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Developing Students' Cultural Competence Through Cultural Geography Education: The Role of Project-Based Learning and Digital Technologies

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Abstract: Increasing cultural diversity and globalization require higher education institutions to prepare future geography teachers who can work effectively in culturally diverse environments. Developing cultural competence has therefore become an important objective of geography teacher education, requiring instructional approaches that combine disciplinary knowledge with authentic learning experiences and digital innovation. This study investigated the effectiveness of integrating project-based learning (PBL) and digital technologies into a Cultural Geography course to enhance university students' cultural competence. A mixed-methods quasi-experimental design was employed involving 73 second-year geography students, including 35 students in the control group and 38 students in the experimental group. The intervention was implemented over one academic semester. Quantitative data were collected using the Cultural Competence Questionnaire and analysed through mixed repeated-measures ANOVA, while qualitative data from classroom observations, reflective journals, and project reports were analysed using thematic analysis. The results showed that students in the experimental group achieved significantly greater improvements than the control group across all dimensions of cultural competence, including cultural knowledge, cultural sensitivity, cultural skills, and cultural interaction. Qualitative findings further indicated that project-based learning, cultural mapping, and digital technologies, including NetLogo, AnyLogic, and Cesium, enhanced students' engagement, spatial thinking, collaborative inquiry, and understanding of cultural phenomena. Although the study was limited by its relatively small sample from a single university and the one-semester duration of the intervention, the findings provide empirical evidence that integrating project-based learning with digital technologies represents an effective pedagogical approach for strengthening cultural competence in geography teacher education and offers practical implications for competence-oriented curriculum development in higher education.

Keywords: *cultural competence, cultural geography, project-based learning, digital technologies, geography teacher education, higher education.*

Introduction

Rapid globalization, international mobility, and digital transformation have substantially increased cultural interaction across contemporary societies. As a result, higher education institutions are expected to prepare graduates who can engage effectively with culturally diverse communities while preserving cultural heritage and promoting intercultural understanding. Such challenges are particularly relevant in Kazakhstan, where cultural diversity and historical heritage play an important role in shaping national identity. Tirkey (2022) argues that globalization simultaneously stimulates cultural innovation and transforms long-established cultural practices, creating a need to balance openness to global influences with the preservation of cultural heritage.

These developments have increased the importance of cultural competence in education. Educational institutions are expected not only to transmit knowledge but also to prepare learners to engage ef-

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fectively in culturally diverse environments. In this context, cultural competence is increasingly associated with the ability to understand cultural differences, communicate across cultural boundaries, and participate constructively in multicultural societies. Byram (1997) and Cross et al. (1989) emphasize that such competence extends beyond factual knowledge and encompasses values, attitudes, and behavioural dispositions that support meaningful intercultural interaction.

The complexity of cultural competence has led researchers to conceptualize it as a multidimensional construct. Effective participation in culturally diverse contexts requires not only knowledge of cultural traditions and social practices but also openness toward cultural differences and the ability to apply these qualities in authentic situations. Flaskerud (2007) associates these dimensions with cultural knowledge, cultural sensitivity, and community interaction, highlighting the interconnected nature of cultural competence development.

Within higher education, identifying effective approaches to developing cultural competence has become an important educational priority. Geography occupies a distinctive position in this process because it examines the relationships among people, culture, and space. Through the study of cultural landscapes, place identity, and spatial behaviour, geography encourages students to explore how cultural processes are expressed in different geographical contexts. Morgan (2001) notes that geography education provides opportunities to investigate cultural identities and human experiences of place alongside natural and economic processes.

Among the branches of geography, Cultural Geography offers particularly strong potential for addressing issues related to culture and identity. The field focuses on the spatial organisation of cultural phenomena and examines how meanings, values, and social practices become embedded in places and landscapes. Hall and Johnston-Anumonwo (2016) emphasize that cultural landscapes, ethnocultural regions, and processes of cultural diffusion provide important perspectives for understanding the relationship between culture and space.

The educational value of Cultural Geography extends beyond disciplinary knowledge. Learning activities involving cultural landscapes, regional cultural characteristics, and cultural mapping encourage students to explore cultural diversity from geographical perspectives. Such experiences strengthen spatial reasoning, analytical thinking, and awareness of cultural differences while creating meaningful opportunities for competence-oriented learning.

Despite growing scholarly interest in cultural competence, most existing studies have examined its development within language education, teacher education, healthcare, and intercultural communication. Comparatively less attention has been devoted to investigating how discipline-specific courses can systematically foster cultural competence through authentic learning experiences.

Within geography education, Cultural Geography offers considerable potential for developing students' understanding of cultural diversity through the study of place, landscape, and spatial relationships. However, empirical evidence regarding the integration of project-based learning and digital technologies into Cultural Geography for the purpose of developing cultural competence remains limited. Accordingly, there is a need to design and empirically evaluate instructional approaches that integrate Cultural Geography with project-based learning and digital technologies to strengthen students' cultural competence in higher education.

Accordingly, this study aimed to examine the effectiveness of a Cultural Geography course integrating project-based learning and digital technologies in developing students' cultural competence. To achieve this aim, the following objectives were established:

- To analyze the theoretical foundations and structural components of cultural competence;
- To identify the pedagogical potential of Cultural Geography for fostering cultural competence;
- To design and implement a Cultural Geography course integrating project-based learning and digital technologies;
- To evaluate the effectiveness of the proposed instructional approach through a pedagogical experiment.

Accordingly, the study addressed the following research question:

To what extent does a Cultural Geography course integrating project-based learning and digital technologies contribute to the development of students' cultural competence?

