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Development and Psychometric Validation of a School Physical Accessibility Questionnaire for Inclusive Education

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ABSTRACT: This study developed and examined the preliminary psychometric properties of the School Physical Accessibility Questionnaire for Inclusive Education, a 40-item dichotomous instrument assessing accessibility provisions in secondary schools. The questionnaire was organised into eight theoretically derived dimensions: school infrastructure, classroom design, hygiene, sanitation and accessible restrooms and toilets, special learning tools, human resource support, counsellors and support staff, sports and co-curricular activities and teacher efforts towards inclusion. Data were collected from 236 pre-service teacher educators enrolled in the 3-Year Integrated B.Ed.–M.Ed. programme in Odisha, India, who responded with reference to secondary school settings experienced during field exposure, internship, or school-based engagement. Reliability was examined using Cronbach's alpha and McDonald's omega; exploratory factor analysis used a polychoric/tetrachoric correlation matrix, minimum residual extraction and oblimin rotation. The full scale showed strong internal consistency ($\alpha = .905$; $\omega = .907$), while dimension-wise reliability ranged from marginal to good. KMO was .646, Bartlett's test was significant, FA-based parallel analysis suggested a more complex empirical solution and the theory-driven eight-factor solution explained 67.5% of total variance. Although most items showed meaningful loadings, the presence of cross-loadings and weak fit indices indicates that the structure should be interpreted as exploratory. The questionnaire offers preliminary psychometric evidence for assessing school physical accessibility in inclusive secondary education.

1. INTRODUCTION

Inclusive education is closely linked with equity, dignity, participation and the right of every learner to quality education. However, inclusion cannot be realised only by placing learners with disabilities in mainstream schools. It depends on the availability of school physical accessibility provisions that enable learners to enter, move, learn, interact, receive support and participate in school life. When such provisions are absent, partial, or poorly maintained, the school environment itself becomes a barrier to inclusion (Hayes & Bulat, 2017; Obah, 2024).

In this study, school physical accessibility is understood in a functional school sense rather than a purely architectural sense. It includes accessible infrastructure, classroom layout, sanitation and restroom facilities, safe mobility pathways, learning resources, assistive devices, teacher support, counselling services, co-curricular opportunities and safety arrangements. Human-resource support, counselling services and teacher efforts are included because accessibility provisions become meaningful only when they are supported, maintained and translated into everyday inclusive practice.

International literature shows that inclusive participation requires teaching adaptations, assistive technologies, accessible learning materials and school-based support services (Genovesi et al., 2025; Hunt, 2021; McNicholl et al., 2021; Zabek et al.,

2023). In the Indian secondary school context, assessing the actual availability of these provisions is important because policy commitment alone cannot ensure meaningful participation. Therefore, this study develops and examines the psychometric properties of the School Physical Accessibility Questionnaire for Inclusive Education, a multidimensional instrument for assessing whether secondary schools possess the accessibility conditions required for inclusive education.

2. MATERIALS AND METHODS

2.1 Research Questions

1. What theoretical dimensions constitute the School Physical Accessibility Questionnaire for Inclusive Education in secondary school settings?
2. What are the full-scale and dimension-wise reliability properties of the questionnaire?
3. What evidence does exploratory factor analysis of the dichotomous-item data provide for the proposed eight-dimensional structure of the questionnaire?

2.2 Review of Related Literature

School physical accessibility in inclusive education has shifted from a narrow architectural concern to a multidimensional construct centred on the availability of conditions that make participation possible. Contemporary literature locates accessibility within rights-based and systems-oriented frameworks, where inclusive schooling depends not only on enrolment but also on policy support, reasonable accommodation, teacher preparation, assistive resources, budgeting, monitoring and accountability (Hayes & Bulat, 2017; Waisath et al., 2024). Universal Design for Learning strengthens this view by emphasising flexible engagement, representation and expression as proactive ways of reducing barriers before exclusion occurs (AlRawi & AlKahtani, 2022; Bray et al., 2024). Ecological evidence shows that educational barriers emerge through the interaction of physical, attitudinal, service-related, communication, technological and policy conditions (Bani Odeh & Lach, 2024). Together, these perspectives establish school physical accessibility as interconnected provisions enabling learners to enter, move, learn, communicate, receive support and participate.

