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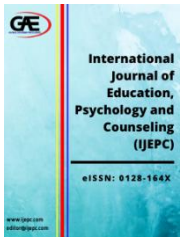


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# MEASURING THE UNMEASURABLE: A CRITICAL REVIEW OF ENVIRONMENTAL FACTORS IN THE CFAM-PS WITHIN A BIOPSYCHOSOCIAL FRAMEWORK

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**Abstract:**

Environmental factors are crucial to understanding how biopsychosocial models explain functioning. However, defining and measuring these factors within school-based assessments remains challenging. This article critically reviews the Environmental Factors section of the Child Functional Abilities Measure for Primary Schools (CFAM-PS). CFAM-PS is a locally developed instrument used to assess the functional abilities of primary school pupils with special educational needs in Malaysia. The review highlights the conceptual, methodological, and psychometric issues involved in translating environmental influences in the school environment into measurable assessment constructs. The review draws on data from a larger validation study of the CFAM-PS, involving 85 special education teachers and 167 pupils with special educational needs from seven public primary schools in Malaysia. The Environmental Factors section consisted of 26 items, which covered school and home contexts, and was analysed using the Rasch Measurement Model. The findings indicate that the section was able to capture a range of contextual issues that may influence pupils' functioning. These included relationships, attitudes, physical surroundings, access to resources and services, and conditions within the home and school environments. However, the Rasch results also raised several measurement concerns. In particular, the section showed weak evidence of unidimensionality, lower person reliability and separation, ceiling effects, rating scale disorder, and several misfitting items. Taken together, these findings suggest that environmental factors in the CFAM-PS may not function as a single

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construct. Rather, they appear to represent a set of related but distinct contextual influences that vary according to the pupil, setting, and type of support or barrier involved. While the Environmental Factors section of the CFAM-PS remains useful for identifying supports and barriers in pupils' daily functioning, its total score should be interpreted carefully. Future refinement should include clearer item definitions, improved rating categories, possible subdomain groupings, and further validation across diverse educational settings.

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**Keyword:**

Assessment, Biopsychosocial Framework, Environmental Factors, ICF-CY, Instrument, Pupils with Special Educational Needs, Rasch Analysis



## Introduction

In contemporary research on disability and education, environmental factors have become increasingly important for understanding pupils' functioning and participation. Within the biopsychosocial framework, disability is conceptualized as an outcome of dynamic interactions between individuals and their contextual environments (World Health Organization, 2001). This framework is elaborated in the International Classification of Functioning, Disability and Health (ICF) and, subsequently, in its Children and Youth version (ICF-CY). The framework describes environmental factors as a broad spectrum of external influences, ranging from physical settings and social relationships to institutional structures and societal attitudes (World Health Organization, 2001, 2007). These environmental factors can either facilitate or constrain participation.

Assessment practices have gradually moved away from viewing disability mainly in terms of pupils' impairments and limitations. Instead, more emphasis is currently being placed on how learners perform in their everyday environments (Klein & De Camargo, 2018; Cappa et al., 2021). In inclusive education, the school environment can either support or limit pupils' participation and learning. This may include the way the classroom is arranged, how teaching is carried out, the quality of interaction with teachers and peers, attitudes towards inclusion, and the availability of support facilities (World Health Organization, 2001; Kang et al., 2025). Although these factors are clearly important in the ICF framework, turning them into clear and measurable assessment constructs remains a challenge (Cappa et al., 2021).

Current assessment models show inconsistencies in the way environmental contexts are defined, measured, and assessed within educational settings (Cappa et al., 2021; Kang et al., 2025). Compared with the domains of body functions and activity and participation, which are more easily observed, environmental factors are highly context-dependent, relational, and often

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influenced by subjective interpretation. Therefore, environmental factors are often difficult to standardize, which can compromise the clarity, precision, and reliability of measurement. These challenges become particularly evident in school-based assessments, as the nature of environmental factors within those settings are more complex and dynamic (Schwab et al., 2022).

With the introduction of the Zero Reject Policy in Malaysia in 2019, the need to understand environmental influences on pupils' functioning has become increasingly important, particularly due to the greater diversity and complexity of students in mainstream schools (Othman & Mohd Matore, 2020; Musa et al., 2021). Even though efforts geared towards enhancing inclusion have resulted in better access to inclusive education for children with special educational needs, issues remain, such as teacher readiness, adjustment of teaching strategies, and the application of assessment data in teaching diverse students (Abu Bakar & Nordin, 2024). Current assessment methods may not fully consider the complexity of inclusive classroom and home environments because they are mainly concerned with assessing pupils' individual performance. Therefore, there is a need for new assessments that address how the environment influences pupils' performance.

Several international tools have attempted to include environmental influences in the assessment of children's participation. For instance, the Participation and Environment Measure for Children and Youth (PEM-CY) and the Young Children's Participation and Environment Measure (YC-PEM) consider environmental supports and barriers within the contexts where children participate (Coster et al., 2011; Khetani et al., 2014). In contrast, the Craig Hospital Inventory of Environmental Factors (CHIEF) gives more attention to the barriers that individuals perceive in their surrounding environment (Whiteneck et al., 2004). However, reviews have shown that existing instruments vary considerably in their conceptualization and measurement approaches, and no standardized, internationally comparable tool has been established for assessing environmental influences on school participation (Cappa et al., 2021).

