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INCLUSIVE EDUCATION IN UNIVERSITY GEOGRAPHY: BARRIERS, PEDAGOGICAL CONDITIONS AND A MODALITY-BASED MODEL OF ACCESSIBLE LEARNING

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Abstract

Geography is one of the few university disciplines in which learning is simultaneously visual-cartographic, field-based, digital-analytical and quantitative. Each of these modalities carries a distinct profile of barriers for students with sensory, motor, cognitive and psychosocial needs, yet inclusive-education research treats the discipline mostly through the single lens of fieldwork. The purpose of the study is to systematise the barriers to participation in university geography by learning modality and to substantiate a set of pedagogical conditions under which the discipline's core outcomes can be achieved by all students without lowering academic standards.

The review integrates three bodies of literature: international disability-geography and inclusive-fieldwork research (2002–2022), Universal Design for Learning as the leading framework of inclusive higher education, and Ukrainian policy and empirical work on inclusive higher education, including the standard for speciality 106 Geography. A barriers–modalities matrix was constructed for four modalities (cartographic-visual, field-based,

geoinformation-digital and spatial-quantitative) and four groups of educational needs. Five pedagogical conditions were derived from the matrix: multi-modal representation of spatial information; flexible field-learning design with equivalent alternatives; accessible geoinformation environment; adapted assessment of geographic learning outcomes; and inclusive competence of the teaching staff.

Field-based and cartographic-visual modalities generate the highest concentration of barriers, whereas the geoinformation-digital modality is the strongest compensatory resource when accessibility requirements are met at the design stage. Readiness of academic staff is the system-forming condition. The model offers a discipline-specific operationalisation of inclusion for geography faculties in Ukraine, where the legal framework for inclusive higher education exists but subject-specific methodology remains fragmentary.

Key words: inclusive education; geography; universal design; students with disabilities; higher education; fieldwork

ІНКЛЮЗИВНЕ НАВЧАННЯ В УНІВЕРСИТЕТСЬКІЙ ГЕОГРАФІЇ: БАР'ЄРИ, ПЕДАГОГІЧНІ УМОВИ ТА МОДАЛЬНІСНА МОДЕЛЬ ДОСТУПНОГО НАВЧАННЯ

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Анотація

Географія є однією з небагатьох університетських дисциплін, у яких навчання одночасно є візуально-картографічним, польовим, цифрово-аналітичним і кількісним. Кожна з цих модальностей формує особливий профіль бар'єрів для студентів із сенсорними, руховими, когнітивними та психосоціальними потребами, проте дослідження інклюзивної освіти розглядають дисципліну переважно крізь призму польової практики. Мета дослідження – систематизувати бар'єри участі в університетській географії за модальностями навчання та обґрунтувати сукупність педагогічних умов, за яких ключові результати навчання дисципліни можуть бути досягнуті всіма студентами без зниження академічних вимог.

В огляді інтегровано три масиви літератури: міжнародні дослідження географії

інвалідності та інклюзивної польової практики (2002–2022), універсальний дизайн навчання (UDL) як провідну рамку інклюзивної вищої освіти, а також українську нормативну базу й емпіричні праці з інклюзивної вищої освіти, включно зі стандартом спеціальності 106 Географія. Побудовано матрицю «бар'єри – модальності» для чотирьох модальностей (картографічно-візуальна, польова, геоінформаційно-цифрова, просторово-кількісна) і чотирьох груп освітніх потреб. З матриці виведено п'ять педагогічних умов: мультимодальне подання просторової інформації; гнучке проєктування польового навчання з еквівалентними альтернативами; доступне геоінформаційне середовище; адаптоване оцінювання географічних результатів навчання; інклюзивна компетентність науково-педагогічних працівників.

Найвища концентрація бар'єрів припадає на польову та картографічно-візуальну модальності, тоді як геоінформаційно-цифрова модальність є найпотужнішим компенсаторним ресурсом за умови врахування вимог доступності на етапі проєктування. Готовність викладачів є системоутворювальною умовою. Модель пропонує дисциплінарно специфічну операціоналізацію інклюзії для географічних факультетів України, де правова база інклюзивної вищої освіти існує, але предметна методика залишається фрагментарною.