Physical and environmental accessibility literature shows that participation is shaped by the availability and usability of everyday school spaces. Studies indicate that exclusion is produced not only by inaccessible buildings but also by poorly organised environments and limited school-level services (Bani Odeh & Lach, 2024). Evidence on outdoor play shows that playgrounds and outdoor spaces support mobility, peer interaction, autonomy and inclusion for children with disabilities (Orain et al., 2025). Classroom accessibility depends on spatial arrangement, seating, lighting, visibility and contrast, especially for learners with visual or learning-related needs (Ahmad Najmee et al., 2024), while flexible teaching arrangements and concrete learning aids reduce participation barriers in mainstream classrooms (Hove & Phasha, 2023). WASH studies show that water, sanitation, hygiene, menstrual hygiene provisions and disability-friendly toilets affect health, dignity, attendance and participation (Poague et al., 2022; Seroney et al., 2026; Sharma et al., 2024). This evidence identifies infrastructure, classrooms, mobility spaces, playgrounds and WASH facilities as core dimensions of accessibility availability.

Assistive technology and accessible learning-resource literature extends accessibility from physical entry to functional participation in learning. Assistive technology supports communication, reading, writing, mobility, curriculum access and classroom engagement, but its effectiveness depends on whether appropriate devices and support systems are available and usable (Hunt, 2021). Evidence on braille literacy technologies indicates that accessible resources must provide meaningful feedback, support independent practice and respond to learner needs (Hoskin et al., 2024). UDL-related technology research adds that digital tools can enhance access when they support representation, engagement, communication and learner expression, although studies often emphasise representation more than other dimensions (Bray et al., 2024). Inclusive classroom research shows that learners with developmental disabilities require teaching adaptations, targeted support, whole-class strategies and accessible materials to participate meaningfully (Genovesi et al., 2025). These studies support assistive devices, accessible learning materials and instructionally usable resources as measurable components of school physical accessibility.

Teacher support and school-based services constitute another dimension because facilities and resources cannot produce inclusion without human and professional support. Studies on teacher preparation show that positive attitudes toward inclusion are insufficient when teachers lack training, readiness and instructional materials (Ginja & Chen, 2023; Triviño-Amigo et al., 2022). Inclusive pedagogy research emphasises flexibility, whole-class approaches, learner capability, professional development

and teacher–assistant collaboration as conditions for participation (Losberg & Zwozdiak-Myers, 2024). Socio-pedagogical evidence links differentiated instruction, scaffolding, collaboration, assistive technologies and socio-emotional support with academic and social participation among learners with special educational needs (Wang, 2026). Counselling and support-service literature identifies inclusion coordinators, family-school collaboration, school counsellors, mental health professionals and multi-tiered support systems as essential for addressing emotional, behavioural, developmental and adjustment-related barriers (Hirata & Ozawa, 2023; Slowik et al., 2023; Zabek et al., 2023). Thus, trained teachers, counselling services and coordinated support systems are measurable dimensions of accessibility availability.

A comprehensive understanding must also consider participation and safety-related preparedness. Learners may enter classrooms but remain excluded from play, sports, peer interaction, leadership and co-curricular life when adapted opportunities and supportive personnel are unavailable. Research on adaptive sports and school sport shows that inclusive participation can strengthen social inclusion, emotional resilience, empathy, autonomy, competence and belonging, while barriers arise from inadequate facilities, limited opportunities, insufficient trained leaders and weak student voice (Robinson et al., 2023; Shao et al., 2025). Safety literature expands the construct by showing that general emergency procedures may not address the mobility, sensory, communication, cognitive, emotional, behavioural and medical needs of learners with disabilities. Individualised emergency planning, staff preparedness, evacuation support, communication systems and inclusive emergency operations are therefore necessary accessibility provisions (Asher et al., 2024; Columbia Embury et al., 2019; Kurto et al., 2026). These studies identify co-curricular access, supportive personnel and safety preparedness as contextual concerns within available school accessibility.