Although existing instruments provide useful models for assessing environmental influences, most were developed in contexts outside Malaysia, particularly in Western contexts. These instruments may not fully reflect the realities of Malaysian inclusive classrooms, teacher practices, family involvement, and school support systems (Mohd Nazli et al., 2026). This creates a need for a locally relevant assessment approach that can capture environmental influences in ways that are meaningful for teachers and applicable within Malaysian schools.
As part of ongoing efforts to develop assessment tools that address context-related aspects of functioning among children with special educational needs, the Child Functional Abilities Measure for Primary Schools (CFAM-PS) contains an Environmental Factors section that is intended to assess key contextual factors influencing functioning in specific environments (Mohd Nazli et al., 2026). Unlike assessment that focuses mainly on pupils' individual abilities, the CFAM-PS attempts to include both personal functioning and contextual influences. Although including the Environmental Factors section is consistent with the ICF-CY framework, the early findings show that assessing this construct is not straightforward.

The initial findings from the CFAM-PS validation study suggest that this part of the measure may be more open to different interpretations, as environmental factors often depend on the pupil's unique setting, the support available, and how teachers or parents understand the

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situation (Mohd Nazli et al., 2026). This makes the environmental aspects more difficult to define and quantify consistently.

This article presents a detailed review of the Environmental Factors section of the CFAM-PS, with a focus on the conceptual, methodological, and psychometric challenges that arise when measuring environmental influences. Guided by a biopsychosocial perspective and supported by relevant literature, the discussion explains why environmental factors are particularly difficult to measure. It also highlights key considerations for improving how these factors are represented in school-based assessments. This review forms part of a broader study on instrument development, content validation, and psychometric testing using the Rasch analysis approach.

## Literature Review

### *Biopsychosocial Model of Functioning*

The International Classification of Functioning, Disability and Health (ICF) use a biopsychosocial model to explain functioning. In this model, functioning is not viewed only in relation to a person's health condition, but also through the continuous interaction between body functions and structures, activities, participation, and environmental factors (World Health Organization, 2001). These components do not operate independently and are closely linked. A change in one area, such as body function or environmental support, may affect how a person performs activities or participates in daily life. Figure 1 shows how these components relate to one another. This way of understanding functioning has influenced how assessment is approached in education, particularly when pupils' needs are considered beyond diagnosis alone.

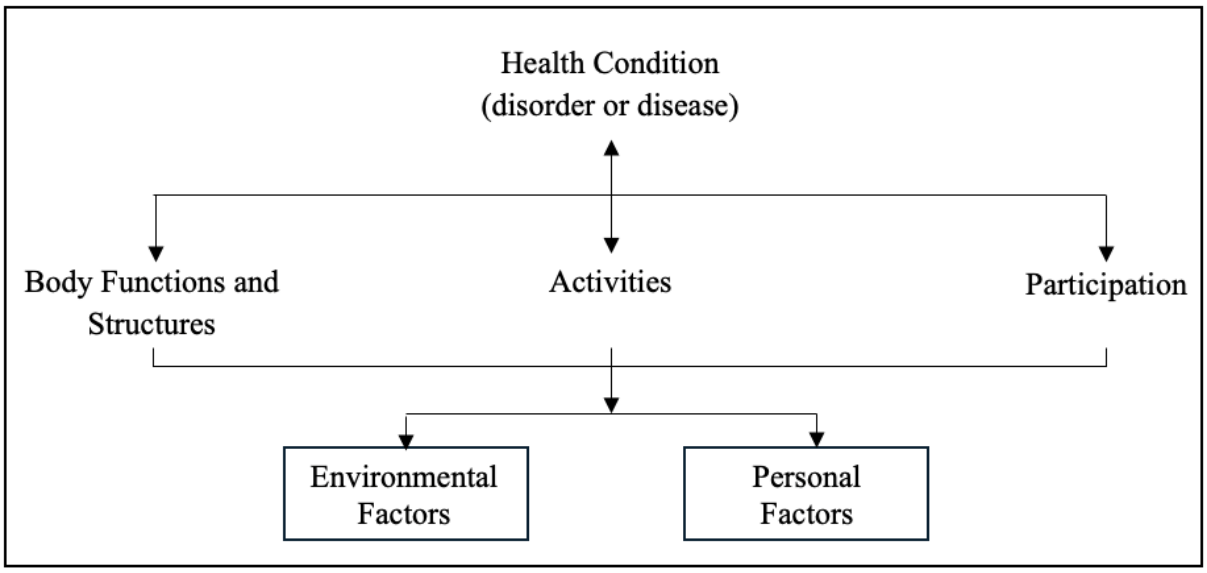


**Figure 1: The Biopsychosocial Model**

Source: International Classification of Functioning, Disability, and Health: ICF by the World Health Organization (WHO), 2001, World Health Organization.

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Within the ICF framework, *body functions* refer to the physiological and psychological functions of the body, while *body structures* refer to anatomical parts such as organs, limbs and their related components (World Health Organization, 2001). Difficulties or deficits in body functions or structures will be termed as *impairment.* However, disabilities cannot be considered in terms of impairment alone, rather it should be considered as part of a broader view of functioning.