Literature Review

Theoretical Foundations of Cultural Competence

The increasing cultural diversity of contemporary societies has positioned cultural competence as a fundamental outcome of higher education. Universities are expected not only to develop students' disciplinary knowledge but also to prepare graduates who can communicate effectively, collaborate across cultures, and respond responsibly to global social and cultural challenges. Consequently, cultural competence has become closely associated with global citizenship, social inclusion, and education for sustainable development (Byram, 1997; Cross et al., 1989).

Cultural competence is widely recognised as a multidimensional construct incorporating cognitive, affective, and behavioural dimensions. Deardorff (2006) conceptualises cultural competence as the integration of cultural knowledge, attitudes, skills, and appropriate behaviour that enables individuals to interact effectively in culturally diverse contexts. Similarly, Flaskerud (2007) emphasises that cultural competence extends beyond awareness of cultural differences to include empathy, respect, and the ability to adapt communication and behaviour across cultural settings.

Recent international educational frameworks further reinforce the importance of cultural competence within higher education. UNESCO (2021) highlights intercultural dialogue, cultural diversity, and global responsibility as essential educational priorities, while the OECD (2018) identifies global competence as a key outcome that enables learners to analyse global issues, appreciate multiple perspectives, and engage constructively with individuals from different cultural backgrounds. More recent research suggests that digital competence and intercultural competence are becoming increasingly interconnected as higher education integrates technology-rich learning environments. Digital learning environments support collaborative inquiry, intercultural communication, and authentic learning experiences that contribute to competence-oriented education (Vojteková et al., 2023; Lee, 2023).

Despite extensive research in teacher education, healthcare, and language education, comparatively little attention has been devoted to examining how Cultural Geography can systematically contribute to the development of cultural competence. This gap highlights the need for discipline-specific pedagogical models that integrate geographical inquiry with competence-oriented learning.

Pedagogical Potential of Cultural Geography

Culture and geographical space are inherently interconnected, making Cultural Geography a valuable disciplinary context for developing students' cultural competence. The discipline explores cultural landscapes, place identity, cultural diffusion, ethnocultural regions, and the spatial organisation of human activities, enabling students to understand how culture is shaped by geographical processes (Morgan, 2001; Winders, 2014; Hall and Johnston-Anumonwo, 2016.

From an educational perspective, Cultural Geography supports inquiry-based and student-centred learning by encouraging learners to investigate authentic geographical problems through fieldwork, cultural mapping, spatial analysis, and collaborative investigation. These learning experiences foster critical thinking, spatial reasoning, intercultural awareness, and reflective learning while connecting theoretical concepts with real-world cultural phenomena.

The educational potential of Cultural Geography is further strengthened through the integration of project-based learning and digital technologies. Contemporary geography education increasingly incorporates Geographic Information Systems (GIS), digital mapping platforms, geospatial simulations, virtual learning environments, and immersive technologies to support active learning and spatial inquiry. Recent studies demonstrate that web-based GIS, augmented reality, virtual reality, and mobile learning improve students' spatial thinking, inquiry skills, collaborative learning, and engagement in geography education (Vojteková et al., 2023; Lee, 2023). Empirical evidence from higher geography education further supports these findings. Grobelski et al. (2023) demonstrated that project-based geography courses enabled undergraduate students to develop stronger geographical inquiry skills, intercultural understanding, collaborative learning, and ethical awareness through authentic research projects. Similarly, Yan et al. (2023) reported that blended GIS-supported learning significantly improved students' learning experiences, motivation, and perceived learning outcomes in higher education by integrating active learning with digital geospatial technologies.Systematic reviews further indicate that successful implementation depends on

adequate teacher preparation, curriculum design, and technological infrastructure.

Consequently, integrating project-based learning with geospatial technologies provides opportunities for students to investigate authentic cultural issues, construct knowledge collaboratively, and develop competencies required for professional practice in increasingly digital and culturally diverse societies.

Empirical Research on Developing Cultural Competence

Empirical research consistently demonstrates that active learning approaches contribute more effectively to competence development than traditional lecture-based instruction. Project-based learning encourages students to investigate authentic problems, collaborate with peers, reflect on their experiences, and apply theoretical knowledge in practical contexts. Such learning environments have been associated with improvements in intercultural understanding, communication, critical thinking, and self-directed learning (Thomas, 2000; Bell, 2010; Deardorff, 2006).

The growing integration of digital technologies has further expanded opportunities for competence-oriented learning in geography education. Recent literature reviews indicate that GIS applications, geospatial technologies, digital mapping platforms, and virtual learning environments enhance students' spatial reasoning, motivation, collaborative inquiry, and digital competence while supporting more authentic and interactive learning experiences (Vojteková et al., 2023; Panjaitan et al., 2023). Nevertheless, these reviews also identify persistent challenges related to infrastructure, teacher preparedness, and effective pedagogical integration.

Recent empirical studies also provide evidence that project-based and technology-supported geography education positively influences students' engagement and disciplinary competencies. For example, Grobelski et al. (2023) found that project-based learning transformed students' understanding of geography from factual knowledge acquisition to active geographical inquiry through authentic collaborative projects. Likewise, Cascante-Campos (2023) demonstrated that university instructors who perceived greater pedagogical value in geospatial technologies were significantly more likely to adopt GIS-based teaching practices, highlighting the importance of digital pedagogy in higher geography education.

Although the educational benefits of project-based learning and digital technologies have been widely acknowledged, empirical evidence concerning their combined application within Cultural Geography remains limited. Most previous studies have focused on geography education broadly, digital competence, or technology integration, whereas comparatively few have investigated how project-based learning and digital technologies jointly contribute to the development of cultural competence through Cultural Geography. Furthermore, relatively few studies have adopted mixed-methods designs that combine quantitative evidence of learning outcomes with qualitative analysis of students' learning experiences.

