's rapidly evolving digital landscape, technological advancements continue to reshape human lifestyles, making robust digital competence (DC) essential in an interconnected world. This study addresses existing gaps in the literature by evaluating the digital competence of Indonesian students and examining the influence of parental educational backgrounds and daily internet usage frequency. Utilizing convenience sampling and online questionnaires, data were collected from 251 students and analyzed using the Rasch Model with Winsteps software version 5.7.3.0. The findings reveal gender-based differences in digital skills, indicating the need for tailored educational strategies. Additionally, students with less educated parents tend to prioritize personal data protection, while those with highly educated parents display broader digital competencies. Although high internet usage is associated with enhanced digital competence, it also carries risks to mental health, such as increased internalizing symptoms and cognitive distortions. This study contributes to ongoing discussions on improving student digital competence and underscores the importance of balanced internet usage strategies.

KEYWORDS: Demographic, Internet Usage, Rasch, Students' Digital Competence.

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1. Introduction

In the 21st century, human lives have been increasingly shaped by technological advancements that facilitate communication, productivity, and access to information. Innovations in areas such as telemedicine, digital payments, autonomous transportation, and e-commerce highlight the pervasive role of digital technology in everyday life. The integration of digital tools is not a temporary response to a global crisis but a continuous evolution that transforms how individuals live, learn, and interact. Modern people no longer live with technology; they live within it. While the COVID-19 pandemic may have accelerated this trend, the

[1] corresponding author - email: whp823@ums.ac.id

broader digital transformation remains an enduring and significant force in shaping modern society. As everyday activities intertwine with technology, mastering digital competence becomes essential due to its comprehensive focus on ethical, safety, and social dimensions, alongside the incorporation of diverse knowledge, abilities, and aspirations of individuals (Falloon, 2020). Consequently, acquiring digital competence encompasses not only proficiency in operating ICT devices but also a comprehensive set of abilities that contribute to overall well-being and quality of life (UNESCO, 2018).

Furthermore, digital competence (DC) is becoming a prerequisite in an internet-connected world, opening new job opportunities for the future. A study by Murphy and Feeney (2023) indicates that the impact of AI on future employment has led to the creation of professions requiring digital skills and data analysis mastery. For example, the legal and accounting professions are undergoing significant transformation due to AI and data analytics, signaling a shift toward knowledge-orientated activities (Mendoza-Chan & Pee, 2024). This development supports the prediction that jobs that rely solely on basic human skills will be disrupted in the next decade. According to Guitert et al. (2021) and Zhao et al. (2021a), the key components of DC are crucial for fostering continuous learning and enhancing employability. Digital competence is increasingly vital for career prospects and advancement. Juárez Arall and Marqués Molías (2019) note that the rapid development of ICT has led to progressive digitalization, reshaping the labor market and making digital competence essential for successful job searches and greater autonomy. Moreover, women's professional development requires digital proficiency to minimize digital disparities in the job market (Sánchez-Canut et al., 2023).

Unfortunately, as challenges to adopting advanced technology rise, the problem of digital gaps remains a significant issue in third world countries. Indonesia, with a vast digital community of more than 220 million individuals, faces numerous challenges and issues. The primary challenge for the government is to ensure equitable access to technology for all citizens (Prasetiyo et al., 2022). Two studies indicate persistent inequality in digital access between urban and rural communities (Gayatri et al., 2014; Puspitasari & Ishii, 2016). A survey conducted by the Association of Indonesian Internet Providers (APJII, 2018) reveals a striking digital divide between the West and East regions of Indonesia. Western regions such as Java, Sumatra, and Borneo dominate internet use with 83.6%, while the Eastern region accounts for only 16.4%.

In 2008, the government issued Law Number 11/2008 on Information and Electronic Transactions (UU ITE) to supervise online activities and combat cybercrime, such as hacking, malware, and fraudulent transactions. The Ministry of Communication and Informatics (MoCI) has established a digital literacy initiative called "Siberkreasi" or Indonesian National Digital Literacy Movement aimed at educating people to mitigate the spread of harmful content, including cyberbullying, fake news, hate speech, pornography, and digital piracy (Rudiantara, 2019). To support this program, MoCI distributed 21 digital literacy books to the public, covering topics such as cybersecurity, legal protections for internet users, appropriate online behavior, and digital skills like infographics, e-commerce, and internet governance.

Additionally, several countries have successfully integrated technology into educational settings to enhance students' digital competence. Luo et al. (2021) highlight that China, the United States and Australia have established national policies and curricula to guide the incorporation of technology in early childhood education. According to Kuka et al. (2022)., AI technologies, such as machine learning, data mining, and learning analytics, are gradually reshaping higher education by enhancing instructional practices, learning experiences, and educational decision-making. Integration of AI integration in education provides insights into automating administrative processes and tasks, as well as creating curriculum and educational materials (Vrcelj et al., 2023). Research indicates that factors such as providing adequate ICT infrastructure, offering training programmes for teachers and students, implementing clear policies, fostering collaboration among stakeholders, and promoting didactic ICT innovation projects are common strategies in countries like Spain, Norway, Ireland and others (Esteve□Mon et al., 2023; McGarr et al., 2021; Valverde-Berrocoso et al., 2021). The UK's Digital Capabilities Framework promotes six components to help students self-direct their learning for advancement (Biggins et al., 2017). According to Castaño Muñoz et al. (2023), most European educational systems view digital competence as a cross-cutting topic in the curriculum.

Various studies have tested digital competence among students. Jeong et al. (2024) found that student digital readiness significantly enhances academic performance. Patwardhan et al. (2023) note that higher digital competencies in students significantly impact learning outcomes. Additionally, Scholes et al. (2024) revealed that high socioeconomic levels, such as the occupation of parents and educational background, correlate with improved digital skills in students. However, studies to date do not provide complete knowledge about the digital competencies of students from developing countries compared to their counterparts in developed nations. Without additional references, it is challenging to make a balanced comparison regarding whether students from third

world countries have sufficient opportunities to face similar future challenges. While some studies have described the level of digital competence among students (Hidayat et al., 2025; Nguyen et al., 2024; Syahrin et al., 2023), few focus on demographic conditions and internet usage habits.

Therefore, new research directions are needed to capture these challenges and guide efforts to improve student digital competence. This study aims to fill gaps in the literature by assessing the digital competence of Indonesian students and the influential factors, such as parents' work and education backgrounds, as well as the frequency of daily internet usage. We hope that this study contributes to ongoing discussions about factors affecting student digital competence and introduces ideas for the development of student competence related to mastery and technology skills.

2. Literature Review

2.1 Student's Digital Competence

Digital technology is playing an increasingly important role in modern life, making digital competence essential. The Council of the European Union (2018) identified digital competence as one of the key competencies for lifelong learning, while Kjällander et al. (2021) highlighted its significance in education. Digital competence involves using digital tools and media effectively while practising good digital citizenship (Martzoukou et al., 2022). High digital competence allows students to grasp learning material more easily and excel in online education (Palomares-Ruiz et al., 2020). Conversely, students with low digital abilities face greater challenges, particularly in online learning environments (Kjällander et al., 2021).