Instrument-development evidence further supports the need for structured tools in inclusive education research. Validated school-based self-assessment tools can examine inclusive resources, practices and areas requiring institutional improvement. However, existing tools address broader inclusive education rather than the specific availability of secondary-school physical accessibility provisions, supporting the need to develop and psychometrically validate a focused questionnaire for this purpose (Carvalho et al., 2022).

Methodological literature strengthens the psychometric basis of the present study. Scale development is understood as a staged process involving domain identification, item generation, content validity, factor extraction, dimensionality testing, reliability assessment and validity evidence (Boateng et al., 2018). In exploratory factor analysis, factor-retention decisions are critical because reliance on eigenvalues alone may provide insufficient support for determining the number of factors, whereas approaches such as parallel analysis offer stronger methodological justification (Hayton et al., 2004). For dichotomous questionnaire or test items, factor-analytic procedures require particular care, especially in relation to tetrachoric correlations and the selection of an appropriate number of factors (Finch, 2023). Reliability, binary items, factor models and validity should also be interpreted as interconnected aspects of psychometric evaluation rather than as separate statistical outputs (McDonald, 2013). Together, these methodological positions support expert/content review, reliability analysis, tetrachoric correlation-based exploratory factor analysis, factor-retention justification and item-level interpretation in the present study.

2.3 Research gap

The reviewed literature establishes that inclusive education depends on school-level accessibility provisions, including infrastructure, classroom design, sanitation facilities, assistive learning resources, human-resource support, counselling services, co-curricular participation and teacher efforts. However, these dimensions are often examined separately rather than as an integrated school physical accessibility construct. Existing tools also tend to assess broader inclusive practices rather than the specific availability of physical accessibility provisions in secondary schools. Thus, limited evidence is available on an integrated, psychometrically examined instrument that measures these provisions together in inclusive secondary school settings. This creates both a substantive and methodological gap: school physical accessibility remains under-examined as a multidimensional availability construct and limited validation evidence exists for a focused questionnaire designed to assess it through dichotomous items. The present study addresses this gap by developing the School Physical Accessibility Questionnaire for Inclusive Education and examining its reliability and exploratory factor-analytic evidence.

2.4 Research Design and Participants

The present study followed a psychometric scale development and validation design. It was conducted among pre-service teacher educators enrolled in the 3-Year Integrated B.Ed.–M.Ed. programme in Odisha, India. The target population consisted of 600 students from four teacher education institutions and the final sample comprised 236 complete and valid responses.

A non-probability voluntary response sampling approach was used. The online questionnaire link was distributed through institutional communication channels and respondents answered with reference to secondary school settings experienced during field exposure, internship, or school-based academic engagement. Unequal institutional response distribution was expected because participation was voluntary and the survey was administered online.

2.5 Ethical Considerations

Permission to conduct the study was obtained from the participating institutions. Participants were informed about the study purpose, voluntary participation, withdrawal before submission, confidentiality and academic use of data. Informed consent was obtained through the online questionnaire. Formal ethics committee approval was not obtained, which is acknowledged as a limitation.

2.6 Instrument Construction

The School Physical Accessibility Questionnaire for Inclusive Education was developed as a multidimensional checklist to measure the availability of school-level accessibility provisions relevant to inclusive education. Each item recorded the presence or absence of a specific physical, material, or human-resource provision in secondary school settings.