Although previous studies have demonstrated the educational benefits of project-based learning and digital technologies, little empirical evidence has examined their combined contribution to cultural competence development within Cultural Geography courses in higher education. Accordingly, the present study addresses this gap by investigating the effectiveness of a Cultural Geography course integrating project-based learning and digital technologies using a mixed-methods quasi-experimental design. By combining quantitative and qualitative evidence, the study seeks to provide a more comprehensive understanding of how competence-oriented geography education can support the development of university students' cultural competence.

Materials and methods

Research Design

This study employed a quasi-experimental research design using a pre-test–post-test control group approach to examine the effectiveness of a Cultural Geography course integrating project-based learning (PBL) and digital technologies in developing university students' cultural competence. A quasi-experimental design was selected because the participants were enrolled in existing academic groups, making random assignment impractical.

The study involved two groups. The experimental group participated in a redesigned Cultural Geography course that incorporated project-based learning activities and digital technologies, while the control group studied the same course using conventional lecture-based instruction and standard classroom activities. Both groups completed identical questionnaires before and after the instructional intervention.

The intervention was conducted over 15 weeks, with three academic hours of instruction per week, during the first semester of the academic year. The effectiveness of the instructional approach was evaluated by comparing pre-test and post-test results within and between the two groups.

The study adopted a mixed-methods approach by integrating quantitative and qualitative data. Quantitative findings from the quasi-experimental design were complemented by qualitative data obtained from students' reflective journals, classroom observations, and project reports to provide a more comprehensive understanding of the intervention outcomes.

This study adopted an explanatory sequential mixed-methods design, in which quantitative findings from the quasi-experimental phase were subsequently explained and enriched through qualitative analysis of reflective journals, classroom observations, and project reports.

Participants

The participants were 73 second-year undergraduate students enrolled in the Geography Teacher Education programme at Abai Kazakh National Pedagogical University, Kazakhstan. Participants ranged in age from 18 to 21 years and had successfully completed introductory Geography courses but had not previously studied Cultural Geography as a separate university course.

Because the study was conducted within an authentic educational setting, random assignment was not feasible. Instead, two existing academic classes were used. One intact class was designated as the experimental group (n = 38; 18 females and 20 males), while the other served as the control group (n = 35; 20 females and 15 males). Group allocation was established before the beginning of the semester according to the university timetable and was not influenced by the researchers.

All second-year students enrolled in the Cultural Geography course during the study period were invited to participate. Eligibility criteria included enrolment in the course, regular class attendance throughout the semester, and completion of both the pre-test and post-test questionnaires. No participants withdrew during the study, and complete datasets were obtained from all 73 students; therefore, no missing data treatment was required.

Both groups were taught by the same instructor over a 15-week semester (three academic hours per week) and followed the same Cultural Geography syllabus, learning objectives, assessment schedule, and contact hours. The only difference between the two groups was the instructional approach. The experimental group participated in project-based learning activities supported by digital technologies, whereas the control group received conventional lecture-based instruction and standard classroom activities. This design helped minimise potential instructor-related variation and ensured that differences in learning outcomes could be more confidently attributed to the instructional intervention.

Participation in the study was voluntary. Before data collection, all participants were informed about the purpose of the research and provided written informed consent. Participant anonymity and confidentiality were maintained throughout the study, and all collected data were anonymised before analysis.

The sample size was determined by the number of students enrolled in the Cultural Geography course during the study period. As the study employed intact academic classes in a quasi-experimental design, no additional sampling procedure was undertaken. Although no *a priori* statistical power analysis was performed, all eligible students available during the intervention were included in the study.

Before data collection, all participants received information about the purpose of the study, the voluntary nature of participation, confidentiality procedures, and their right to withdraw from the study at any stage without academic consequences. Written informed consent was obtained from all participants prior to participation. All data were anonymized before analysis and used solely for research purposes in accordance with the ethical principles of the Declaration of Helsinki.

Research Instruments

A researcher-developed questionnaire was designed to assess students' cultural competence in the context of the Cultural Geography course. The instrument was developed specifically for this study based on an extensive review of the literature on cultural competence, cultural geography education, project-based learning, and digital learning environments. The questionnaire consisted of 30 items organised into four dimensions: Cultural Knowledge (8 items), Cultural Sensitivity (7 items), Cultural Skills (8 items), and Cultural Interaction (7 items). Responses were measured using a five-point Likert scale ranging from

1 (strongly disagree) to 5 (strongly agree).

To establish content validity, the questionnaire was reviewed by two academic experts, including a professor specialising in Geography and a professor specialising in Pedagogy. Their recommendations were incorporated to improve the clarity, relevance, and comprehensiveness of the questionnaire before data collection.

The reliability of the instrument was assessed using Cronbach's alpha coefficient (Cronbach, 1951). The questionnaire demonstrated high internal consistency across all four dimensions: Cultural Knowledge ($\alpha = 0.887$), Cultural Sensitivity ($\alpha = 0.901$), Cultural Skills ($\alpha = 0.913$), and Cultural Interaction ($\alpha = 0.882$). The overall reliability coefficient for the 30-item questionnaire was $\alpha = 0.921$, indicating excellent internal consistency.

Construct validity was evaluated using Exploratory Factor Analysis (EFA). The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.907, indicating excellent suitability for factor analysis. Bartlett's Test of Sphericity was statistically significant ($\chi^2(435) = 1248.56$, $p < .001$), confirming that the correlation matrix was appropriate for factor analysis and supporting the four-dimensional structure of the questionnaire.