Beyond individual functioning, the ICF distinguishes between activity and participation as key components of human functioning. *Activity* refers to the execution of specific tasks, while *participation* relates to involvement in everyday life situations (World Health Organization, 2001). In educational settings, this distinction highlights the difference between what pupils can perform under structured or controlled situations and how they actually engage within authentic classroom and social environments (McQuaid et al., 2021). Participation can be described and measured either objectively (e.g. frequency or situation counts) or subjectively (e.g. importance or satisfaction levels) (World Health Organization & UNICEF, 2023).

In practice, measuring participation is not always straightforward. Participation and functioning cannot be fully explained without considering the contextual conditions in which they occur (World Health Organization & UNICEF, 2023). Contextual conditions include environmental factors, such as physical surroundings, social relationships, and attitudinal and institutional conditions that influence an individual's experiences (World Health Organization, 2001). These factors may act as either supports or barriers, depending on the individual and the situation and they are often complex to measure.

Other than environmental factors, personal factors are also part of contextual conditions. Although not formally coded within the ICF due their complexity, their contribution to functioning cannot be neglected. Characteristics such as age, gender, temperament, motivation, and personal interests may influence how a pupil responds to daily routines, academic expectations, support, and environmental demands (World Health Organization, 2001). This is particularly relevant in school-based assessment, as two pupils with the same diagnosis may function differently due to these personal factors. Assessment should therefore move beyond impairment alone and consider how the pupil functions within real educational and home contexts.

Despite the strong emphasis on contextual factors within the ICF, many assessment practices still do not capture these factors adequately (Silveira-Maia et al., 2019). This can be seen by examining available assessment tools that still continue to focus mainly on individual characteristics, such as cognitive ability, behavioural functioning, adaptive skills, or academic performance. Environmental influences are often treated as background information rather than examined as conditions that may support or limit participation (World Health Organization & UNICEF, 2023; Kang et al., 2025). Assessing environmental factors is especially important in inclusive education, where pupils' participation may be influenced by classroom organisation, teacher support, peer interaction, accessibility of learning spaces, availability of support services, and active family involvement. Unfortunately, they are rarely measured in public health and disabilities monitoring (World Health Organization & UNICEF, 2023).

ICF-based approaches have been used in several educational contexts, including Portugal, Italy, and Switzerland, where the framework has informed assessment and curriculum planning (Hollenweger, 2011; Moretti et al., 2012; Sanches-Fereira et al., 2013). Recent studies have

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also explored the use of ICF principles in non-Western education systems, with attention to local cultural and institutional conditions (Kang et al., 2025). These studies suggest that the ICF provides a useful structure for understanding functioning. However, when it is applied in education, it needs to be adapted carefully so that it remains relevant to teachers, families, and the pupils being assessed.

***Conceptual and Measurement Challenges in Defining Environmental Factors***

Despite the significant role of environmental factors within the biopsychosocial framework, defining and measuring these constructs remains conceptually and methodologically complex. One of the primary challenges is their multidimensional nature, as they span physical, social, and policy-related dimensions. Environmental factors are conceptualised within the ICF as part of a broader system of interacting domains, rather than as discrete independent constructs. This interdependence makes it difficult to clearly differentiate environmental influences from other components of functioning, particularly activities and participation (Alehagen et al., 2025).

Another challenge that we faced is the fact that environmental factors are not static and vary considerably across settings, time, and personal experiences. This is due to their context-dependent and relational nature. The concept of *affordances* was introduced by Schwab et al. (2022), which explains the possibilities for action that arise from the interaction between an individual and their environment. These are not fixed environmental properties; rather, they are shaped by an individual's abilities and the specific situation they are in. This inherent variability in both environmental and personal factors make standardising environmental constructs quite difficult. Their meaning and impact cannot simply be assumed to be consistent from one person or context to another (Schwab et al., 2022).

These conceptual issues also lead to methodological and psychometric challenges. One difficulty is that such variability is not easy to measure. Many assessment approaches depend on reports from individuals or from proxies such as caregivers and teachers. Although these reports are useful, they may also be shaped by the respondents' own perceptions, expectations, and experiences, which can affect the consistency of the assessment findings (Cappa et al., 2021).

The subjective nature of the input raises concerns about the reliability and consistency of interpretation. As explained earlier, environmental constructs are often difficult to conceptualise; hence, they are usually broadly defined and lack clear operational indicators (Whiteneck et al., 2004; Alehagen et al., 2025). The fluid nature of environmental factors can further complicate efforts to achieve standardised measurement, as standardised models usually apply an assumption of a certain level of construct stability across different respondents and settings.

These tensions become particularly relevant within psychometric frameworks such as Rasch measurement, which rely on assumptions of unidimensionality and stable latent trait representation (Abu Kassim, 2024). Environmental factors, however, may not function as stable traits in the same manner as observable functional behaviours due to responses reflective of contextual interpretation. Environmental factors may also be more prone to local dependency, inconsistent item functioning, and contextual variability across respondents and settings.

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Taken together, these conceptual and measurement challenges highlight the difficulty of translating environmental factors from theoretical constructs into reliable and meaningful assessment variables. Although the ICF framework provides a strong basis for understanding how environmental factors influence functioning, applying this framework in educational assessment is still challenging. From conceptualising and defining environmental factors to standardising and measuring these factors as constructs, creating a reliable school-based instrument is a highly challenging task (Kang et al., 2025; Whiteneck et al., 2004). These limitations point to the need for assessment approaches that are more clearly defined and sensitive to context, especially in inclusive education settings.