The definition of digital competence has broadened to encompass a multidisciplinary approach, focusing on the skills necessary for citizens to be literate and engaged. (Ferrari, 2012) defines digital competence as the ability to comprehend media, effectively search for and analyze information, and communicate using various methods. It incorporates technical skills, critical thinking about digital technology, and an inclination to participate in digital culture (Ilomäki et al., 2016). The Digital Competence Framework for Citizens outlines digital competence in terms of information and data literacy, communication and collaboration, creation of digital content (including programming and intellectual property issues), safety (including digital well-being and cybersecurity), and problem solving with digital tools tools (Carretero et al., 2017; Vuorikari et al., 2016).

Students' digital competence is thus a multifaceted skill set requiring continuous attention and support from educational institutions to ensure that they are prepared for the digital age. A digitally competent student can effectively search for and evaluate information online, collaborate using digital tools like Google Docs or Slack, and create engaging digital content such as videos or blog posts. They are also aware of online safety measures, such as using strong passwords and being cautious about sharing personal information, and possess problem-solving skills to troubleshoot technical issues. It is crucial for educational institutions to identify specific areas where students need improvement and provide appropriate support and training to enhance their digital competence (Verdú-Pina et al., 2024).

2.2 Factors Affecting Digital Competence

Sociodemographic differences among individuals can significantly impact their digital competence. The digital gap, influenced by access and competence, is often correlated with gender (Grande-de-Prado et al., 2021; Rodríguez Muñoz & Ruiz-Domínguez, 2021). Previous studies indicate that men, who frequently use various websites, tend to have greater digital knowledge, leading to more frequent technology use compared to women (Grande-de-Prado et al., 2021). Flores-Lueg and Roig-Vila (2019) and Padilla-Carmona et al. (2016) generally found that women are less competent in digital mastery compared to men. However, Hatlevik et al. (2015) demonstrated that girls scored higher on digital competency tests than boys. Not all research identifies gender differences in digital competence; for example, Bejarano et al. (2021) found no significant differences between men and women in mastering digital competencies, with gender not being a significant predictor of digital competency levels.

Research has also examined the influence of socio-familial variables. Shala & Grajcevci (2018) found that parents' education levels did not significantly affect students' IT skills. Chea and Chea (2022) showed that parental education negatively impacts children's technology readiness, keeping the wealth effect constant. Conversely, Casillas-Martín et al. (2022) discovered that students' digital competency is closely related to their families' economic and cultural status and access to digital gadgets at home. Higher economic and cultural status and more devices at home enhance digital knowledge and communication and collaboration skills. Fernández-Mellizo and Manzano (2018) found a positive correlation between students' digital competence and their access to new technology outside school, partly attributable to families' financial status. Thus, students living in different environments develop different levels of digital competency.

3. Method

3.1 Instrumentation

This study employed a digital competence measurement instrument adapted from the framework developed by Tzafilkou et al. (2022), originally comprising 28 items measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Prior to the adaptation process, all items were translated into Indonesian. The translated version was subsequently reviewed by both a language expert and an educational technology specialist to ensure clarity, accuracy, and contextual appropriateness.

Based on the experts' evaluations, several adjustments were made to tailor the instrument to the context of Indonesian senior high school students. These adjustments included not only the removal of certain items but also the addition of new ones that better reflect the digital practices and realities of the target population. The response scale was also modified to a four-point Likert scale (ranging from 1 = Strongly Disagree to 4 = Strongly Agree) to eliminate the neutral midpoint and encourage more definitive responses.

In terms of content adjustments, the entire domain of "Develop, Apply, Modify" was excluded from the final instrument. This decision was made due to the nature of the items, which assess proficiency in statistical analysis software such as SPSS or R—tools that are typically not introduced at the high school level in Indonesia. Similarly, items within the "Communicate, Collaborate, Share" domain that referred to teaching through e-seminars or e-courses were also removed, as such activities are not part of the instructional experience of Indonesian high school students. To enhance the instrument's contextual relevance, four additional items were developed and incorporated to capture students' digital communication behaviors and interactions across various social media platforms.

Despite these modifications, the adapted instrument preserves the core structure of the original framework, encompassing key domains of digital competence including information search and access, content development and modification, communication and collaboration, data management, critical evaluation, and digital safety and protection. The complete version of the final instrument is provided in the Appendix.

To ensure the psychometric robustness of the instrument, item analysis and reliability testing were conducted. The corrected item-total correlations ranged from 0.57 to 0.78, indicating strong alignment of each item with the overall construct. Internal consistency was confirmed by a Cronbach's alpha of 0.966 and a standardized alpha of 0.967, both of which demonstrate excellent reliability. These results suggest that the instrument is both psychometrically sound and contextually appropriate for assessing digital competence among Indonesian high school students.

3.2 Respondents

The study sampled students from six Higher Secondary and Higher Teaching Schools in Surakarta, Central Java, Indonesia, using convenience sampling techniques. An online questionnaire, prioritizing confidentiality and informed consent, was administered to gather responses. Respondents consented to provide their biodata and responses, and the initial presentation of the study includes the identity of respondents. The researchers then distributed the questionnaire personally among the participants. A total of 251 participants provided their feedback on digital competence, with researchers ensuring accurate completion of the questionnaires.

3.3 Data Collection and Analysis

The collected data were entered into a Microsoft Excel file and analyzed using the Rasch Model via Winsteps software version 5.7.3.0. This phase involved instrument validation and reliability analysis, as well as simultaneous testing of person and item compatibility. Instrument validation was assessed based on the Outfit Mean Square (MNSQ) value (acceptable range: $0.5 < MNSQ < 1.5$), Outfit Z-Standard (ZSTD) value (acceptable range: $-2.0 < ZSTD < +2.0$) and Point Measure Correlation (Pt Mean Corr) (acceptable range: $0.4 < Pt\ Mean\ Corr < 0.85$) (Sumintono & Widhiarso, 2014). Consistent with Widhiarso and Sumintono (2016), items and persons that fit the model indicate no respondents deviated significantly from the response patterns of others. The analysis included all student responses, with no missing data. The demographic profile of the students is shown in Table 1.

Table 1 - Respondent's demographic profile.

Characteristics Demographic	*Students % (n = 251)*
Sex	
Male	44.2% (111)
Female	55.8% (140)
School	
SMA Batik 1 Surakarta	40.6% (102)
SMA Batik 2 Surakarta	18.3% (46)
SMK Batik 2 Surakarta	14.7% (37)
SMA Muhammadiyah 1 Surakarta	18.3% (46)
SMA Muhammadiyah PK Surakarta	8.0% (20)
SMA Batik 1 Surakarta	40.6% (102)
Class	
XII IPA (Natural Science Class)	52.6% (132)
XII IPS (Social Science Class)	30.7% (77)
XII MM (Multimedia)	2.0% (5)
XII OTKP (Office and Management)	7.2% (18)
XII TKKR (Beauty and Body Care)	7.6% (19)