In addition to the cultural competence questionnaire, students completed a separate five-item scale measuring the perceived pedagogical contribution of digital technologies. This scale was treated as an intervention-related outcome reflecting students' perceptions of the instructional approach rather than as a dimension of cultural competence. Therefore, pedagogical impact scores were analysed separately and were not included in the calculation of the overall cultural competence score.

Instructional Intervention

The instructional intervention was implemented over a 15-week semester, with three academic hours of instruction per week. Both the experimental and control groups studied the same Cultural Geography curriculum, covering identical learning objectives, thematic content, and assessment requirements. The same instructor taught both groups, ensuring consistency in course delivery, instructional time, and assessment procedures. The only difference between the two groups was the teaching approach adopted during the intervention.

The experimental group participated in a project-based learning (PBL) programme supported by digital technologies. Students worked collaboratively in small groups to investigate authentic cultural geography issues, including cultural landscapes, cultural heritage, regional identity, cultural diversity, and sustainable cultural development. Throughout the semester, students designed and implemented inquiry-based projects involving cultural mapping, spatial data analysis, field observations, collaborative discussions, digital storytelling, and project presentations. Each project required students to collect, analyse, and interpret cultural-geographical information before presenting evidence-based solutions to real-world cultural challenges.

To support project implementation, several digital technologies were integrated into the learning process. Geographic Information Systems (GIS) were used for spatial data analysis and digital cultural mapping. Cesium provided three-dimensional visualisation of cultural landscapes and heritage sites. NetLogo enabled students to simulate cultural diffusion processes and explore spatial interaction patterns, while AnyLogic was employed to model human–environment relationships and population dynamics. Additional digital platforms were used for collaborative learning, presentation design, and reflective learning activities. These technologies encouraged active participation, collaborative inquiry, and the development of digital and spatial thinking skills.

In contrast, the control group received conventional lecture-based instruction following the standard university curriculum. Teaching methods primarily included lectures, textbook-based learning, teacher explanations, classroom discussions, and individual written assignments. Although both groups studied identical course content and were assessed using the same criteria, the control group did not participate in project-based learning activities or use the digital technologies incorporated into the experimental intervention.

Student learning was evaluated using identical assessment criteria in both groups to ensure comparability of learning outcomes. Assessment included project tasks, classroom participation, written assignments, presentations, and the pre-test and post-test cultural competence questionnaire. A detailed

description of the weekly instructional activities, project tasks, digital technologies employed, and assessment rubric is provided in Appendix A to facilitate replication of the intervention.

Data Collection Procedure

Data collection was conducted in three stages. During the first week of the semester, all participants completed the pre-test questionnaire to determine their initial level of cultural competence. Following the pre-test, the experimental group participated in the project-based learning intervention integrated with digital technologies, while the control group continued with conventional instruction over the 15-week semester.

At the end of the intervention, all participants completed the post-test questionnaire using the same instrument administered before the intervention. The collected data were anonymised and coded prior to statistical analysis to ensure confidentiality and accuracy.

Before data collection, all participants received information about the purpose of the study, the voluntary nature of participation, confidentiality procedures, and their right to withdraw from the study at any stage without academic consequences. Written informed consent was obtained from all participants prior to participation. All data were anonymized before analysis and used solely for research purposes in accordance with the ethical principles of the Declaration of Helsinki.

Data Analysis

The collected data were analysed using IBM SPSS Statistics (Version 27). Descriptive statistics, including means and standard deviations, were calculated to summarise students' performance before and after the intervention.

The reliability of the questionnaire was assessed using Cronbach's alpha coefficient, while construct validity was evaluated through Exploratory Factor Analysis (EFA), supported by the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity.

Prior to the intervention, independent-samples t-tests were conducted to examine baseline equivalence between the experimental and control groups. The effectiveness of the instructional intervention was then evaluated using mixed repeated-measures analysis of variance (ANOVA), with group (experimental vs. control) as the between-subjects factor and time (pre-test vs. post-test) as the within-subjects factor. This analysis was performed to determine whether changes in students' cultural competence over time differed significantly between the two groups.

Effect sizes were reported using partial eta squared (η^2) to assess the magnitude of the intervention effects. Statistical significance was established at $p < .05$.

Results

Baseline Comparison of the Study Groups

Before evaluating the effectiveness of the intervention, baseline equivalence between the control and experimental groups was assessed using independent-samples *t*-tests. As presented in Table 1, no statistically significant differences were observed between the two groups across any measured variable ($p > .05$). The control and experimental groups demonstrated comparable baseline levels of cultural knowledge, cultural sensitivity, cultural skills, cultural interaction, students' perceived pedagogical contribution of digital technologies, and overall cultural competence.

Because this study employed a quasi-experimental design using intact classes rather than random assignment, the absence of statistically significant baseline differences should not be interpreted as evidence of complete group equivalence. Therefore, the effectiveness of the intervention was evaluated primarily through mixed repeated-measures ANOVA, which directly examined changes over time between the two groups.

Table 1. *Baseline comparison of cultural competence between the control and experimental groups*

Outcome	Control (n = 35) Mean ± SD	Experimental (n = 38) Mean ± SD	p
Cultural knowledge	3.21 ± 0.54	3.25 ± 0.58	.731
Cultural sensitivity	3.34 ± 0.49	3.29 ± 0.52	.684
Cultural skills	3.17 ± 0.56	3.20 ± 0.51	.792
Cultural interaction	3.28 ± 0.53	3.31 ± 0.55	.765
Pedagogical impact of digital technologies	3.12 ± 0.61	3.15 ± 0.57	.814
Overall cultural competence	3.22 ± 0.48	3.24 ± 0.50	.756

Note. Independent-samples *t*-tests revealed no statistically significant baseline differences between the control and experimental groups across any outcome variable (all $p > .05$)

Effects of the Cultural Geography Intervention

To examine the effectiveness of the intervention, mixed repeated-measures ANOVA was conducted for each outcome variable. This analysis assessed whether changes in students' cultural competence over time differed between the control and experimental groups.