The questionnaire comprised 40 dichotomously scored items organised under eight dimensions: School Infrastructure, Classroom Design, Hygiene, Sanitation & Accessible Restrooms and Toilets, Special Learning Tools, Human Resource Support, Counsellors & Support Staff, Sports and Co-curricular Activities and Teacher Efforts Towards Inclusion. Each dimension included five items, with responses coded as 1 for “Yes” and 0 for “No.”

Item generation followed a deductive approach based on literature on inclusive education, school accessibility and disability-related support provisions. For analytical reporting, items were coded as SI1-SI5, CD1-CD5, HSART1-HSART5, SLT1-SLT5, HRS1-HRS5, CSS1-CSS5, SCA1-SCA5 and TEI1-TEI5.

2.7 Expert Review and Content Validation

Following initial item generation, the draft School Physical Accessibility Questionnaire for Inclusive Education was subjected to expert review to establish the relevance, clarity, conceptual appropriateness and domain representation of the proposed items. The review focused on whether the items adequately represented the eight theoretically derived dimensions of school accessibility and whether their wording was suitable for assessing the availability of accessibility provisions in secondary-school settings. Particular attention was given to conceptual alignment between individual items and their intended dimensions, clarity of expression, redundancy and contextual suitability for inclusive education.

The feedback received through the process of expert reviews guided in the revision of wording of items and the placement of items within each dimension prior to actual data collection. This generated an instrument which contained 40 dichotomously scored items with five items in each of the eight dimensions. At this point, content validation took a qualitative approach. The content validity index on item level (Item-Level Content Validity Index; I-CVI), scale level (Scale-Level Content Validity Index; S-CVI) and content validity ratio (CVR) could not be determined since no formal rating of items for content validity had been carried out. Expert review was, therefore, considered a form of preliminary assessment of content validity only.

2.8 Data Collection and Analysis

Data were gathered through a Google Forms questionnaire shared with eligible participants through the communication channels of the participating institutions. Only complete responses that were suitable for analysis were retained, resulting in a final dataset of 236 valid cases. The data were analysed using JASP (JASP Team, 2026). Internal consistency was examined for the full scale and for each dimension using Cronbach’s alpha and McDonald’s omega.

Because the questionnaire items were dichotomously scored, exploratory factor analysis was carried out using a polychoric/tetrachoric correlation matrix. Minimum residual extraction and oblimin rotation were applied, as the dimensions of school physical accessibility were expected to be related rather than completely independent. The Kaiser–Meyer–Olkin

measure and Bartlett's test of sphericity were used to examine whether the data were suitable for factor analysis. Factor retention was considered through theoretical dimensionality, eigenvalues, scree-plot inspection and FA-based parallel analysis. Since the questionnaire had been deductively developed around eight theoretical dimensions, an eight-factor solution was examined and interpreted cautiously with reference to item loadings, cross-loadings, conceptual relevance and correspondence with the proposed dimensions.

3. RESULTS AND DISCUSSION

3.1 Preliminary Analysis

The psychometric properties of the School Physical Accessibility Questionnaire for Inclusive Education were examined using item-level analysis, reliability estimation and exploratory factor analysis. All analyses were conducted on the final 40-item version of the questionnaire.

3.2 Reliability Analysis

Table 1. Overall Reliability of the 40-Item School Physical Accessibility Questionnaire

Scale	Items	α	95% CI	ω	95% CI
Full scale	40	.905	[.889, .920]	.907	[.890, .924]

Note. α = Cronbach's alpha; ω = McDonald's omega; CI = confidence interval.

The full-scale reliability analysis indicated excellent internal consistency for the 40-item questionnaire. Cronbach's alpha was .905, while McDonald's omega was .907, suggesting that the items collectively measured a coherent construct of school physical accessibility for inclusive education.