### *Child Functional Abilities Measure for Primary School (CFAM-PS)*

The Child Functional Abilities Measure for Primary School (CFAM-PS) was developed as a school-based assessment instrument designed to evaluate the functional abilities of pupils with special educational needs in Malaysian primary school. The instrument is grounded in the ICF-CY framework, with domains structured to reflect key areas of functioning, including body functions, activities and participation, and environmental factors. A key feature of the CFAM-PS is its emphasis on functional performance in real-life educational settings (Mohd Nazli et al., 2026). This aligns with contemporary perspectives that views functioning as context-dependent and influenced by interactions between the individual and their environment (Klein and de Camargo, 2018).

The CFAM-PS adopts a multi-informant approach, allowing both teachers and parents to provide input on pupils' functioning across school and home environment. This design enhances ecological validity by capturing behaviour across different contexts and routines (Mohd Nazli et al., 2026). Importantly, the CFAM-PS incorporates a dedicated environmental factors component, reflecting the increasing recognition of contextual influences on pupils' participation and learning (Kang et al., 2025; Damyanov, 2024). Despite its strong psychometric properties in the body functions and activities and participation domains, its environmental factors section warrants further critical examination, particularly in relation to conceptual definition, measurement precision, and psychometric robustness.

## Methodology

### *Participants*

This study utilised data obtained during the broader validation process of the Child Functional Abilities Measure for Primary School (CFAM-PS). However, the present article specifically focuses on the Environmental Factors domain of the instrument. The study recruited 85 special education teachers from seven public primary schools in Malaysia. With parental consent, these teachers recruited 167 pupils with special educational needs (SEN) under their care to be part of the study sample.

In choosing the sample, the study applied quota sampling to achieve proportional representation of the major disability categories of pupils with SEN registered in Malaysian public primary schools. The sample consisted of pupils with autism spectrum disorder (ASD), intellectual disability, attention deficit hyperactivity disorder (ADHD), dyslexia, visual and hearing impairments, and multiple disabilities. Quota sampling was used to ensure that the sample was diverse in terms of functional and contextual characteristics. As the study involved

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a vulnerable population, practical limitations related to school accessibility, parental consent, and participant recruitment procedures were ethically addressed.

Consistent with local educational research guidelines involving children, teachers served as proxy respondents throughout the assessment process. Teacher participants were recruited based on the following eligibility criteria: (1) currently teaching in a Special Education program in a public primary school, (2) holding at least a bachelor's degree in education or a related field, and (3) having a minimum of two years' experience working with pupils with diverse learning needs.

Pupil participants were eligible if they: (1) were currently enrolled in a Special Education program in a public primary school, (2) were between 6 and 13 years old, and (3) had been diagnosed with a disability by qualified medical professionals, as documented by the school. The demographic profile of the pupil participants is summarised in Table 1.

**Table 1: Demographic Profile of the Pupil Participants**

| Demographic Data | Subjects (n) | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Male | 105 | 62.9 |
| Female | 62 | 37.1 |
| **Age (M = 9;07)** | | |
| 6;0-7;11 | 38 | 24.6 |
| 8;0-9;11 | 54 | 31.7 |
| 10;0-11;11 | 53 | 31.1 |
| 12;0-13;11 | 22 | 12.6 |
| Unknown | 4 | 2.4 |
| **Disability Category** | | |
| Hearing Impairment | 10 | 6.0 |
| Vision Impairment | 6 | 3.6 |
| Speech Impairment | 4 | 2.4 |
| Physical Impairment | 3 | 1.8 |
| Multiple Disabilities | 7 | 4.2 |
| Dyslexia | 13 | 7.8 |
| Down's Syndrome | 3 | 1.8 |
| ADHD | 15 | 9.0 |
| Autism Spectrum Disorder | 60 | 35.9 |
| Intellectual Disability | 40 | 24.0 |
| Others | 6 | 3.6 |

***Instrument***

The CFAM-PS consists of seven sections encompassing demographic and assessment-related information, body functions, activities and participation in school and home settings, environmental factors, and an overall scoring summary.

For the purpose of this study, the analysis focused specifically on the Environmental Factors components, which include:

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1. Environmental Factors in School Settings (12 items), and
2. Environmental Factors in Home Settings (14 items).

Together, these sections comprise 26 items intended to capture contextual conditions that may either support or restrict pupils' functioning and participation in daily educational and home environments. The items assess multiple contextual dimensions, including instructional assistance, peer relationships, family support, accessibility of the environment, availability of learning resources, and environmental accommodations. Responses were recorded using a four-point Likert rating scale supported by a standardised administration manual. The manual included scoring procedures, operational explanations, and illustrative examples aimed at promoting consistency among teacher raters.

***Data Collection Procedure***

The study was subjected to ethical clearance from the university's ethics committee and subsequently approval from the Ministry of Education and State Education Department. Once approval was granted, the selected school administrators were approached to secure institutional consent.

Briefing sessions was conducted to explain the study's objectives and procedures to special education teachers and parents. Teachers who agreed to participate in the study were later invited for training sessions in administering the instrument. These sessions introduced the conceptual basis of the CFAM-PS, administration procedures, and scoring guidelines.