Descriptive statistics indicated improvements in both groups between the pre-test and post-test assessments; however, improvements were consistently greater in the experimental group. These descriptive trends were subsequently confirmed by the mixed repeated-measures ANOVA.

Mixed repeated-measures ANOVA demonstrated statistically significant Group × Time interaction effects for every measured outcome. Significant interaction effects were found for overall cultural competence ($F(1,71)=219.34$, $p<.001$, partial $\eta^2=.755$), cultural knowledge ($F(1,71)=568.46$, $p<.001$, partial $\eta^2=.889$), cultural sensitivity ($F(1,71)=139.44$, $p<.001$, partial $\eta^2=.663$), cultural skills ($F(1,71)=224.31$, $p<.001$, partial $\eta^2=.760$), cultural interaction ($F(1,71)=98.71$, $p<.001$, partial $\eta^2=.582$), and students' perceived pedagogical contribution of digital technologies ($F(1,71)=28.18$, $p<.001$, partial $\eta^2=.284$).

According to Cohen's (1988) guidelines, the interaction effects ranged from moderate to large, with the strongest effects observed for cultural knowledge, cultural skills, and overall cultural competence.

Table 2. *Mixed repeated-measures ANOVA results for changes in cultural competence outcomes*

Outcome	Control Pre	Control Post	Experimental Pre	Experimental Post	Group × Time F(1,71)	p	Partial η^2
Cultural knowledge	3.21 ± 0.54	3.38 ± 0.49	3.25 ± 0.58	4.32 ± 0.45	568.46	< .001	.889
Cultural sensitivity	3.34 ± 0.49	3.46 ± 0.47	3.29 ± 0.52	3.98 ± 0.48	139.44	< .001	.663
Cultural skills	3.17 ± 0.56	3.35 ± 0.51	3.20 ± 0.51	4.21 ± 0.43	224.31	< .001	.760
Cultural interaction	3.28 ± 0.53	3.44 ± 0.49	3.31 ± 0.55	4.15 ± 0.46	98.71	< .001	.582
Pedagogical impact of digital technologies	3.12 ± 0.61	3.29 ± 0.55	3.15 ± 0.57	4.41 ± 0.40	28.18	< .001	.284
Overall cultural competence	3.22 ± 0.48	3.38 ± 0.42	3.24 ± 0.50	4.21 ± 0.38	219.34	< .001	.755

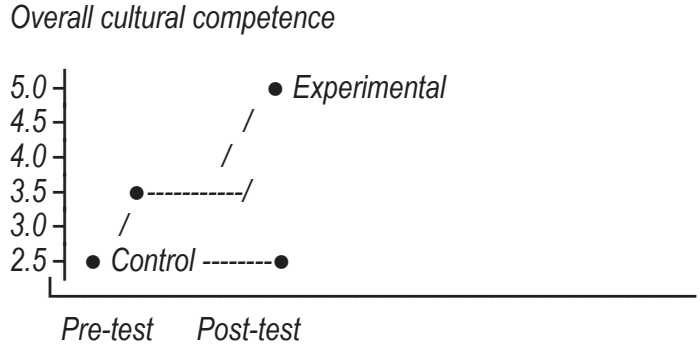

Figure 1. *Estimated marginal means of overall cultural competence at pre-test and post-test (95% confidence intervals)*

Changes in Individual Dimensions of Cultural Competence

To facilitate interpretation of the intervention effects, mean pre-post change scores (Δ) were calculated for each outcome variable (Table 3).

The experimental group demonstrated substantially greater improvements than the control group across all measured dimensions. The largest improvement was observed in students' perceived pedagogical contribution of digital technologies (Δ = 1.26), followed by cultural knowledge (Δ = 1.07) and cultural skills (Δ = 1.01). Improvements were also evident for cultural interaction (Δ = 0.84) and cultural sensitivity (Δ = 0.69). In contrast, students in the control group demonstrated only modest improvements across all measured variables.

Overall cultural competence increased by 0.97 points in the experimental group compared with 0.16 points in the control group, corresponding to an additional improvement of 0.81 points following the intervention.

Table 3. *Mean pre-post change (Δ) in cultural competence outcomes*

Outcome	Control (Δ)	Experimental (Δ)	Difference
Cultural knowledge	0.17	1.07	0.90
Cultural sensitivity	0.12	0.69	0.57
Cultural skills	0.18	1.01	0.83
Cultural interaction	0.16	0.84	0.68
Students' perceived pedagogical contribution of digital technologies	0.17	1.26	1.09
Overall cultural competence	0.16	0.97	0.81

Note: Δ = Post-test mean − Pre-test mean

As shown in Table 3, the experimental group demonstrated greater improvements than the control group across every measured outcome. The largest between-group differences were observed for students' perceived pedagogical contribution of digital technologies and cultural knowledge, whereas the smallest difference was found for cultural sensitivity.

Qualitative Findings

Qualitative findings were used to support the interpretation of the quantitative results rather than to provide an in-depth qualitative evaluation of the intervention. Data collected from students' reflective journals, classroom observations, and project reports were analysed using thematic analysis following the six-phase approach proposed by Braun and Clarke (2006). The qualitative data were coded and analysed by the first author through repeated reading of the data, generation of initial codes, identification and refinement of themes, and review of thematic consistency. Four recurring themes were identified that complemented and explained the quantitative findings obtained from the mixed repeated-measures ANOVA.