Characteristics Demographic	*Students % (n = 251)*
Parent Educational Level	
Elementary School	5.2% (13)
Junior High School	9.2% (23)
Senior High School	53% (133)
Bachelor	25.5% (64)
Master	6% (15)
Doctorate	1.2% (3)
Parents' Occupation	
Teacher	6.8% (17)
Entrepreneur	33.9% (85)
Military/Policeman	2.8% (7)
Civil Servant	3.2% (8)
Fishery/Farmer	1.2% (3)
Labor	12.7% (32)
Other(s)	39.4% (99)
Length of Internet Usage in a Day (in Hours)	
1-3 (Low)	8% (20)
4-6 (Medium)	26,7% (67)
7-9 (Medium High)	28,3% (71)
> 9 (High)	37,1% (93)
Gadgets Used	
Smartphone	66,5% (167)
Tablet	0,4% (1)
Laptop	0,4% (1)
Desktop/PC	0,4% (1)
Smartphone, Tablet	2% (5)
Smartphone, Laptop	23,1% (58)
Smartphone, Dekstop/PC	1,6% (4)
Laptop, Dekstop/PC	0,4% (1)
Smartphone, Laptop, Dekstop	3,2% (8)
Smartphone, Tablet, Laptop	2% (5)
Internet Budged per Month	
IDR10.000-25.000	9,2% (23)
IDR26.000-50.000	25,1% (63)
IDR51.000-75.000	31,1% (78)
> IDR75.000	34,7% (87)

3.4 Validity and Reliability

In this study, validity and reliability were assessed using Rasch Model analysis via Winsteps software version 5.7.3.0. The Rasch model was selected due to its capability to calibrate the difficulty level of items and the abilities of respondents, as well as to identify matching items and measure respondents' knowledge creation levels. This model enables researchers to more accurately predict respondents' answers to items that conform to the measurement model, based on the person's ability and the item's difficulty level. These benefits are crucial in the application of the Rasch model (Bond & Fox, 2007a; Boone et al., 2014b; Engelhard, 2013; Linarce, 2012; Sumintono & Widhiarso, 2014a; Wirth et al., 2016). Furthermore, the Rasch model analysis produces more precise results, aiding in maintaining respondents' consistency with the questionnaire (person fit statistic). The measurements are derived using a logarithmic function, resulting in either an interval scale or a unit scale (logit), which allows for a calibration measurement model that establishes the relationship between item difficulty and respondent ability. Consequently, this study employed Wright maps to evaluate individuals and items, assessing the quality of the 30 items measuring students' digital proficiency and the responses of 251 participants. The measurement of items was centralized at zero, enabling students to "float" and calibrate their levels of digital competence. The internal quality of the instrument, including digital competence and psychometric properties, was determined by referencing the statistical fit score or reliability index in logit size, as shown in Table 2.

Table 2 - Summary Statistics of Person and Items.

Psychometric Properties	*Person*	*Item*
N	251	30
Outfit mean square	1.07	1.05
Mean	0.88	0.00
SD	1.40	0.53
Separation	3.55	5.26
Reliability	0.97	0.97
Alpha Cronbach	0.95	
Chi-square (χ^2)	14449.3303	
Raw Variance Explain by Measure $p < 0.0001$	44.7%	

According to Table 2, the person reliability index of 0.96 indicates that the consistency of student responses is classified as 'very good' (Sumintono & Widhiarso, 2014). Similarly, the item reliability index of 0.96 falls into the "exceptionally good" category (Sumintono & Widhiarso, 2014), demonstrating that both the items and responses exhibit 'very good' reliability. Additionally, the Alpha Cronbach coefficient of 0.97 (see Table 2) signifies a high level of interaction between the 251 students and the 30 items, categorizing the coefficient as 'very good'. Bond and Fox (2007) assert that a reliable instrument should have high psychometric internal consistency, reflecting "very good" reliability. Consequently, the Digital Competence (DigComp) tool is deemed reliable across various respondent groups. Furthermore, Fisher (2007) highlighted that instrument reliability can also be assessed through one-dimensional scores of raw variance explained by the Measure, which should exceed the 40% standard. The Raw Variation Explained by Measures score of 46.1% indicates that the Digital Competence (DigComp) instrument

effectively measures students' digital competence levels. Boone et al. (2014) and Engelhard (2013) noted that the effectiveness of an instrument can be evaluated by examining the outfit mean square values for both person scores and items, with values close to 1.0 being ideal. They also emphasized that a significant chi-square score, as a standard for evaluation, demonstrates that the data align well with the model.

The subsequent analysis involved evaluating the separation index to estimate the effectiveness and quality of the Digital Competence Instrument (DigComp). This phase aimed to differentiate between "personal abilities" and latent variables using the separation index score. A higher separation index indicates a greater ability to distinguish between respondents based on their correct responses, reflecting the range of item difficulty from accessible to complex. In addition to categorizing items, the spread analysis also determines the fit of items, where a broader item spread suggests better item matching. A separation score equal to or greater than three indicates a well-fitting model (Boone et al., 2014; Fisher, 2007). The separation index scores presented in Table 2 show that both the person separation index (4.93) and the item separation index (5.01) are reliable and effectively distributed across respondents and items, meeting the fit model criteria and accurately identifying students' levels of digital competence.

Given these findings, the Rasch measurement model was deemed appropriate for data analysis, as it effectively measures latent traits in assessing human perceptions and attitudes. Winsteps version 5.7.3.0 was utilized to evaluate students' digital competence levels based on demographic characteristics, including gender, class type, parental education level, and daily internet usage, using descriptive statistics (mean and standard deviation), item logit values, and person logit values. A positive logit value for a person indicates that the student's digital competence perception is higher than the average item difficulty. Thus, a higher logit score reflects a greater level of digital competence among students.

4. Results

4.1 Introduction Respondent demographics affect student digital competence

According to Table 3, the mean person measure (logit) is +0.88 with a standard deviation (SD) of +1.40. This indicates that, on average, students possess a strong knowledge and understanding of technology and the Internet, as the average logit measure of +0.88 (SD = +1.40) is above zero. The data reveal variations in the levels of digital competence among students, as illustrated in the subsequent display.

Figure 1 illustrates the variations in digital competence levels among students based on gender. The analysis revealed significant differences in digital competence across 24 of the 30 identified items, including S1, S2, S3, S4, S5, M1, M3, M4, M5, B3, B4, B5, Ev1, Ev2, Ev3, Ev4, Ev5, D1, D2, D5, P1, P2, P3, and P4. Specifically, items S5, Ev3, D2, M3, B3, P1, and P4 indicated that male students generally exhibited higher levels of digital competence compared to female students, particularly in aspects related to data protection. Conversely, female students demonstrated greater proficiency in managing, operating, and evaluating technology. For other items, such as B1, B2, and D3, there were no significant differences in digital competence between genders.

Table 3 - Results of Student's Digital Competence.

Descriptive Statistics	*Person*	*Item*
N	251	30
Measure		
Mean	0.88	0.00
SD	1.40	0.53
Standard Error	0.09	0.10

Furthermore, Figure 2 presents the distribution of person scores based on digital competence levels categorized into "strong," "moderate," and "weak" as visualized on the Wright map. The map shows that individuals, both female and male, are distributed across the categories, with those in the 'weak' category having logit scores < +0.88, and those in the 'strong' category having logit scores > +1.40. Both gender groups are evenly represented across the three clusters.