Ключові слова: інклюзивна освіта; географія; універсальний дизайн; студенти з інвалідністю; вища освіта; польова практика

Introduction

The right of persons with disabilities to inclusive education at all levels, including tertiary education, is fixed in Article 24 of the UN Convention on the Rights of Persons with Disabilities [1] and elaborated in the UNESCO guidance on inclusion and equity in education [2]. The international discussion has moved from access to participation and achievement: Ainscow [3] stresses that inclusion is a process of removing barriers to presence, participation and achievement rather than a placement decision. In Ukraine this shift is reflected in the Law "On Education" [4], the Procedure for organising inclusive education in higher education institutions approved by the Cabinet of Ministers in 2019 [5], and the National Strategy for a barrier-free space until 2030 [6]. At the same time, the higher-education literature consistently reports a gap between declared policy and classroom practice: Moriña [7] identifies attitudinal, methodological and architectural barriers as the most persistent ones in universities, and Fuller et al. [8], in one of the first systematic studies of disabled students at a single university, show that barriers are concentrated not in buildings but in teaching, learning

and assessment.

Geography occupies a specific position in this discussion. It is a discipline whose epistemology is built on seeing, moving through and computing space. Its learning outcomes, as formulated in the Ukrainian standard of higher education for speciality 106 Geography [9], require the graduate to read and construct maps, to collect data in the field, to use geoinformation systems and to apply quantitative methods to spatial data. Each of these requirements presupposes a particular sensory, motor and cognitive configuration of the learner. The disability-geography tradition, beginning with Golledge's survey of geography and the disabled [10] and continued by Kitchin [11] and Gleeson [12], has convincingly shown that space is socially produced as ableist; it is therefore not surprising that the discipline that studies space also reproduces exclusion in the way it is taught.

The most developed strand of research concerns fieldwork. Hall, Healey and Harrison [13, 14] and Hall and Healey [15] demonstrated that disabled geography students in the United Kingdom were routinely excused from, rather than included in, fieldwork, and that "discourses of exclusion" were embedded in the assumptions of staff. The Geography Discipline Network guides [16] were the first attempt to translate these findings into practice. The geoscience-education community in the United States subsequently produced a body of empirical work on accessible field trips [17–21], on the perspectives of autistic geoscientists [22], and on the wider barriers to fieldwork in undergraduate degrees [23, 24]. Recent contributions formulate practical recommendations for the whole family of geography, Earth and environmental sciences [25, 26, 27].

Three limitations of this literature motivate the present study. First, it is almost exclusively concerned with fieldwork and physical or sensory disability, leaving the cartographic, geoinformation and quantitative modalities of geography education, as well as neurodivergent and psychosocial needs, under-theorised. Second, it is descriptive: barriers and good practices are listed, but rarely linked to the structure of the discipline's learning outcomes or to a controllable set of pedagogical conditions; the methodological value of deriving conditions from an explicit matrix rather than from an unordered list has been shown for other specialities [28]. Third, it is Anglophone: Ukrainian research on inclusive higher education has grown rapidly [29–33] but has not yet produced a geography-specific methodology, although the war has made both the number of students with disabilities and the share of distance learning in geography programmes substantially higher [34, 35].

The purpose of the study is to systematise the barriers to participation in university geography according to its learning modalities and to substantiate a set of pedagogical

conditions under which the learning outcomes of speciality 106 Geography can be achieved by students with different educational needs without lowering academic requirements.

Materials and methods

The study is a theoretical review with elements of structural-logical modelling. Three groups of sources were analysed: (1) international peer-reviewed literature on disability geography, inclusive fieldwork and accessible geoscience education published in 1993–2025 and retrieved from Scopus, Web of Science and Google Scholar using the terms "inclusive", "accessible", "disabled students", "fieldwork", "geography education", "tactile map", "GIS accessibility"; (2) framework documents of inclusive education, above all the Universal Design for Learning (UDL) Guidelines [36, 37], the inclusive-pedagogy approach of Florian and Black-Hawkins [38] and the Index for Inclusion [39]; (3) Ukrainian legal acts and empirical studies on inclusive higher education [4–6, 9, 29–35], including the standard of higher education for speciality 106 Geography.

The analytical procedure comprised four steps. In the first step the programme learning outcomes of the standard [9] were grouped into four learning modalities that are specific to geography: cartographic-visual, field-based, geoinformation-digital and spatial-quantitative. In the second step four groups of educational needs were distinguished in accordance with the categories used in the Ukrainian Procedure [5] and in the international literature: sensory (visual and hearing impairment), motor (limited mobility and fine-motor control), cognitive and neurodivergent (dyslexia, dyscalculia, ADHD, autism spectrum) and psychosocial (mental-health conditions, post-traumatic stress, displacement and socio-economic disadvantage). In the third step a 4 × 4 barriers–modalities matrix was populated with barriers documented in the literature; each cell was coded as high (H), medium (M) or low (L) barrier concentration according to the number of independent sources reporting the barrier and the degree to which the barrier blocks a programme learning outcome rather than a particular teaching form. In the fourth step pedagogical conditions were derived as the minimal set of interventions that neutralise all high-concentration cells; each condition was then mapped to the UDL principles of representation, action and expression, and engagement [36].