Theme 1. Strengthening cultural knowledge through cultural mapping

Reflective journals and classroom observations indicated that cultural mapping activities enhanced students' understanding of cultural landscapes, sacred sites, and regional identities. Students demonstrated greater confidence in interpreting cultural phenomena using geographical concepts and spatial thinking. These observations are consistent with the substantial quantitative improvement observed in

cultural knowledge. One student noted, "Creating cultural maps helped me understand how cultural traditions are connected to geographical space" (Participant 12).

Theme 2. Digital technologies enhanced learning engagement

Students frequently described GIS applications, NetLogo, AnyLogic, and Cesium as valuable learning resources that supported the visualisation and interpretation of cultural phenomena. Classroom observations suggested that these technologies increased engagement, participation, and motivation throughout the learning process. These findings correspond with the improvement observed in students' perceived pedagogical contribution of digital technologies. As one participant reflected, "Using NetLogo and GIS made cultural processes easier to visualise and understand than traditional lectures" (Participant 21).

Theme 3. Project-based learning promoted cultural skills and interaction

Project-based learning encouraged collaboration, communication, and shared problem-solving. Students demonstrated greater confidence in collecting, analysing, organising, and presenting geographical information while working collaboratively with classmates. Classroom observations likewise indicated higher levels of participation and collaborative engagement. These findings support the quantitative improvements observed in cultural skills and cultural interaction. A student commented, "Working on projects with classmates improved my communication and teamwork skills" (Participant 8).

Theme 4. Increased cultural awareness and sensitivity

Reflective journals suggested that participation in the course increased students' awareness of Kazakhstan's cultural diversity, historical heritage, and regional traditions. Students also demonstrated greater appreciation of different cultural perspectives and recognised the importance of preserving cultural heritage. These observations complement the quantitative improvement identified in the cultural sensitivity dimension. One participant wrote, "The course helped me appreciate the cultural diversity of Kazakhstan from a geographical perspective" (Participant 15).

Integration of Quantitative and Qualitative Findings

The qualitative findings provided contextual explanations for the statistically significant improvements observed in the quantitative analyses. While the mixed repeated-measures ANOVA demonstrated significant Group × Time interaction effects across all measured dimensions, the qualitative evidence suggested that project-based learning, cultural mapping, collaborative learning, and digital technologies created meaningful learning experiences that supported the development of students' cultural competence.

The qualitative findings converged with the quantitative results by providing explanatory evidence for the statistically significant Group × Time interaction effects. Students consistently described how project-based learning, collaborative inquiry, cultural mapping, and digital technologies enhanced their understanding of cultural phenomena, strengthened cultural interaction, and increased engagement. Thus, the qualitative evidence supported the interpretation of the quantitative findings rather than serving as an independent source of theory generation.

Discussion

Interpretation of the Main Findings

The present study investigated whether integrating project-based learning (PBL) and digital technologies into a Cultural Geography course could enhance university students' cultural competence. The findings demonstrated that students who participated in the intervention achieved significantly greater improvements than those in the control group across all measured dimensions of cultural competence, including cultural knowledge, cultural sensitivity, cultural skills, and cultural interaction. Qualitative findings further indicated that project-based learning, cultural mapping, collaborative inquiry, and digital technologies created authentic learning experiences that strengthened students' engagement and supported the development of intercultural understanding. These findings reinforce the conceptualisation of cultural competence as a multidimensional construct comprising cognitive, affective, and behavioural dimensions that develop through meaningful educational experiences rather than through factual knowledge alone (Byram, 1997; Deardorff, 2006).

One explanation for these findings lies in the pedagogical characteristics of project-based learning. Rather than relying on teacher-centred instruction, students investigated authentic cultural-geographical

problems, analysed cultural landscapes, interpreted regional identities, produced digital cultural maps, and collaborated with peers throughout the semester. Such learning experiences encouraged active knowledge construction, reflection, communication, and collaborative problem-solving. These results are consistent with previous studies showing that project-based learning enhances higher-order thinking, collaboration, and authentic learning in higher education (Thomas, 2000; Bell, 2010). They also support Grobelski et al. (2023), who demonstrated that project-based geography education promotes geographical inquiry, collaborative learning, and intercultural understanding through authentic research activities.

The findings further highlight the educational value of Cultural Geography as a disciplinary context for competence-oriented learning. By examining relationships among culture, place, identity, and geographical space, students developed a deeper understanding of cultural diversity and the spatial processes shaping cultural landscapes. Unlike instructional approaches that address culture primarily from historical or sociological perspectives, Cultural Geography enables students to investigate cultural phenomena through spatial inquiry and geographical interpretation. These findings are consistent with previous work emphasising the contribution of Cultural Geography to understanding cultural landscapes, place identity, and spatial relationships (Morgan, 2001; Hall and Johnston-Anumonwo, 2016; Winders, 2014).

Digital technologies represented another essential component of the instructional intervention. The integration of GIS applications, NetLogo, AnyLogic, and Cesium enabled students to visualise cultural landscapes, construct digital cultural maps, simulate geographical processes, and analyse cultural phenomena from spatial perspectives. Rather than functioning solely as technological resources, these tools supported inquiry-based learning, collaborative investigation, and the development of spatial thinking. These findings are consistent with Kerski (2008), who emphasised the contribution of geospatial technologies to geographical inquiry, and with Wilensky and Rand (2015), who highlighted the educational value of modelling environments for analysing complex systems. They also align with recent empirical evidence showing that digital geospatial technologies improve students' spatial reasoning, collaborative inquiry, motivation, and disciplinary learning outcomes in higher education (Lee, 2023; Yan et al., 2023; Vojteková et al., 2023).