Eligible pupils were identified by participating teachers based on the predetermined inclusion criteria. Written informed consent was obtained from parents or guardians prior to participation. Teachers were given some time to administer the CFAM-PS for pupils under their supervision through classroom observations, school-based interactions, and available contextual information from school and home environments.

The assessment process was conducted over approximately three months between June and August 2024. Completed instruments were collected through school administrators and returned to the researchers for data management and analysis.

***Data Analysis***

Data analysis was conducted using the Rasch Measurement Model with Winsteps version 5.8.1. As this article specifically examines the Environmental Factors domains of the CFAM-PS, the analysis focused on the conceptual and psychometric performance of the environmental items rather than the instrument as a whole.

Several Rasch measurement indicators associated with environmental assessment were evaluated, including unidimensionality, person and item reliability, person and item separation, targeting, floor and ceiling effects, rating scale performance, and item fit statistics.

The purpose of the analysis was to determine the extent to which environmental factors could be operationalised as consistent and measurable constructs within a standardised school-based assessment context.

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## Results

### *Unidimensionality*

The Principal Component Analysis of Residuals (PCA-R) findings for the Environmental Factors section of the CFAM-PS did not provide strong support for unidimensionality. The raw variance explained by the Rasch dimension fell below the recommended 40% criterion (28.8%). The first contrast eigenvalue (3.8) exceeded the acceptable threshold of 3.0. Nevertheless, the unexplained variance in the first contrast remained within the acceptable limit of 15% (10.5%). The summary of the results is presented in Table 2.

**Table 2: Reliability and Separation Indices and Dimensionality**

| Statistics | Output* | Threshold | Results |
|---|---|---|---|
| **Reliability and Separation Indices:** | | | |
| Person reliability (real) | Table 3.1 | >0.8 | 0.72 |
| Item reliability (real) | Table 3.1 | >0.8 | 0.91 |
| Cronbach Alpha | Table 3.1 | >0.8 | 0.93 |
| Person separation index | Table 3.1 | >2.0 | 1.61 |
| Item separation index | Table 3.1 | >2.0 | 3.27 |
| **Dimensionality:** | | | |
| Raw variance explained by measures | Table 23 | >40% | 28.8% |
| Unexplained variance in the first contrast | Table 23 | <15% | 10.5% |
| Eigenvalue of the first contrast | Table 23 | <3.0 | 3.8 |

### *Person and Item Reliability and Person and Item Separation*

Although the other domains demonstrated strong psychometric properties, the Environmental Factors section of the CFAM-PS showed relatively lower person reliability (0.72) and person separation (1.61). These results suggest that the section was less effective in differentiating pupils according to their environmental factor profiles. In contrast, item reliability remained high at 0.91, while the item separation value of 3.27 indicated a sufficiently broad spread of item difficulty across the construct.

In Rasch measurement, reliability indices comparable to Cronbach's alpha are generally expected to reach at least 0.80 to reflect satisfactory measurement consistency (Boone, 2016) Similarly, separation indices exceeding 2.0 are typically interpreted as indicating adequate differentiation across levels of ability or item difficult (Bond & Fox, 2015).

### *Targeting, Floor, and Ceiling Effect*

Table 3 summarizes the targeting analysis, floor effect, and ceiling effect for the Environmental Factors section of the CFAM-PS. The section recorded a Rasch person mean of 1.69 logits, representing the smallest gap between person ability and item difficulty compared to the other domains. This finding suggests relatively better alignment between respondent measures and item calibrations within the Environmental Factors construct.

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However, despite the closer targeting, the Environmental Factors section demonstrated a substantial ceiling effect of 13.9%, exceeding the recommended threshold of 5%. This indicates that a considerable proportion of respondents achieved high scores on the environmental items, suggesting that the section may have had limited sensitivity in distinguishing pupils experiencing more favorable environmental conditions. No floor effect was observed for this section.

**Table 3: Targeting, Floor Effect, and Ceiling Effects**

| Indicator | Values |
|---|---|
| Average Person Measure (Logits) | 1.69 |
| % Ceiling | 13.9% |
| % Floor | 0.00 |

The Wright Map for the Environmental Factors section (Figure 2) further illustrates the relationship between person measures and item difficulty distribution along a shared logit continuum. The map provides a visual representation of the extent to which the environmental items adequately targeted the range of contextual experiences demonstrated by the respondents.