Overall, significant differences among student majors do not indicate a dominant pattern in digital competence. For instance, students majoring in Automation of Office Management (AOM) exhibit higher levels of digital competence in data protection, as evidenced by items P1, P3, P4, B2, and S2. Conversely, Social Science majors demonstrate superior proficiency in technology use and internet communication, particularly in evaluating websites, as indicated by items B3, D2, and Ev3. Students majoring in Natural Sciences show an advantage in searching for visible data, as reflected in items S4 and S5. Additionally, the Multi-Media (MM) major achieved the highest scores across items B1, B4, B5, B6, Ev1, Ev2, Ev4, Ev5, D3, D4, D5, S1, S3, M1, and M5, indicating they possess balanced capabilities across all dimensions. Figure 4 reveals that the distribution of students in Natural Science and Social Science majors spans across the strong, moderate, and weak clusters, with only a few students in the Skin and Hair Beautification major classified in the strong cluster. Notably, no students from the Multi-Media and Automation of Office Management majors fall into the

strong level category; these majors only reach the medium category.

Figure 5 presents that most items exhibit significant differences across educational levels, with twenty items showing notable variation. Specifically, significant differences were observed for items B1, B2, B5, B6, D1, D2, D3, D4, D5, Ev1, Ev3, Ev4, M3, M5, P1, P3, S2, S4, and S5. Among these, students whose parents have only completed elementary school demonstrate the highest levels of digital competence across sixteen items. In contrast, students whose parents hold doctoral degrees scored highest on eleven items. Students with parents who have completed master's, junior high school, bachelor's, and senior high school education followed in subsequent rankings.

The data also reveal that students with parents having primary or junior high school education tend to exhibit greater proficiency in personal data protection, as indicated by items P1, P2, P3, and P4. Conversely, students with parents holding advanced degrees, such as doctoral or master's, show a more balanced distribution of competence across various aspects. The results of the DIF analysis align with the distribution of student responses across items, as depicted in Figure 5. The Wright map further illustrates the levels of digital competence among students based on parental education, showing that students with parents who have only completed high school or bachelor's degrees are in the most vulnerable category of digital competence (see Figure 6).

Figure 7 shows variations in digital competence levels based on students' daily Internet usage. Students with low Internet usage (1-3 hours per day) primarily engage in online tasks and hobbies, as indicated by items D1, D2, M1, M4, B3, B6, and S3. Those in the Medium category (4-6 hours per day) use the Internet mainly for simple productivity activities, such as searching for information and using office applications. Students in the Medium-High category (7-9 hours per day) exhibit significant self-protection behaviors, as demonstrated by differences in items P2, P3, P4, and Ev3. The digital competence of students in the High category (more than 9 hours per day) is evenly distributed across various aspects, with this group showing proficiency in most activities across all subcategories of digital competence, including items B1, Ev2, Ev4, M2, M5, S5, and D3, D4. This suggests that extensive Internet use in this group is associated with communication, productivity, copyright management, and personal data management.

Furthermore, the distribution of digital competence levels among students, based on Internet usage frequency, is depicted in the Wright map (Figure 8). This map categorizes students into "strong", "moderate", and "weak" groups based on their logit scores. The "weak" category is represented at the bottom right of the map with logit scores < +0.88, while the "strong" category is shown at the top right with logit scores > +1.40.

4. Discussion

In our research, we discovered notable differences in digital competence between male and female students. Specifically, male students rated themselves higher in areas like data protection, aligning with findings by Grande-de-Prado et al. (2020) that men often perceive themselves as more competent with ICTs. On the other hand, female students excelled in management, operational, and evaluation aspects of technology use. This observation is consistent with Huatay et al. (2023), who found that females in Peru had higher competence in online safety and technical problem-solving. The ICILS study (Gebhardt et al., 2019) also supports our findings, revealing that female students performed better in tasks related to communication, design, and creativity, whereas male students excelled in technical and security-related tasks. Cabezas González and Casillas Martín (2018) further reinforces this pattern, noting that male students scored higher in ICT familiarity, while females assessed themselves more positively in their attitudes towards ICT. These consistent results across various studies highlight the complex nature of gender differences in digital competence (Bachmann & Hertweck, 2023; Khoo et al., 2023; Zhao et al., 2021).

Parents play a crucial role in shaping their children's digital competence, serving as significant learning agents alongside family and friends (Antolín et al., 2018; Martínez-Piñeiro et al., 2018). They influence how children use and access technologies within the home, mediating their learning and development of digital skills (Antolín et al., 2018). The educational background and perceptions of parents determine the technologies available to their children, impacting how they guide them in using digital tools (Dias et al., 2016). Additionally, family economics and cultural backgrounds influence the level of digital knowledge and skills students possess Casillas-Martín et al. (2022). Our research found that students with parents who have primary or junior high school education levels tend to have a stronger awareness of personal data protection. On the other hand, students whose parents hold advanced degrees, such as doctorates and masters, display a more balanced and significant digital competence across various areas. This aligns with Pons-Salvador et al. (2022), who noted that more educated parents often have better digital skills, which positively influences their children's internet use.

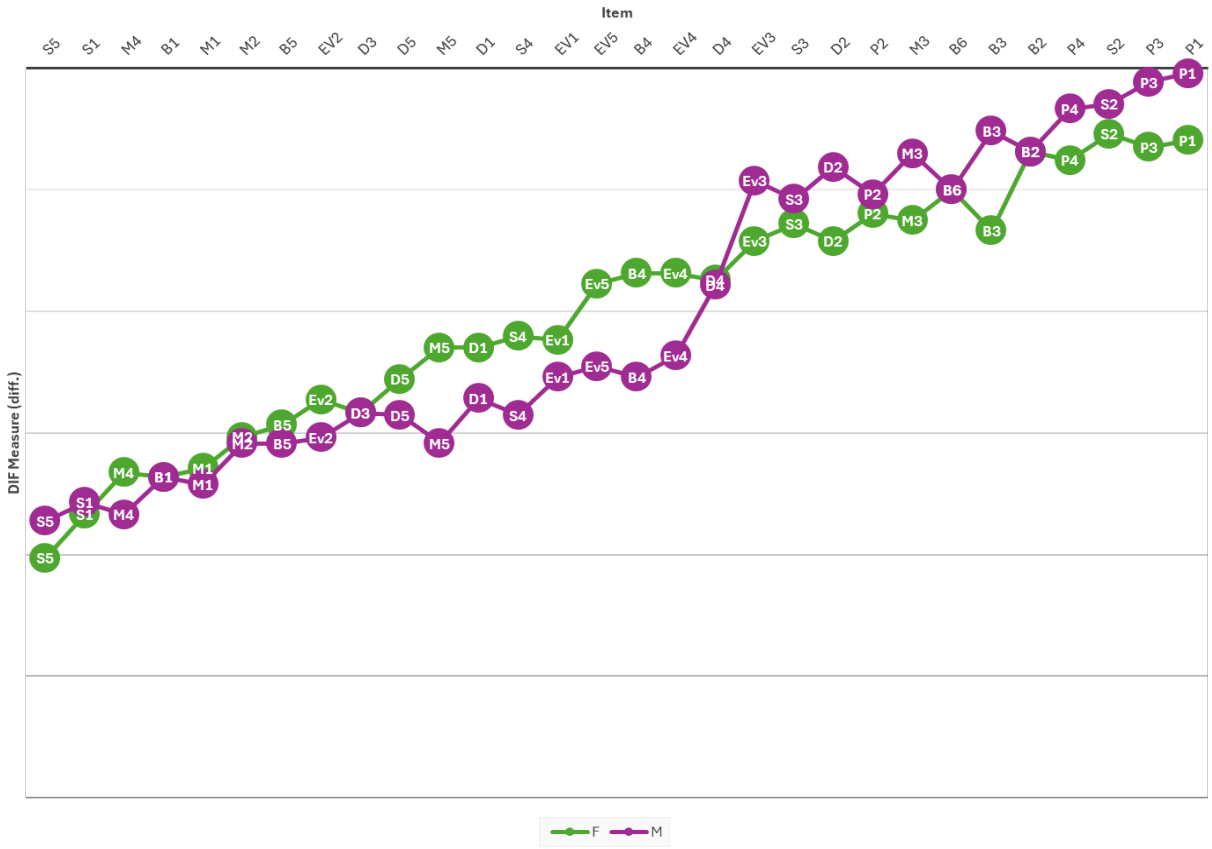

Figure 1 - Person DIF plot based on Gender. Noted: M: Male; F: Female.