Table 2. Dimension-Wise Reliability of the 40-Item Questionnaire

Dimension	Item Codes	Items	α	ω	Interpretation
School Infrastructure	SI1–SI5	5	.658	.680	Marginal / acceptable with caution
Classroom Design	CD1–CD5	5	.700	.757	Acceptable
Hygiene, Sanitation & Accessible Restrooms and Toilets	HSART1–HSART5	5	.715	.727	Acceptable
Special Learning Tools	SLT1–SLT5	5	.719	.726	Acceptable
Human Resource Support	HRS1–HRS5	5	.712	.723	Acceptable
Counsellors & Support Staff	CSS1–CSS5	5	.810	.820	Good
Sports and Co-curricular Activities	SCA1–SCA5	5	.697	.725	Borderline acceptable
Teacher Efforts Towards Inclusion	TEI1–TEI5	5	.632	.645	Marginal / acceptable with caution

Note. α = Cronbach's alpha; ω = McDonald's omega.

Dimension-wise reliability ranged from marginal to good. The Counsellors & Support Staff dimension showed the strongest reliability, while Teacher Efforts Towards Inclusion and School Infrastructure showed comparatively lower internal consistency. Overall, most dimensions demonstrated acceptable or near-acceptable reliability, supporting the continued use of the eight theoretically proposed dimensions.

3.3 Exploratory Factor Analysis

Table 3. *KMO and Bartlett's Test for Exploratory Factor Analysis*

Test / statistic	Value
KMO / Overall MSA	.646
Bartlett's test of sphericity, χ^2	59273.604
df	780
p	< .001

Note. KMO = Kaiser–Meyer–Olkin; MSA = measure of sampling adequacy.

The Kaiser–Meyer–Olkin value was .646, indicating acceptable sampling adequacy for exploratory factor analysis. Bartlett's test of sphericity was statistically significant, $\chi^2(780) = 59273.604$, $p < .001$, confirming that the correlation matrix was suitable for factor extraction.

Table 4. *FA-Based Parallel Analysis for Factor Retention*

Factor	Real data factor eigenvalue	Simulated data mean eigenvalue	Decision
Factor 1	13.311	0.958	Retain
Factor 2	2.688	0.805	Retain
Factor 3	2.056	0.732	Retain
Factor 4	1.597	0.665	Retain
Factor 5	1.431	0.606	Retain
Factor 6	1.124	0.549	Retain
Factor 7	0.972	0.495	Retain
Factor 8	0.709	0.448	Retain
Factor 9	0.630	0.392	Retain
Factor 10	0.479	0.340	Retain
Factor 11	0.357	0.295	Retain
Factor 12	0.262	0.266	Not retained

Note. Factors were retained when the real data factor eigenvalue exceeded the simulated mean eigenvalue. FA-based parallel analysis suggested an 11-factor empirical solution.

FA-based parallel analysis indicated that the observed eigenvalues exceeded the simulated mean eigenvalues from Factor 1 to Factor 11, while Factor 12 did not exceed the simulated value. This suggested a possible 11-factor empirical solution. However, the questionnaire was deductively developed across eight theoretical dimensions; therefore, an eight-factor solution was examined as a theory-driven exploratory model to assess the correspondence between the proposed dimensional structure and the empirical loading pattern. The eight-factor solution was interpreted cautiously with attention to item loadings, cross-loadings, conceptual relevance and dimension-wise correspondence.

Table 5. *Exploratory Factor Loadings of the 40-Item Questionnaire*

Item	Code	F1	F2	F3	F4	F5	F6	F7	F8	Uniqueness
Q1	SI1			.323			.429		-.372	.352
Q2	SI2			.352			.419			.450
Q3	SI3						.889			.118
Q4	SI4			-.372			.724			.333
Q5	SI5						.664			.522
Q6	CD1					.436	.415			.301
Q7	CD2	.424				.392		.313		.430
Q8	CD3					.787				.252
Q9	CD4				.470					.572
Q10	CD5					.851				.174
Q11	HSART1		.301				.401			.280
Q12	HSART2					.372		.399		.373
Q13	HSART3					.580		.368		.551
Q14	HSART4								.518	.438
Q15	HSART5								.577	.275
Q16	SLT1									.507
Q17	SLT2				.756					.261
Q18	SLT3				.797					.239
Q19	SLT4			.356	.574					.295
Q20	SLT5				.767					.197
Q21	HRS1									.599
Q22	HRS2	.335								.403
Q23	HRS3	.705				.331				.200
Q24	HRS4	.324								.348
Q25	HRS5	.335			.340	.329				.185
Q26	CSS1		.752							.226
Q27	CSS2		.882							.202
Q28	CSS3		.873							.160
Q29	CSS4	.512	.304							.296
Q30	CSS5	.565	.367							.280
Q31	SCA1				.323			.614		.259