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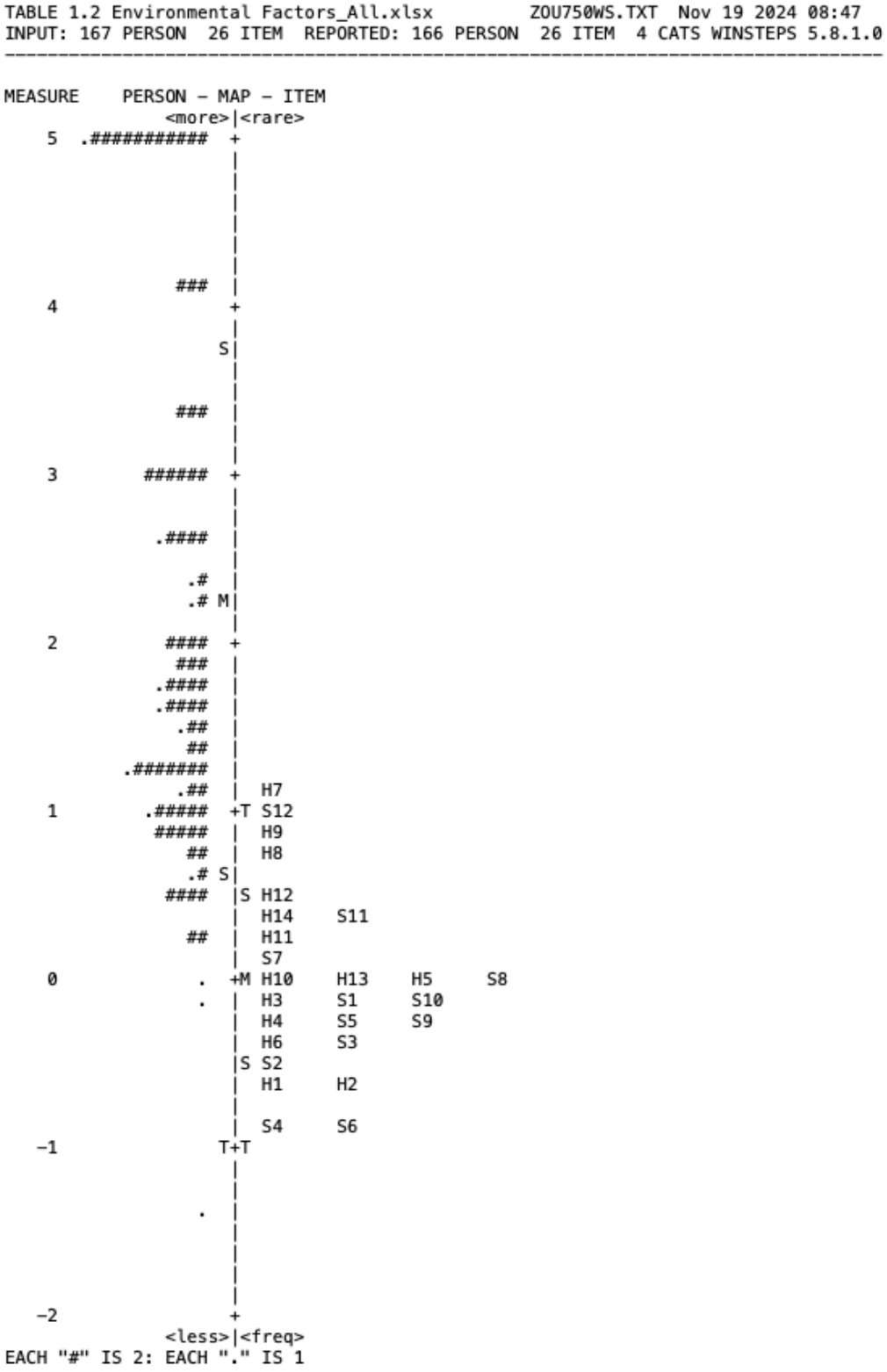


**Figure 2: The Wright Map for the Environmental Factors Section**

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### *Rating Scale Functioning*

The Environmental Factors section utilised four response categories (0–3), with the category structure summary presented in Table 4. Analysis of the Rasch rating scale diagnostics revealed several issues relating to category functioning within this section. In particular, the Andrich thresholds did not advance monotonically, indicating disordered category progression and suggesting that respondents may have experienced difficulty distinguishing consistently between adjacent response categories.

**Table 4: Rating Scale Performance**

| Category Label | Observed Count | Observed % | Observed Average | Infit MNSQ | Outfit MNSQ | Andrich Threshold |
|---|---|---|---|---|---|---|
| 0 – Unknown | 146 | 3 | 0.37 | 1.34 | 1.89 | None |
| 1 – Hinder participation | 125 | 3 | 0.59 | 0.99 | 1.07 | 0.45 |
| 2 – Neutral | 1,033 | 24 | 1.04 | 0.92 | 0.77 | -1.23 |
| 3 – Facilitate participation | 2,949 | 69 | 2.14 | 0.92 | 0.97 | 0.78 |

The Category Probability Curve (CPC) for the Environmental Factors section (Figure 3) further demonstrated weaknesses in the functioning of the rating scale. Specifically, Category 1 (blue curve) failed to achieve a distinct peak probability at any point along the latent continuum, indicating that it did not function effectively as an intermediate response category between Categories 0 and 2. This finding suggests potential overlap or ambiguity in how respondents interpreted the category distinctions within the environmental domain.