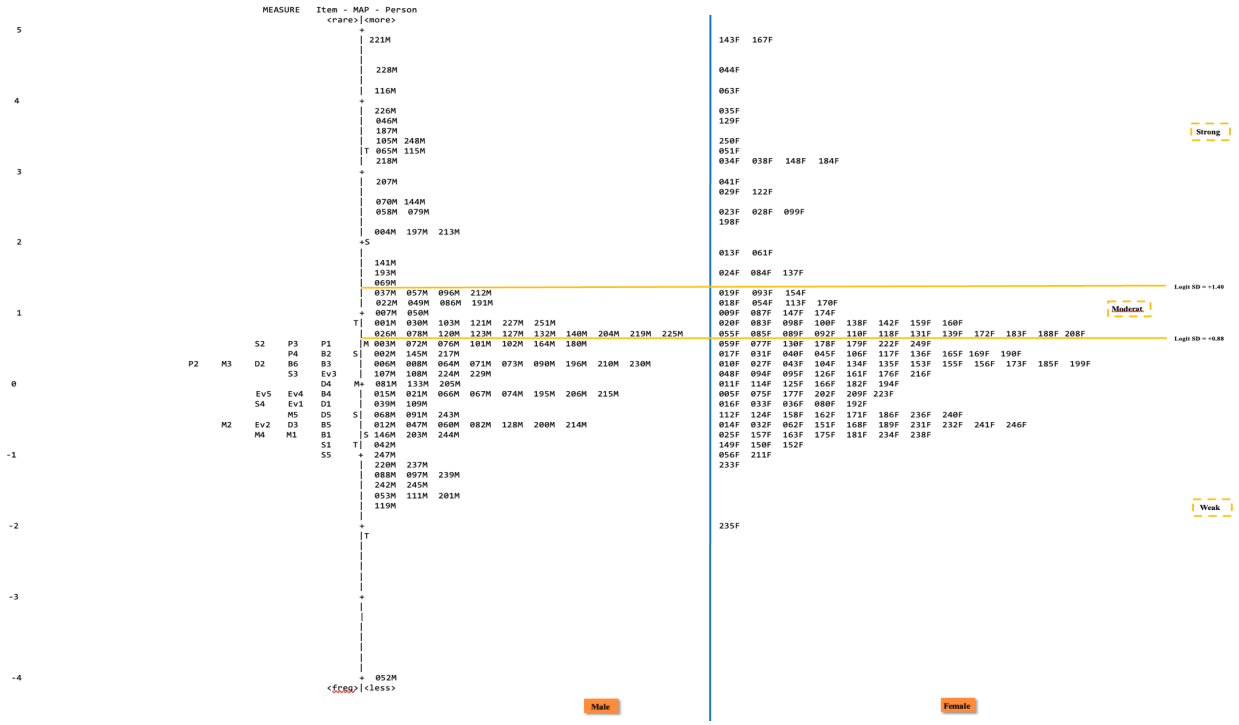

Figure 2 - Rasch Wright Person Logit Map of Digital Competence based on Gender.

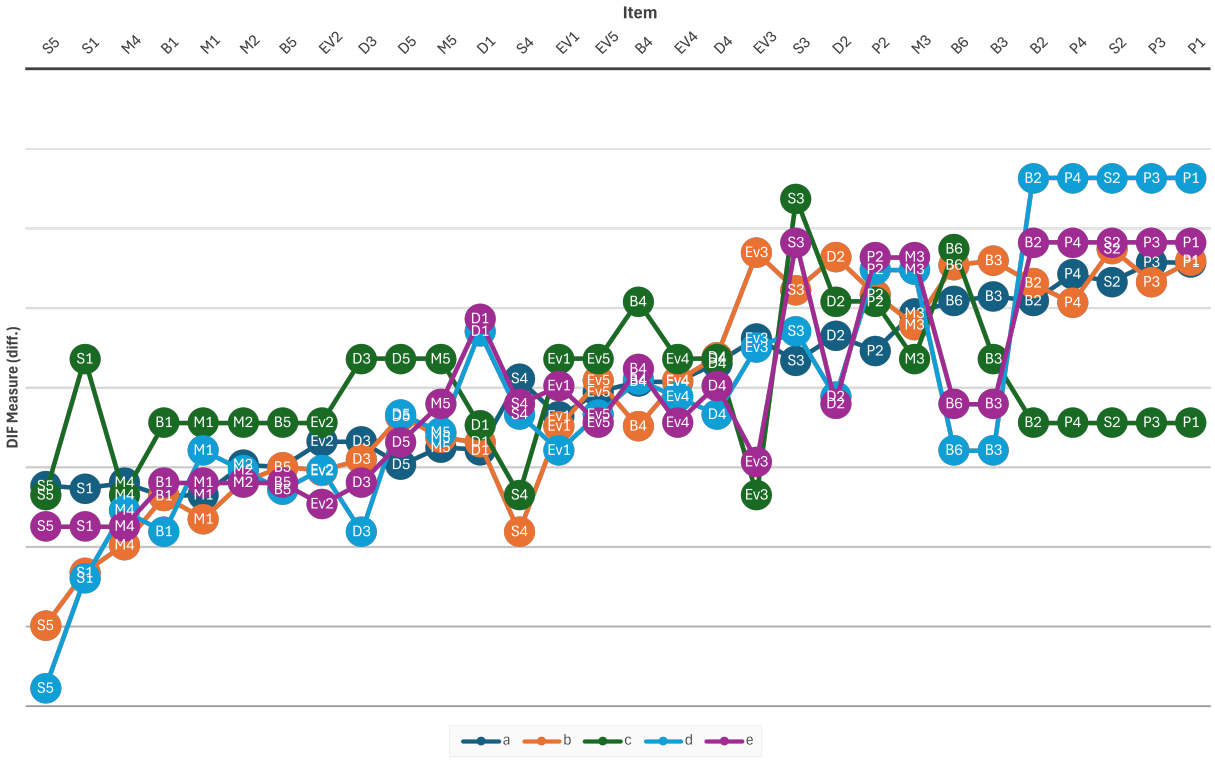

Figure 3 - Person DIF based on Class/Students Major. Noted: a: XII Natural Science (NS), b: XII Social Science (SS), c: XII Multi-Media (MM), d: XII Automation of Office Management (AOM).