The study did not involve human participants; ethical approval and informed consent were therefore not applicable.

Results

Learning modalities of university geography and their barrier profiles

The cartographic-visual modality covers reading, interpreting and constructing maps,

aerial and satellite imagery, diagrams and atlases. It is the most pervasive modality: maps appear in almost every geography course, in textbooks and in examinations. For students with visual impairment this modality is the primary barrier. Golledge [10] noted three decades ago that geography had almost nothing to offer blind learners; subsequent research on tactile maps has shown both the potential and the limits of haptic representation: Lawrence and Lobben [40] found that thematic tactile symbols require a dedicated design grammar, and Lobben and Lawrence [41] showed that navigators who are blind rely on environmental features that are seldom included on standard tactile maps. Ukrainian experience of typhlo-technologies in the university environment [29] confirms that screen-readers and Braille displays alone do not make cartographic content accessible: the semantic structure of a map must be re-encoded verbally or haptically. For students with dyslexia and attentional difficulties the barrier is different in kind: dense legends, small fonts and multi-layer symbology overload working memory, a mechanism well documented in inclusive-technology studies of disabled university students [42, 43].

The field-based modality includes excursions, field practices, expeditions and independent data collection outdoors. It is the modality with the richest evidence base and the highest barrier concentration for motor and, to a lesser extent, sensory and psychosocial needs. Hall, Healey and Harrison [13, 14] documented the practice of excusing disabled students from fieldwork and the resulting sense of exclusion; Stokes et al. [20] and Atchison et al. [19] showed, through accessible field courses, that terrain, pace, transport, sanitation and the "one route for all" design, not the field itself, generate the barrier. Giles, Jackson and Stephen [23] extended the argument to financial, cultural and safety barriers, and Kingsbury et al. [22] gave voice to autistic geoscientists for whom sensory overload and unpredictability in the field are the main obstacles. Chiarella and Vurro [24] and Lawrence and Dowey [25] summarise the accumulated experience into practical adaptations: pre-trip information, multiple routes, flexible timing, quiet spaces and clear roles.

The geoinformation-digital modality covers geographic information systems, remote sensing software, web maps, spatial databases and, increasingly, virtual and immersive field environments. Two opposite tendencies coexist here. On the one hand, GIS interfaces are among the least accessible professional software: they are mouse-driven, colour-dependent and poorly supported by screen-readers; Golledge, Rice and Jacobson [44] argued early that multimodal interfaces for geospatial information are required. On the other hand, this modality is the strongest compensatory resource: mobile technologies [21] and immersive technologies [45] make it possible to bring the field to students who cannot reach it, and

digital technologies in general expand access for vulnerable groups [31, 42]. Ukrainian universities that operated "without walls" during the war [34, 35] have shown that the digital modality can become the backbone of the programme, but also that digital inequality and the low digital competence of staff are its main limits [31, 46].

The spatial-quantitative modality includes statistical processing of spatial data, spatial modelling, map algebra and the quantitative interpretation of graphs. Its barriers are least visible and least studied. For students with dyscalculia and for those with attentional difficulties it produces a "silent" barrier that is usually attributed to insufficient ability rather than to the design of instruction; the inclusive-pedagogy literature [38] shows that such attribution is itself a form of exclusion. For blind and low-vision students the barrier is technical: charts, scatterplots and model outputs are rarely provided with data tables or sonification.

Table 1. Barriers-modalities matrix of university geography (H – high, M – medium, L – low barrier concentration)

Learning modality of geography	Sensory needs	Motor needs	Cognitive and neurodivergent needs	Psychosocial needs
Cartographic-visual (maps, imagery, atlases)	H Visual encoding of the whole content; no tactile or verbal equivalent [10, 29, 40, 41]	L Fine-motor drawing tasks only	H Dense symbology, legends, working-memory overload [42, 43]	M Time-pressured map tests; anxiety
Field-based (excursions, practices, expeditions)	M Orientation, hearing instructions outdoors [13, 16]	H Terrain, pace, transport, sanitation, single route [14, 19, 20]	M Sensory overload, unpredictability [22]	H Cost, safety, group dynamics, displacement, trauma [23, 25]
Geoinformation-digital (GIS, remote sensing, web maps, VR)	H Mouse-driven, colour-dependent interfaces [44]	M Precision pointing; compensable by keyboard/voice input	M Interface complexity; compensable by structured tutorials	M Digital inequality, hardware and connectivity [31, 46]

Learning modality of geography	Sensory needs	Motor needs	Cognitive and neurodivergent needs	Psychosocial needs
Spatial-quantitative (spatial statistics, modelling)	M Charts and model outputs without data tables	L Minimal	H Dyscalculia, attention; misattributed to ability [38]	M Mathematics anxiety; deadline pressure

Source: compiled by the author on the basis of [10, 13, 14, 16, 19, 20, 22, 23, 25, 29, 31, 38, 40–44, 46].