Item	Code	F1	F2	F3	F4	F5	F6	F7	F8	Uniqueness
Q32	SCA2			.650		-.322				.315
Q33	SCA3			.846						.234
Q34	SCA4	-.304	.368	.646						.294
Q35	SCA5			.787						.095
Q36	TEI1	.501								.447
Q37	TEI2	.745								.323
Q38	TEI3	.746								.357
Q39	TEI4	.587							.486	.250
Q40	TEI5	.337								.619

Note. F1–F8 = extracted factors. Only factor loadings with an absolute value of .30 or above are reported. Blank cells indicate loadings below .30. Extraction method = minimum residual; rotation = oblimin.

Exploratory factor analysis was conducted using a polychoric/tetrachoric correlation matrix, minimum residual extraction and oblimin rotation. Although FA-based parallel analysis suggested a more complex empirical solution, the eight-factor solution was specified because the questionnaire was theoretically developed across eight dimensions. Most items showed meaningful loadings above .30. However, cross-loadings and weaker loading patterns indicate that the factor structure should be interpreted as exploratory rather than confirmed.

The empirical factor pattern only partially corresponded with the theoretically proposed eight-dimensional structure. School Infrastructure items loaded mainly on F6, Classroom Design items mainly on F5, Special Learning Tools mainly on F4, Counsellors & Support Staff mainly on F2, Sports and Co-curricular Activities mainly on F3 and Teacher Efforts Towards Inclusion mainly on F1. However, Hygiene, Sanitation & Accessible Restrooms and Toilets and Human Resource Support showed more mixed loading patterns. Several items also demonstrated cross-loadings, indicating that the empirical structure should be interpreted cautiously and that further item refinement may be required.

Table 6. *Proposed Dimensions and Empirical Factor Pattern*

Proposed dimension	Main empirical factor pattern	Interpretation
School Infrastructure	Mostly F6	Partially supported; some cross-loadings
Classroom Design	Mostly F5	Partially supported
Hygiene, Sanitation & Accessible Restrooms and Toilets	Mixed F5, F6, F7, F8	Requires refinement
Special Learning Tools	Mostly F4	Mostly supported; Q16 weak
Human Resource Support	Mostly F1 but mixed	Requires refinement
Counsellors & Support Staff	Mostly F2	Strongly supported
Sports and Co-curricular Activities	Mostly F3	Partially supported; some cross-loadings
Teacher Efforts Towards Inclusion	Mostly F1	Mostly supported; some overlap with support factors

Note. Primary factor assignment was based on the highest absolute loading for each item. Items loading at .30 or above on more than one factor were treated as cross-loading items.

Cross-loadings were observed for items such as Q1, Q6, Q7, Q11, Q12, Q13, Q19, Q23, Q25, Q29, Q30, Q31, Q32, Q34 and Q39, while Q16 and Q21 did not show loadings of .30 or above on any factor. These items were retained at this stage because the study aimed to preserve the theoretically developed 40-item structure and because the full-scale reliability was strong. However, these items should be examined further in future validation studies.