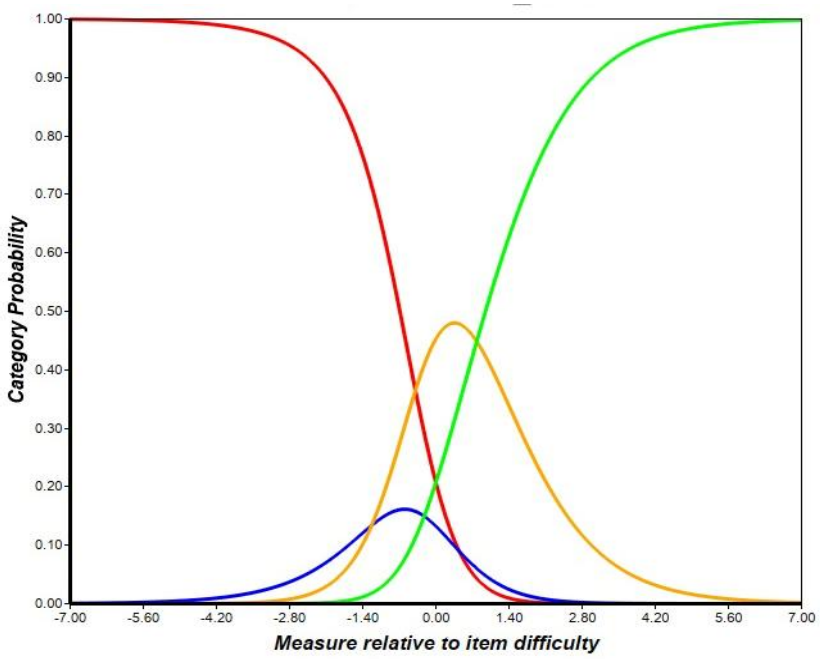


**Figure 3: Category Probability Curve for the Environmental Factors Section**

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In addition, Category 0 demonstrated substantial misfit, reflected by a high outfit mean square (MNSQ) value of 1.89. This indicates unexpected or inconsistent response patterns associated with the category. Collectively, these findings suggest that the four-category rating structure may not have functioned optimally for measuring environmental factors, potentially reflecting the interpretive complexity and context-dependent nature of environmental constructs.

### *Item Fit Statistics and Misfit*

Item fit analysis for the Environmental Factors section identified several items that did not conform adequately to Rasch model expectations (Table 5). In interpreting item fit, greater emphasis was placed on the mean square (MNSQ) statistics rather than ZSTD values, as MNSQ indices are generally less affected by sample size. This is particularly important in Rasch analysis, where large samples may produce inflated ZSTD values even for relatively minor deviations from model expectations.

Within the Environmental Factors domain, five items demonstrated evidence of misfit based on infit and/or outfit MNSQ statistics. These items represented both school- and home-related environmental influences. School-based misfitting items included teacher and school staff attitudes (S2), school meals during recess (S3), infrastructure accessibility for pupils with disabilities (S11), and access to additional support services such as therapists and government clinics (S12). One home-based item related to access to medical supplies (H7) also demonstrated substantial misfit.

**Table 5: Misfitting Items Identified by the Item Fit Statistics**

| Sub-domain | Item No | Initial Item Version | Infit | | Outfit | |
|---|---|---|---|---|---|---|
| | | | MNSQ | ZSTD | MNSQ | ZSTD |
| School | S2 | Attitude of teachers and school staff involved in learning *Helps:* Teachers consistently give positive reinforcement *Hinders:* Teachers do not pay attention to student development | 0.58 | -2.48 | 0.65 | -1.60 |
| | S3 | School meals during recess *Helps:* Students have access to nutritious food and aid (RMT) *Hinders:* Students lack access to nutritious food | 1.44 | 2.04 | 1.79 | 2.81 |
| | S11 | Infrastructure for disabled students (e.g., ramps, accessible toilets) | 1.32 | 1.95 | 1.80 | 3.58 |
| | S12 | Access to additional support (e.g., therapist at 3PK, government clinics) | 1.47 | 3.57 | 1.90 | 4.88 |
| Home | H7 | Medical supplies if needed | 2.17 | 8.04 | 2.65 | 8.21 |

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Among the identified items, H7 ("Medical supplies if needed") demonstrated the highest level of misfit, with infit and outfit MNSQ values exceeding 2.0 alongside highly elevated ZSTD values. This finding suggests considerable unpredictability in respondent ratings for this item. Similarly, items related to access to support services and environmental infrastructure showed elevated outfit statistics, indicating inconsistent responses on items that may be more contextually variable or less uniformly experienced across participants.

In contrast, Item S2 relating to teacher and school staff attitudes demonstrated lower-than-expected MNSQ values, suggesting potential overfit. This may indicate that responses to the item were overly predictable or highly redundant with other environmental items within the construct.

Overall, the presence of misfitting environmental items suggests that certain contextual factors may not function as stable measurement indicators within a standardised assessment framework. These findings may reflect the inherently relational, context-dependent, and subjective nature of environmental influences, where responses are shaped not only by environmental conditions themselves but also by individual perceptions, experiences, and contextual variability across school and home settings.

**Discussion**

The Principal Component Analysis of Residuals (PCA-R) findings indicate that the Environmental Factors section of the CFAM-PS provides only moderate evidence of unidimensionality. Although the unexplained variance in the first contrast remained within the acceptable limit, the relatively low proportion of variance explained by the Rasch dimension and the elevated first-contrast eigenvalue suggest that there may be additional sources of variation within this section. This means that the environmental items may not be measuring one single and homogenous latent construct. Instead, the items may be capturing several related but distinct aspects of environmental influence.

This finding is understandable when viewed in relation to the nature of the environmental factors within the ICF framework. Environmental factors include a diverse range of contextual elements, such as physical surroundings, social relationships, attitudes, services, and institutional supports (World Health Organization, 2001; Alehagen et al., 2024). These elements may influence pupils' functioning in different ways and may not necessarily occur together. Therefore, the elevated first contrast may reflect the heterogenous nature on the Environmental Factors domain rather than simply indicating a weakness in the assessment instrument.