Two structural features of the matrix are important. First, high-concentration cells are not evenly distributed: they cluster in the cartographic-visual and field-based modalities, which are precisely the modalities that define the identity of geography as a discipline. This explains why "reasonable accommodation" in geography programmes so often takes the form of exemption rather than adaptation [13]: the barrier touches the core of the discipline, and staff perceive adaptation as a threat to standards. Second, the geoinformation-digital modality is the only one in which every cell can be reduced to low concentration by design decisions that do not depend on the individual student; it therefore functions as the compensatory axis of the whole model.

Pedagogical conditions for inclusive university geography

Five pedagogical conditions were derived as the minimal set neutralising all high-concentration cells of Table 1. They are formulated at the level of the programme and the department, not of the individual course, because the analysis of the international experience shows that course-level adaptations without programme-level support remain fragile [7, 8].

Condition 1. Multi-modal representation of spatial information. Every cartographic product used for teaching and assessment is available in at least two modalities: visual, and verbal-structured (a text description following a fixed scheme: location, extent, pattern, anomaly) or haptic (tactile map, 3D-printed relief). This condition directly implements the UDL principle of multiple means of representation [36] and neutralises the sensory and cognitive cells of the cartographic-visual modality. The evidence on tactile symbols [40, 41] shows that the haptic alternative must be designed, not merely converted.

Condition 2. Flexible design of field learning with equivalent alternatives. Field practices are designed around learning outcomes rather than around a route: each outcome is achievable through at least two of the following – an accessible on-site route, a peer-mediated data-collection role, a virtual or remote-sensing field environment, or a data-analysis task

using data collected by the group. Pre-trip information, quiet zones, flexible timing and explicit roles are standard elements [20, 24, 25, 27]. The condition neutralises the motor and psychosocial cells of the field-based modality without removing the student from the field community, which Atchison et al. [19] identify as the decisive factor of successful inclusion.

Condition 3. Accessible geoinformation environment. The department selects and configures software and web-mapping platforms according to accessibility criteria: keyboard operability, screen-reader compatibility, colour-blind-safe palettes, exportable data tables for every chart and map. Mobile and immersive technologies are used deliberately as compensatory tools [21, 45], and staff digital competence is developed systematically [31, 46]. This condition converts the geoinformation-digital modality from a barrier into the compensatory axis of the model.

Condition 4. Adapted assessment of geographic learning outcomes. Assessment measures the outcome, not the modality: a student may demonstrate the ability to interpret spatial distribution through a map, a verbal description, a data table or a model output. Time extensions and format alternatives are planned at the syllabus stage rather than negotiated individually, which reduces the stigma reported by disabled students [8, 43]. This condition implements the UDL principle of multiple means of action and expression [36] and neutralises the high cognitive cell of the spatial-quantitative modality.

Condition 5. Inclusive competence of the teaching staff. Academic staff of geography departments receive discipline-specific training in inclusive pedagogy: not general awareness sessions but work with concrete cases of the four modalities. The inclusive-pedagogy research [38] and the analysis of pedagogical conditions in other specialities [28] converge in showing that staff readiness is the system-forming condition: without it, the other four are implemented formally. Attitudinal research [47] also shows that attitudes towards persons with disabilities are malleable and respond to structured contact.

Table 2. Mapping of pedagogical conditions to UDL principles and to the high-concentration cells of the matrix

Pedagogical condition	UDL principle [36]	High-concentration cells neutralised	Key evidence
1. Multi-modal representation of spatial information	Representation	Cartographic × sensory; cartographic × cognitive	[10, 29, 40, 41, 42]
2. Flexible field design with equivalent	Engagement; Action and expression	Field × motor; field × psychosocial	[13, 14, 19, 20, 22, 25]

Pedagogical condition	UDL principle [36]	High-concentration cells neutralised	Key evidence
alternatives			
3. Accessible geoinformation environment	Representation; Action and expression	GIS × sensory (and all GIS cells to low)	[21, 31, 44, 45, 46]
4. Adapted assessment of learning outcomes	Action and expression	Quantitative × cognitive; cartographic × cognitive	[8, 38, 43]
5. Inclusive competence of teaching staff	All three (system-forming)	All cells indirectly	[7, 28, 38, 47]

Source: compiled by the author.