Finally, the findings support current international educational priorities that emphasise competence-oriented learning, intercultural understanding, and digital innovation. UNESCO (2021) identifies cultural diversity, global citizenship, and education for sustainable development as central goals of higher education, while the OECD Global Competence Framework (OECD, 2018) highlights learners' ability to understand multiple perspectives and engage constructively in culturally diverse societies. The instructional model examined in this study demonstrates how Cultural Geography, project-based learning, and digital technologies can be integrated to support these international educational priorities while providing an evidence-based approach for strengthening cultural competence among future geography teachers.

Practical Implications, Limitations, and Future Research Directions

The findings have several practical implications for geography teacher education and curriculum development. First, they suggest that Cultural Geography courses can extend beyond the transmission of disciplinary knowledge by incorporating authentic project-based activities that promote cultural competence alongside geographical understanding. Integrating project-based learning, cultural mapping, and digital technologies may simultaneously strengthen intercultural awareness, spatial reasoning, collaboration, communication, and problem-solving skills. These competencies are increasingly recognised as essential outcomes of higher education within international educational frameworks (UNESCO, 2021; OECD, 2018).

Second, the instructional approach presented in this study provides a practical model for curriculum innovation in geography education. Combining competence-oriented pedagogy with geospatial technologies may contribute to the modernisation of Cultural Geography curricula while supporting educational programmes related to cultural heritage, sustainability, and global citizenship. The proposed approach may also be valuable for teacher education programmes preparing future educators to work in culturally diverse learning environments.

Several limitations should be acknowledged. The study involved 73 students from a single university and employed a quasi-experimental design using intact classes; therefore, the findings should be interpreted cautiously and should not be generalised beyond similar educational contexts. Furthermore, the intervention lasted one academic semester, which may not have been sufficient for the long-term development of some dimensions of cultural competence, particularly cultural sensitivity and intercultural at-

titudes. Finally, because the study focused exclusively on Cultural Geography, further research is required before extending these findings to other academic disciplines.

Future research should investigate the effectiveness of this instructional approach across multiple universities, cultural contexts, and disciplinary settings. Longitudinal studies involving larger and more diverse samples would provide stronger evidence regarding the sustainability of competence development over time. Future investigations could also explore the educational potential of emerging technologies, including artificial intelligence, advanced Geographic Information Systems (GIS), immersive virtual environments, and digital mapping platforms, for supporting competence-oriented learning in geography education.

Conclusions

This study examined the effects of integrating project-based learning and digital technologies into a university Cultural Geography course on the development of students' cultural competence. The findings indicated that students who participated in the intervention demonstrated greater improvements in cultural knowledge, cultural sensitivity, cultural skills, and cultural interaction than those who received conventional instruction. The qualitative findings further suggested that project-based activities, cultural mapping, collaborative learning, and the use of digital technologies contributed to students' engagement and intercultural learning experiences.

The results suggest that combining project-based learning with digital technologies may provide an effective pedagogical approach for supporting competence-oriented learning in Cultural Geography. By engaging students in authentic geographical inquiry and collaborative problem-solving, the instructional approach created opportunities for connecting theoretical knowledge with real-world cultural contexts. These findings are consistent with current educational priorities that emphasise active learning, intercultural understanding, and the development of transferable competencies in higher education.

From a practical perspective, the study provides an example of how Cultural Geography courses may be redesigned to integrate project-based learning and digital technologies in ways that support students' cultural competence. The proposed instructional approach may also be relevant for curriculum development in geography teacher education and related fields that emphasise cultural diversity, sustainability, and global citizenship.

Several limitations should be acknowledged when interpreting these findings. The study was conducted with a relatively small sample from a single higher education institution using a quasi-experimental design over one academic semester. Therefore, the findings should be interpreted with caution and should not be generalised beyond similar educational contexts without additional empirical evidence.

Future research should examine the effectiveness of this instructional approach across different universities, cultural settings, and academic disciplines. Longitudinal studies involving larger and more diverse samples would provide a better understanding of the long-term development of cultural competence. In addition, future research could explore the potential of emerging technologies, including artificial intelligence, immersive virtual environments, and advanced geospatial tools, to further support competence-oriented learning in Cultural Geography.

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Conflict of interests

The authors declare no conflict of interest.

Data availability statement

The anonymized data supporting the findings of this study are available from the corresponding author upon reasonable request. For more information in this regard, please see:
https://www.ijcrsee.com/index.php/ijcrsee/journal_policies

Informed Consent Statement

Written informed consent was obtained from all participants involved in the study. Participants were informed that their participation was voluntary, that they could withdraw from the study at any time without penalty, and that their responses would remain anonymous and confidential

Institutional Review Board Statement

This study was conducted within the framework of routine educational practice at a higher education institution and involved minimal risk to participants. According to institutional regulations governing educational research, formal approval from an Institutional Review Board or Ethics Committee was not required. The research was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participation was voluntary, all participants were informed about the purpose and procedures of the study before data collection, and written informed consent was obtained from each participant. Participant confidentiality and anonymity were maintained throughout the study, and all data were anonymized prior to analysis.

Author Contributions

Conceptualization, A.S. and K.K.; methodology, A.S. and K.K.; software, Z.M., I.K., and Y.S.; formal analysis, A.S. and A.B.; writing—original draft preparation, A.S., K.K., Z.M., I.K., A.B., and Y.S.; writing—review and editing, A.A., K.K., and Y.S. All authors have read and agreed to the published version of the manuscript.