The items included in this section represent conceptually different types of environmental influence. Some items relate to social relationships and attitudes, while others focus on access to resources, physical surroundings, support services and home or school conditions (Mohd Nazli et al., 2026). Because these factors operate through different mechanisms, they may not vary consistently across respondents. This explains why some degree of multidimensionality was observed in the analysis, which may not be merely a psychometric problem but reflecting the way environmental factors are constructed and experienced in real-life contexts. This is consistent with the view that environmental influences are relational and context-dependent, as their effects depend on the interaction between the individual and the surrounding environment (Coster et al., 2011; Schwab et al., 2022).

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Looking at the item fit findings, several misfitting items were related to highly context-specific environmental conditions, such as access to medical supplies, additional support services, school meals, and infrastructure for pupils with disabilities. These items may not be equally relevant to all pupils, as some environmental conditions are only applicable for pupils with specific medical conditions but may be irrelevant to others. This may explain why these items produced less predictable response patterns (Mohd Nazli et al., 2026). Hence, when treating these misfitting items, rather than excluding it totally from the instrument, they may indicate that certain environmental factors function more as conditional or subgroup-specific indicators than as universal items within a single environmental continuum.

The reliability and separation findings provide further support for this interpretation. Although the item reliability and item separation index exceeded the recommended thresholds, the person reliability and person separation were lower than commonly accepted standards (Bond & Fox, 2015; Boone, 2016). This suggests that, although the environmental items were sufficiently spread across different levels of environmental influence and formed a stable item hierarchy, the instrument was less effective in distinguishing pupils according to their environmental profiles. In Rasch measurement, lower person reliability and separation often indicate limited variability among respondents or reduced sensitivity of the instrument in differentiating individuals across multiple levels of the measured construct (Bond & Fox, 2015).

The Wright map further clarifies this issue by showing a possible targeting limitation within the Environmental Factors section. Most of the environmental items were clustered within a relatively narrow range of measurement continuum, while many respondents were positioned above the item distribution. This pattern suggests that the items may not adequately cover the full range of pupils' environmental experiences. In particular, the limited number of items at the higher end of the continuum may reduce the instrument's sensitivity in differentiating pupils who experience highly supportive or enabling environments. This interpretation is supported by the rating scale analysis, where 69% of observed responses were recorded in Category 3, representing "facilitate participation." This suggests that a large proportion of respondents were clustered within the highest response category. As a result, different degrees of environmental facilitation may have been collapsed into a single category, limiting the instrument's ability to distinguish between moderately supportive and highly supportive environments.

In this case, pupils with different environmental experiences could obtain similar total scores. Coster et al. (2011) explained that environmental support and barriers are experienced differently across children and settings, and that their effects are closely linked to participation within specific contexts. For instance, a pupil may experience positive teacher support but limited access to therapy services, while another may have good access to therapy but weaker family or peer support. Such variation makes it difficult to arrange pupils clearly along a single continuum, which explains the lower person reliability and separation indices observed.

Another issue arises from the structure of the response scale itself. In Rasch analysis, rating categories are expected to function in an ordered manner, where each category represents a progressively higher or lower level of the construct being measured (Bond & Fox, 2015). However, environmental factors ratings do not follow a simple linear order since it has negative (barriers) and positive (facilitators) response options. Some categories are also ambiguous. For example, item rated as "Unknown" does not necessarily mean restricting environment, but rather the factor is irrelevant to the pupil's current situation. Similarly, "Neutral" may reflect either the absence of influence or uncertainty among respondents. Such ambiguity can make it

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difficult for the rating categories to operate as intended, especially when respondents interpret the categories differently across home and school contexts.

Taken together, these findings suggest that the Environmental Factors section should be interpreted with caution as a single overall measure. The results do not necessarily indicate that the section is weak, but rather that the environmental factors are more complex, heterogenous, and context-dependent that domains such as Body Functions or Activities and Participation (Coster et al., 2011; Schwab et al., 2022).

Future refinement of the CFAM-PS could consider grouping environmental items into more specific subdomains. Additional items may also be needed to represent highly supportive and highly restrictive environmental conditions. Other than that, future refinement of the CFAM-PS Environmental Factors section should also consider refining the rating scale categories. Clearer category descriptors can improve consistency in interpretation and strengthen the functioning of the rating scale. Further analyses, such as local dependency, DIF and qualitative review of item interpretation may help improve conceptual clarity and measurement precision of this section.

## Conclusion

In conclusion, this article highlights that measuring environmental factors within the CFAM-PS is conceptually and psychometrically more complex than measuring more individual-centred domains such as body functions or activities and participation. The findings suggest that the Environmental Factors section captures a broad and heterogeneous range of influences, including relationships, attitudes, physical surroundings, resources, services, and home-school contexts, which may not operate as a single unified construct.

Overall, the evidence from the PCA-R, person reliability, person separation, person–item map, and rating scale functioning shows that the Environmental Factors section has value in identifying contextual supports and barriers for pupils with special educational needs. However, its use as a single total score should be approached with caution. The findings should not be viewed only as measurement weaknesses. They also reflect the multidimensional, relational, and context-dependent nature of environmental factors. Future refinement of the instrument should therefore focus on clearer item definitions, improved rating categories, possible regrouping into subdomains, and further validation across different educational contexts. These steps may help strengthen the instrument's psychometric properties, reliability, and validity in assessing functional abilities among pupils with SEN.

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