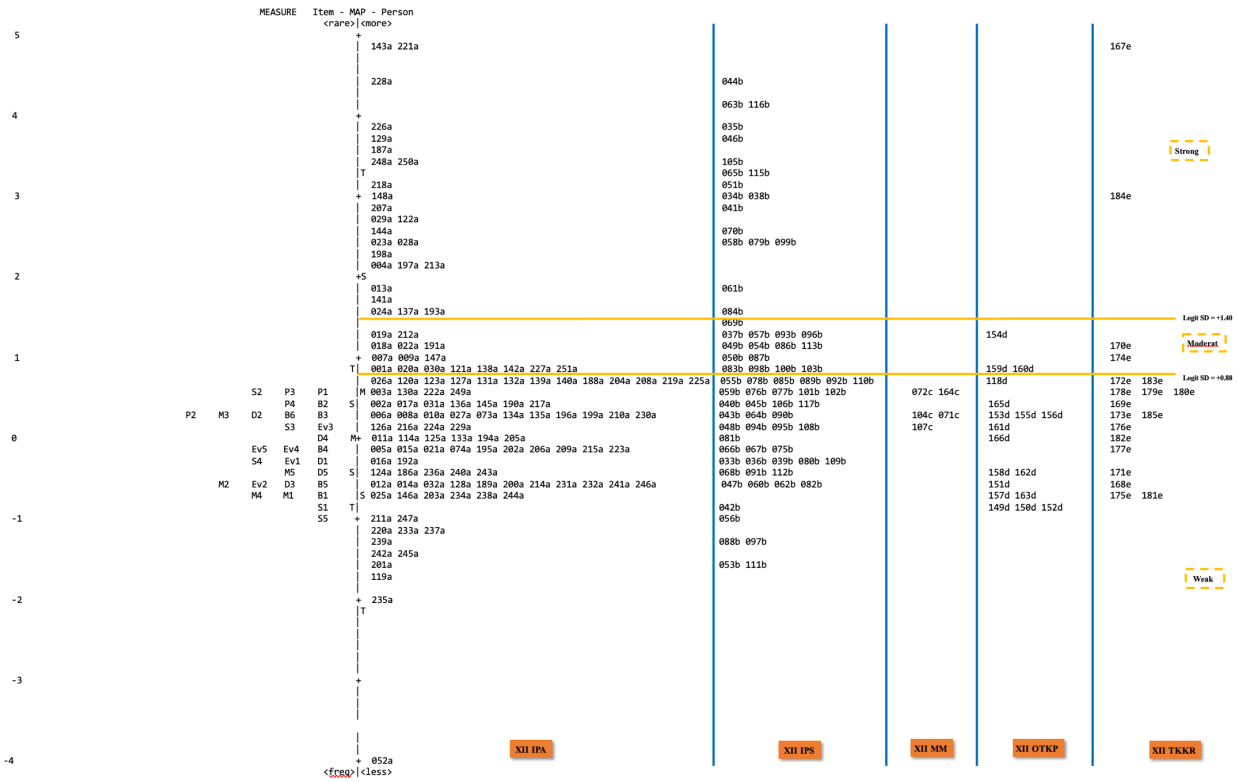

Figure 4 - Rasch Wright Person Logit Map of Digital Competence based on Class/Students Major.

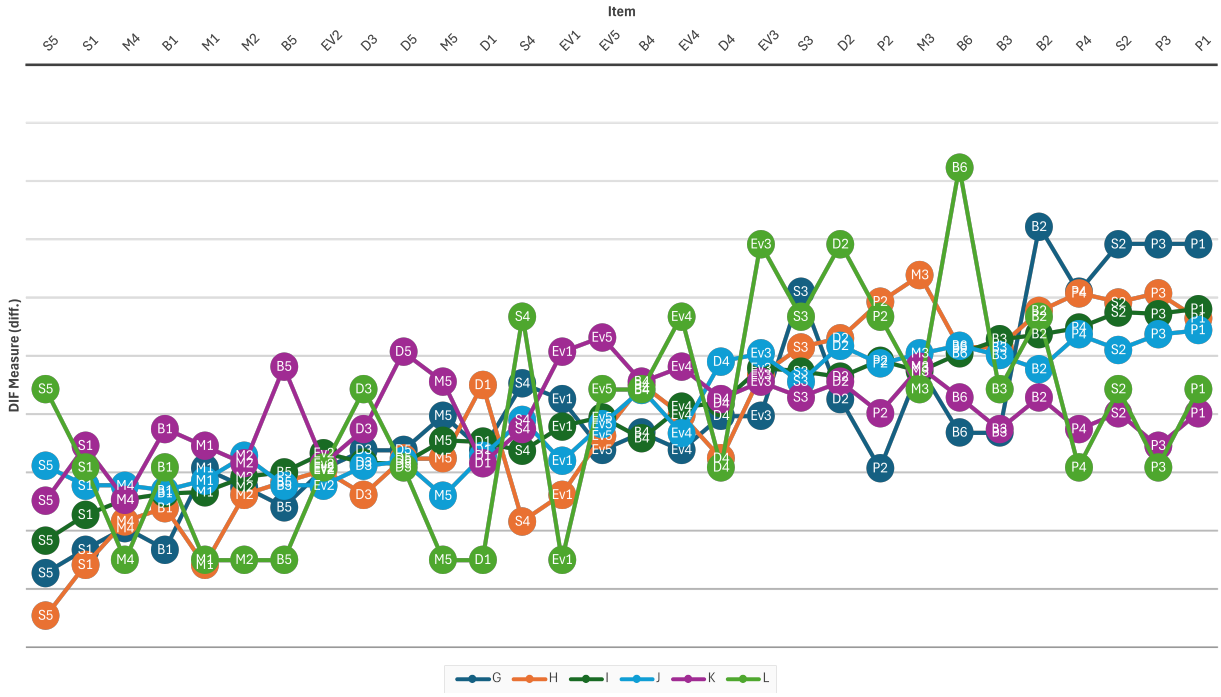

Figure 5 - Person DIF based on Parents Education Level. Noted: G: Elementary School, H: Junior High School, I: Senior High School, J: Bachelor, K: Master, L: Doctorate.