Discussion

The proposed model differs from the existing literature in three respects. First, it treats geography as a multi-modal discipline rather than as "fieldwork plus lectures". The concentration of research on fieldwork [13–27] is understandable – it is the modality in which exclusion is most visible – but it has left the cartographic and quantitative modalities without an inclusive methodology, although they generate barriers of comparable severity for students with visual impairment and with cognitive or neurodivergent needs. The matrix makes these "silent" barriers visible and, importantly, shows that they are addressed by different conditions than fieldwork barriers.

Second, the model locates the compensatory potential of the discipline in its geoinformation-digital modality. This finding is consistent with the international evidence on mobile and immersive technologies in field learning [21, 45] and with Ukrainian experience of "universities without walls" [34, 35], but it must be qualified. Digital compensation works only if accessibility is a design criterion at the moment of software selection; retrofitting is ineffective, as Seale et al. [43] show from the perspective of disabled students themselves. It also depends on the digital competence of staff and on the digital inequality of students [31, 46], which in wartime Ukraine is itself a psychosocial barrier. The digital modality should therefore be understood as a compensatory axis that requires investment, not as a cost-free solution.

Third, the model derives conditions from an explicit matrix and maps them to the UDL framework. This has a practical consequence for Ukrainian geography faculties: the Procedure of 2019 [5] obliges institutions to provide reasonable accommodation, but does not say what accommodation means in a discipline whose learning outcomes are spatial. The five

conditions offer a discipline-specific reading of the Procedure that is compatible with the standard for speciality 106 [9]: none of the conditions lowers a programme learning outcome; each changes the modality through which the outcome is demonstrated. This directly answers the concern, documented by Hall, Healey and Harrison [14], that inclusion threatens academic standards.

The study has limitations. It is a theoretical review; the coding of barrier concentration reflects the density of the literature, which is itself biased towards fieldwork and towards Anglophone contexts, so the medium cells of the matrix may be under-estimated. The four groups of educational needs are broad, and intersectional needs (for example, a displaced student with a hearing impairment) are not modelled separately. The conditions have not yet been tested empirically in a Ukrainian geography programme; the natural next step is a design-based study in which the matrix is validated with students with disabilities and staff of geography faculties, and the conditions are implemented and evaluated across one academic year. The experience of accessible field courses in geoscience [17, 19, 20] suggests that a multiple-case design with mixed methods is appropriate.

Practical implications for geography departments are concrete. A department can audit its programme against Table 1 by asking, for each course, in which modality its outcomes are assessed and whether an equivalent modality exists. The audit typically reveals that the cartographic-visual modality is monopolistic in assessment and that field practices are route-driven rather than outcome-driven. Both findings are correctable within one curriculum cycle and do not require additional infrastructure, only redesign; the six-step and ten-step guides for inclusive fieldwork [25, 26] and the UDL Guidelines [37] provide operational checklists. The condition that requires the largest investment – the accessible geoinformation environment – coincides with the direction in which geography programmes are already moving for reasons unrelated to inclusion, which makes it politically feasible.

Conclusions

1. University geography is a multi-modal discipline whose four learning modalities – cartographic-visual, field-based, geoinformation-digital and spatial-quantitative – have distinct barrier profiles for students with sensory, motor, cognitive and neurodivergent, and psychosocial educational needs. Barriers are concentrated in the cartographic-visual and field-based modalities, that is, in the disciplinary core, which explains why accommodation in geography has historically taken the form of exemption.

2. The geoinformation-digital modality is the only one in which all barriers can be reduced to low concentration by design decisions independent of the individual student; it

constitutes the compensatory axis of inclusive geography education, provided that accessibility is a criterion of software selection and that the digital competence of staff and the digital inequality of students are addressed.

3. Five pedagogical conditions – multi-modal representation of spatial information; flexible field design with equivalent alternatives; accessible geoinformation environment; adapted assessment of geographic learning outcomes; and inclusive competence of teaching staff – form the minimal set neutralising all high-concentration barriers. The fifth condition is system-forming. None of the conditions lowers a programme learning outcome of the standard for speciality 106 Geography; each changes only the modality through which the outcome is demonstrated.

4. The model provides a discipline-specific operationalisation of the Ukrainian Procedure for organising inclusive education in higher education institutions and a basis for auditing geography programmes. Its empirical validation in Ukrainian geography faculties, using a design-based multiple-case study, is the priority direction of further research.

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