References

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. The Clearing House: *A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43. https://doi.org/10.1080/00098650903505415

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Byram, M. (1997). Teaching and assessing intercultural communicative competence. Multilingual Matters.

Cascante-Campos, A. (2023). Adopting and using geospatial technologies for teaching geography in Latin American higher education. *Journal of Geography in Higher Education*, 47(3), 467–484. https://doi.org/10.1080/03098265.2022.2122028

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika,* 16(3), 297–334. https://doi.org/10.1007/BF02310555

Cross, T., Bazron, B., Dennis, K., & Isaacs, M. (1989). Towards a culturally competent system of care: A monograph on effective services for minority children who are severely emotionally disturbed. Georgetown University Child Development Center.

Deardorff, D. K. (2006). The identification and assessment of intercultural competence as a student outcome of internationalization. *Journal of Studies in International Education,* 10(3), 241–266. https://doi.org/10.1177/1028315306287002

Flaskerud, J. H. (2007). Cultural competence: What is it? Issues in *Mental Health Nursing*, 28(1), 121–123. https://doi.org/10.1080/01612840600998154

Grobelski, T., Versluis, A., & McClelland, J. (2023). Discovering geography through doing geography: Project-based learning in an introductory undergraduate world geography course. *Journal of Geography*, 122(2), 31–42. https://doi.org/10.1080/00221341.2023.2189743

Hall, C., & Johnston-Anumonwo, I. (2016). Perspectives on cultural geography in AP Human Geography. *Journal of Geography,* 115(3), 106–111. https://doi.org/10.1080/00221341.2015.1101148

Kerski, J. J. (2008). The role of GIS in Digital Earth education. *International Journal of Digital Earth*, 1(4), 326–346. https://doi.org/10.1080/17538940802420879

Lee, J. (2023). Beyond geospatial inquiry: How can we integrate the latest technological advances into geography education? *Education Sciences*, 13(11), 1128. https://doi.org/10.3390/educsci13111128

Morgan, J. (2001). Popular culture and geography education. International Research in Geographical and Environmental *Education,* 10(3), 284–297. https://doi.org/10.1080/10382040108667446

OECD. (2018). Preparing our youth for an inclusive and sustainable world: The OECD PISA Global Competence Framework. OECD Publishing.

Panjaitan, B. R., Ningrum, E., & Waluya, B. (2023). Digital learning tools in geography education: A systematic literature review. *The Eurasia Proceedings of Educational and Social Sciences,* 33, 135–143. https://doi.org/10.55549/epess.1413355

Thomas, J. W. (2000). A review of research on project-based learning. Autodesk Foundation.

Tirkey, C. A. (2022). Globalization and cultural resilience: Transformations and challenges in India. *Stallion Journal for Multidisciplinary Associated Research Studies*, 1(6), 67–70. https://doi.org/10.55544/sjmars.1.6.9

UNESCO. (2021). Reimagining our futures together: A new social contract for education. UNESCO Publishing.

Vojteková, J., Vojtek, M., Žoncová, M., & Repaská, G. (2023). Digital technologies in geography teaching. *Curriculum and Teaching*, 38(1), 85–111. https://doi.org/10.7459/ct/38.1.06

Wilensky, U., & Rand, W. (2015). An introduction to agent-based modeling: Modeling natural, social, and engineered complex systems with NetLogo. MIT Press.

Winders, J. (2014). From journals to classrooms: Theory and teaching in cultural geography. *Journal of Cultural Geography*, 31(2), 230–244. https://doi.org/10.1080/08873631.2014.906855

Yan, Y., Feng, C.-C., & Leong, L. K. B. (2023). Complex adaptive blended learning for higher GIS education: A theory-driven pedagogy moving forward after the pandemic. *Transactions in GIS*, 27(5), 1479–1502. https://doi.org/10.1111/tgis.13084

Appendix A

Table A1. Week-by-week instructional framework

Week	Topic	PBL Activity	Digital Tool	Learning Outcome
1	Introduction to Cultural Geography	Formation of project groups	Moodle	Understand course objectives
2	Cultural landscapes	Field observation	GIS	Identify cultural landscapes
3	Cultural mapping	Digital cultural map	ArcGIS/QGIS	Develop spatial thinking
4	Regional identity	Community investigation	Google Earth	Analyse regional identity
5	Cultural heritage	Photo documentation	Cesium	Visualise heritage sites
6	Cultural diffusion	Simulation	NetLogo	Model diffusion processes
7	Population and culture	Scenario modelling	AnyLogic	Analyse human-environment interaction
8	Interim project presentation	Peer feedback	Canva	Improve collaboration
9	Ethnocultural regions	GIS analysis	ArcGIS	Interpret spatial patterns
10	Sacred places	Field mapping	Cesium	Digital heritage representation
11	Cultural conflicts	Case study	NetLogo	Problem solving
12	Sustainable cultural development	Project work	GIS	Integrate SDGs
13	Digital storytelling	Video preparation	Canva	Communication skills
14	Final project	Presentation	PowerPoint	Project defence
15	Reflection and evaluation	Portfolio & reflection	LMS	Reflect on competence development

Table A2. *Project assessment rubric*

Criterion	Description	Weight (%)
Project quality	Completeness, organisation, and originality of the project	30
Cultural analysis	Accuracy and depth of cultural-geographical analysis	25
Use of digital technologies	Appropriate use of GIS, NetLogo, AnyLogic, Cesium, and other digital tools	20
Presentation	Clarity of oral presentation and visual communication	15
Reflection	Critical reflection on learning outcomes and cultural competence development	10
Total		100