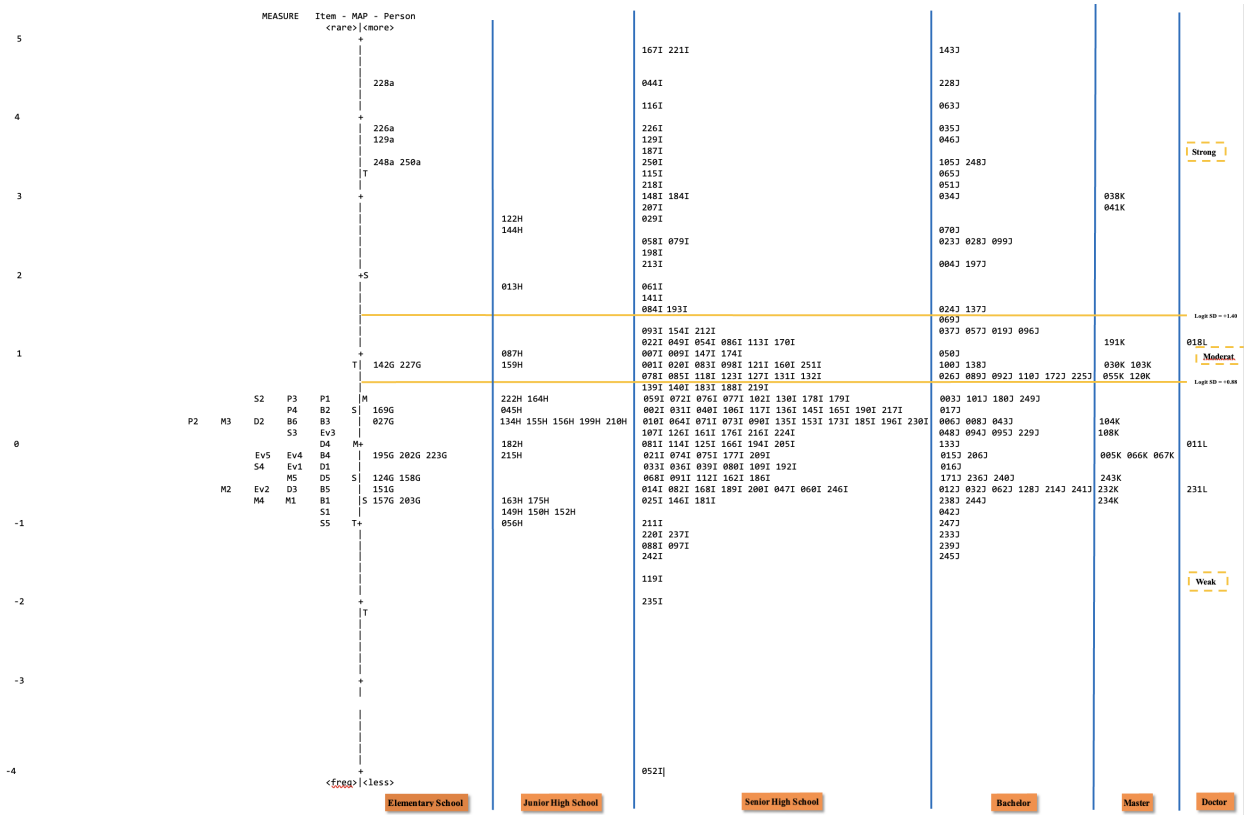

Figure 6 - Rasch Wright Person Logit Map of Digital Competence based on Parents Education Level.

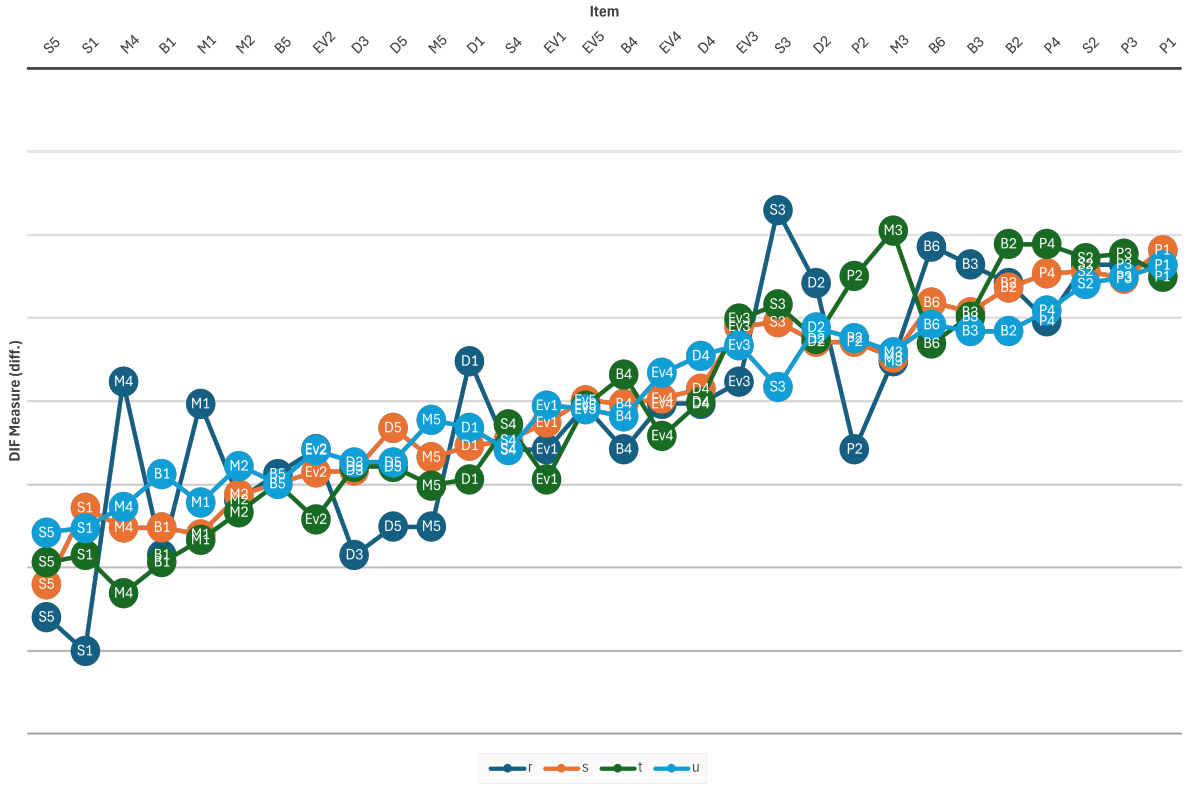

Figure 7 - Person DIF based on Frequency Using Internet. Noted: r: Low, s: Medium, T: Medium High, u: High.