Table 7. *Factor Characteristics and Variance Explained*

Factor	Eigenvalue	Proportion of variance	Cumulative variance	Rotated SS loadings	Rotated proportion	Rotated cumulative
F1	13.612	.340	.340	4.630	.116	.116
F2	3.146	.079	.419	3.982	.100	.215
F3	2.436	.061	.480	3.805	.095	.310
F4	2.003	.050	.530	3.765	.094	.405
F5	1.851	.046	.576	3.677	.092	.496
F6	1.521	.038	.614	3.663	.092	.588
F7	1.344	.034	.648	1.772	.044	.632
F8	1.073	.027	.675	1.693	.042	.675

Note. SS = sum of squared loadings.

The eight-factor solution explained 67.5% of the total variance. The first factor accounted for the largest share of variance, while the remaining factors contributed additional explanatory value. The cumulative variance suggests that the extracted factors captured a substantial proportion of the variability in the 40-item questionnaire.

Table 8. *Factor Correlations among the Extracted Factors*

Factor	F1	F2	F3	F4	F5	F6	F7	F8
F1	1.000	.246	.158	.264	.256	.220	.112	.087
F2	.246	1.000	.219	.280	.287	.280	.074	.167
F3	.158	.219	1.000	.265	.132	.226	.157	-.047
F4	.264	.280	.265	1.000	.170	.246	.185	.097
F5	.256	.287	.132	.170	1.000	.319	-.006	.095
F6	.220	.280	.226	.246	.319	1.000	.130	.114
F7	.112	.074	.157	.185	-.006	.130	1.000	.055
F8	.087	.167	-.047	.097	.095	.114	.055	1.000

Note. F1–F8 = extracted factors.

The factor correlations were small to moderate, indicating that the extracted factors were related but not redundant. This pattern supports the use of oblimin rotation, as the dimensions of school physical accessibility were expected to be conceptually associated rather than completely independent.

Table 9. *Model Fit Indices for the Eight-Factor Exploratory Solution*

Fit index	Value
χ^2	51461.739
df	488
p	< .001
RMSEA	.665
RMSEA 90% CI	[.662, .672]
SRMR	.050
TLI	-.428
CFI	.129
BIC	48795.389

Note. RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; TLI = Tucker–Lewis index; CFI = comparative fit index; BIC = Bayesian information criterion.

The model fit indices were mixed and require cautious interpretation. The SRMR value of .050 suggested acceptable residual-based fit. However, the chi-square value was significant and the RMSEA (.665), CFI (.129) and TLI (-.428) indicated very poor global fit. These results show that the eight-factor exploratory solution should not be interpreted as a confirmed or well-fitting measurement model. Rather, the factor analysis provides preliminary evidence of dimensionality, while also indicating the need for item refinement, empirical factor-retention testing and confirmatory factor analysis with an independent sample.

Taken together, the results supported the preliminary use of the 40-item School Physical Accessibility Questionnaire for Inclusive Education. The instrument showed excellent full-scale reliability, mostly acceptable dimension-wise reliability and acceptable sampling adequacy for exploratory factor analysis. FA-based parallel analysis suggested a more complex 11-factor empirical solution, while the eight-factor model was examined because the questionnaire was deductively developed across eight theoretical dimensions. The eight-factor solution explained 67.5% of the total variance and most items showed meaningful factor loadings. However, cross-loadings, weaker loading patterns and poor global fit indices indicate that the questionnaire should be interpreted as an instrument with preliminary exploratory psychometric support, requiring further confirmation with an independent sample.

3.4 Discussion

The present study developed and examined the psychometric properties of the 40-item School Physical Accessibility Questionnaire for Inclusive Education. The findings provide preliminary support for the instrument as a multidimensional measure of the availability of school physical accessibility provisions. The strong full-scale reliability, with Cronbach's alpha of .905 and McDonald's omega of .907, indicates that the items collectively represent a coherent accessibility construct.

The findings align with inclusive education literature that views accessibility as multidimensional rather than purely architectural. By integrating infrastructure, classroom arrangements, sanitation, assistive resources, teacher support, counselling services and participation opportunities, the questionnaire brings separately studied areas into one structured instrument for assessing school accessibility conditions.

Dimension-wise reliability was mostly acceptable or near-acceptable, although School Infrastructure and Teacher Efforts Towards Inclusion showed comparatively lower reliability. This variation is understandable because school accessibility includes both concrete provisions and human-resource-related practices, indicating that some dimensions may require further item refinement.

The exploratory factor analysis provided preliminary evidence of multidimensionality: the KMO value and Bartlett's test supported factor analysis and the eight-factor solution explained 67.5% of variance. However, FA-based parallel analysis suggested 11 factors and some items showed cross-loadings or weaker loading patterns. The poor RMSEA, CFI and TLI values further indicate that the eight-factor solution should be interpreted as a theory-driven exploratory model rather than a confirmed measurement structure.

The mixed factor pattern suggests that some accessibility dimensions may overlap in actual school contexts. Human-resource support, counselling services and teacher efforts may function as related support forms, while sanitation, classroom access and mobility-related provisions may interact with broader environmental accessibility. Future studies should therefore test alternative solutions, conduct confirmatory factor analysis with an independent sample and examine the tool through direct school observation and test-retest reliability.

3.5 Implications for Educational Context

The School Physical Accessibility Questionnaire for Inclusive Education has practical relevance for secondary school inclusion, teacher education and accessibility-focused research. It can help identify whether schools have the physical, material, human-resource, support-service and participation-related provisions required for meaningful inclusion. In teacher education, it may support field exposure, school internship and reflective practice by sensitising pre-service teachers to accessibility conditions. Since the evidence is exploratory, the tool should currently be used for research, preliminary assessment and institutional reflection until further confirmatory validation is completed.

3.6 Limitations and Directions for Future Research

This study has several limitations. First, the sample was limited to pre-service teacher educators from four teacher education institutions in Odisha; therefore, wider validation with larger and more diverse samples is required. Second, responses were based on reported experiences of secondary school settings rather than direct school observation. Third, the eight-factor solution was theoretically specified and requires further testing through alternative factor solutions and confirmatory factor analysis with an independent sample. Fourth, although expert review/content validation contributed to item development, future studies should strengthen content validity through formal item-level relevance ratings and content-validity indices. Fifth, test-retest reliability and validation across school types, districts and states are needed. Finally, formal ethics committee approval was not obtained; future studies should seek prior ethics approval or institutional ethics clearance before data collection.

4. CONCLUSION

The present study developed and examined the psychometric properties of the 40-item School Physical Accessibility Questionnaire for Inclusive Education. The instrument demonstrated strong full-scale reliability, while dimension-wise reliability ranged from marginal to good. Exploratory factor analysis provided preliminary evidence for the multidimensional nature of the questionnaire and the eight-factor solution explained 67.5% of the total variance. However, cross-loadings and weak fit indices indicate that the structure should be interpreted as exploratory rather than confirmatory. By integrating infrastructure, classroom design, sanitation, learning resources, human-resource support, counselling and support services, co-curricular access and teacher efforts, the questionnaire offers a structured tool for assessing accessibility provisions in secondary schools. With further confirmatory testing and field-based validation, it can contribute to inclusive education research, teacher education and institutional assessment of school accessibility.

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AUTHOR CONTRIBUTIONS

Miss. Reetumbara Parija : Conceptualization, Methodology, Software, Formal Analysis, Writing – Original Draft, and Visualization.

Mr. Anupam Kumar Patel : Conceptualisation, Methodology, Validation, Supervision, software, and Writing – Review & Editing.

Miss. Sushree Suravita Barik : Investigation, Data Curation, Formal Analysis, Resources, and Writing – Review & Editing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Permission to conduct the study was obtained from the participating institutions. Participants were informed about the purpose of the study, voluntary participation, confidentiality and academic use of data. Informed consent was obtained through the online questionnaire. Formal ethics committee approval was not obtained, which has been acknowledged as a limitation of the study.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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