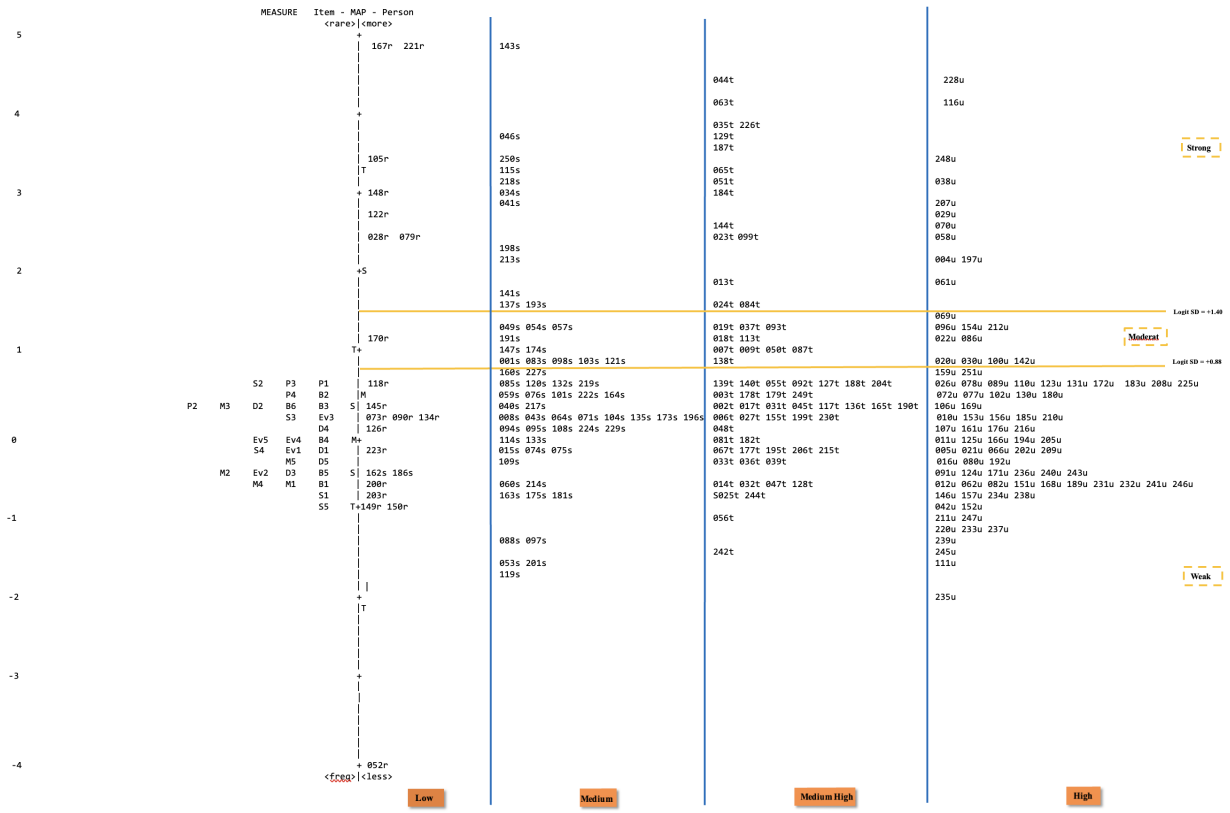

Figure 8 - Rasch Wright Person Logit Map of Digital Competence based on Frekuensi Using Internet.

Similarly, Guillén-Gámez et al. (2024) found that parents with higher academic backgrounds enhance their children's digital skills and self-confidence, mirroring our findings of a more evenly distributed digital competence among these students.

Our research reveals that students with low internet usage tend to limit their online activities to assignments and hobbies. In contrast, those in the medium category use the internet for simple productivity tasks like googling and office applications. When looking at students who use the internet for 7-9 hours a day (Medium High category), there is a noticeable trend towards taking steps to protect personal data. Furthermore, students with very high internet usage (more than 9 hours per day) show a balanced distribution of digital competence across various activities, including communication, productivity, copyright management, and personal data protection. These findings align with Sutormina (2024)'s research, which found that increased internet use is linked to better digital competence, especially when the internet is used for educational purposes like modeling experiments and participating in online competitions. Additionally, Perifanou et al. (2021)'s study supports our findings by demonstrating a strong positive association between frequent YouTube use and improved digital skills, particularly in content evaluation and data protection.

However, it's important to consider the potential downsides of high internet usage. Müller and Scherer (2022) found that excessive internet use is associated with higher rates of internalizing symptoms, cognitive distortions, and internet use disorders among adolescents. This suggests that while high internet usage can enhance digital competence, it also poses risks to mental health. Our findings highlight the need for a balanced approach to internet use. Educational programs should aim to maximize the benefits of internet use for developing digital competence while also teaching students about the potential risks and promoting healthy online habits. By doing so, we can help students develop comprehensive digital skills and protect their well-being.

5. Conclusion

Our research provides valuable insights into the nuanced nature of digital competence among students, particularly in relation to gender differences, parental education, and internet usage. We found that male and female students exhibit different strengths in digital skills, suggesting that educational strategies should be tailored to address these disparities. Specifically, enhancing technical training in data protection for female students and improving management and evaluation skills for male students could help bridge the competency gap. Additionally, the educational background of parents contributes to differences in digital competence preferences. Students with parents who have lower educational levels tend to focus more on personal data protection, while those with highly educated parents demonstrate broader digital skills. This emphasizes the need for educational programs to consider these dynamics and provide tailored support to ensure all students develop strong digital skills, regardless of their family background. Moreover, while high internet usage is associated with enhanced digital competence, our findings also indicate potential risks to mental health, such as increased internalizing symptoms and cognitive distortions. Therefore, a balanced approach to internet use is essential. Educational programs should not only promote the benefits of internet use for developing digital skills but also address the potential mental health risks by teaching healthy online habits. By doing so, educators can help students harness the advantages of digital technologies while safeguarding their well-being, ensuring they are well-prepared to navigate the technological demands of the modern world.

6. Limitations

The limited number of samples in categories presents challenges in fully understanding the diverse preferences and competencies in internet use and digital tools. This limitation restricts our ability to generalize findings and appreciate the broader spectrum of digital skills. Future research should aim to include larger sample sizes to ensure that the data collected is more varied and representative of the wider student population. Additionally, employing a combination of methodologies—such as experiments, interviews, observations, and comprehension assessments—would provide a richer, more nuanced understanding of the factors influencing digital competence. This multi-faceted approach will not only yield more reliable insights but also enable the development of targeted interventions to enhance digital literacy. By addressing these gaps, future studies can contribute significantly to creating a digitally inclusive educational environment where every student is equipped with the necessary skills to thrive in an increasingly digital world.

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Appendix: Items

Component	Acronym	Items
Search, Find, Access	S1	I can search and find specific or similar things using various search engines (e.g., Google, Yahoo, Bing)
	S2	I can search and find specific people in various digital media using various techniques and filters (e.g., various formats of names, photos, email addresses, schools, companies, etc.)
	S3	I can search and find groups on specific topics (e.g., hobbies, professions, artists, science, historical events, travel destinations) in various social media
	S4	I can navigate in the real-world using navigator features (e.g., Google Maps)
	S5	I can read, listen, and view content in various digital media
Develop, Apply, Modify	D1	I can set event notifications on a specific day using a digital calendar (e.g., Google Calendar, Apple Calendar, Microsoft Outlook Calendar, etc.)
	D2	I can design creatively using various digital media (e.g., Canva, PowerPoint, etc.)
	D3	I can create documents with text, diagrams, tables, and reports using various digital media (e.g., Microsoft Word, Microsoft Excel, etc.)
	D4	I can apply copyright to content or software that I create (e.g., naming a self-made image design)
	D5	I can convert content from one format to another format
Communicate, Collaborate, Share	B1	I can communicate using different digital media
	B2	I can edit documents with each other (collaboratively) using digital media
	B3	I can actively participate in society using digital media
	B4	I can upload and share my applications
	B5	I can collaborate with people using various digital media
	B6	I can share my experiences in digital media in interactions with others (e.g., social media, YouTube, etc.)
Store, Manage, Delete	M1	I can take photos or videos and save them in various formats (mp4, gif, jpg, etc.)
	M2	I can download content and save it directly to the appropriate folder
	M3	I can copy and save screenshots from my phone or laptop
	M4	I can delete some of my connections/friends on various social media
	M5	I can organize files on my computer into an organized folder structure
Evaluate	Ev1	I can evaluate an object and/or smart device using appropriate quality criteria (e.g., authenticity, usefulness, ease of use, appearance, functionality, enjoyment)
	Ev2	I can evaluate whether some information is a hoax, fake, fraudulent, or a scam
	Ev3	I can evaluate whether a website is safe and trustworthy
	Ev4	I can identify copyright and intellectual property rights (IPR) from content I find on the Internet
	Ev5	I can evaluate whether an email is spam, adware, phishing, or a scam
Protect	PR1	I can regularly change my passwords and settings for my social media and Internet accounts
	PR2	I can protect my various Internet accounts with different passwords and change them frequently
	PR3	I can protect my personal data from identity theft, harassment, bullying, or defamation
	PR4	I can use digital technology in a healthy and responsible way