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Making Individual Learning Visible in Collaborative Outdoor Fieldwork: Assessing 21st-Century Skills in Undergraduate Geography

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Abstract

Geography fieldwork combines outdoor, place-based learning with authentic tasks, yet assessment often privileges collective products over individually attributable evidence. This study developed and evaluated an assessment model for a multi-day undergraduate geography fieldwork program in Indonesia, focusing on critical thinking, creativity, innovation, collaboration, communication, and information technology (IT) literacy. A two-cycle research-and-development design with mixed methods involved 30 students in 2024 and 100 students in 2025. The 2024 initial model examined performance, project, and portfolio assessment using multiple regression; the 2025 revised model was examined using structural equation modeling in AMOS. Interviews with two supervisors and two student leaders were analyzed using the Strengths, Opportunities, Aspirations, and Results (SOAR) framework. In 2024, performance assessment was the only individually significant predictor, while the three assessment variables jointly explained 62.1% of the variance in the skills outcome. In 2025, performance assessment remained the strongest path, and project assessment was non-significant; the portfolio path was significant, although the reported AMOS outputs were internally inconsistent in direction. Model-fit indices indicated a weak global fit, so the 2025 structural paths were interpreted with caution. Qualitative findings emphasized direct experience, contextual problem solving, collaboration, structured supervision, and individually attributable assessment evidence as priorities for strengthening fieldwork learning.

Introduction

Learning outside the classroom is a central feature of geography education because geographical concepts are often best understood through direct engagement with places, environments, and communities. Fieldwork allows students to connect classroom knowledge with observations, measurements, interviews, mapping, and interpretation in real settings. In the broader literature on outdoor learning, experiences beyond the conventional classroom are valued for creating opportunities for contextual, experiential, and socially situated learning (Behrendt & Franklin, 2014; Neville et al., 2023). Geography fieldwork is therefore not simply an excursion; when deliberately designed, it is an authentic learning environment in which disciplinary knowledge and practice are developed together.

The educational value of fieldwork extends beyond content acquisition. Studies across geography, science, teacher education, and other applied disciplines indicate that well-designed field experiences can strengthen motivation, teamwork, communication, confidence, and the ability to apply theory in practice (Djonko-Moore & Joseph, 2016; Fine et al., 2016; Kandamby, 2018; Zaragoza & Fraser, 2017). These outcomes are especially relevant to contemporary higher education, where students are expected to work collaboratively, evaluate information, communicate across contexts, use digital technologies, and respond constructively to unfamiliar problems.

Assessment is therefore a critical component of fieldwork design. Recent work in tertiary outdoor education has documented a broad range of assessment practices and highlighted the importance of authentic assessment that resembles the competencies students are expected to demonstrate in

professional practice (Polley et al., 2025). Field activities commonly involve preparation, data collection, analysis, presentation, and reporting, yet these stages do not always generate equally interpretable evidence of individual learning. A final group report, map, or portfolio may represent a strong collective outcome while revealing little about how each student reasoned, communicated, solved problems, or contributed to the work. Research on fieldwork assessment similarly shows wide variation in what is assessed, who assesses it, and how individual and group performances are combined (Ferns & Moore, 2012; Sian, 2014).

This problem is particularly important when fieldwork is intended to develop 21st-century skills. The present study focuses on six competencies: critical thinking, creativity, innovation, collaboration, communication, and IT literacy. The first four overlap with widely used learning-and-innovation frameworks, while IT literacy reflects the increasingly digital character of field data collection, mapping, information retrieval, analysis, and communication. Previous studies show that these competencies can be supported by active, contextual, and technology-mediated learning, but their development depends on task design and on how participation is structured and evaluated (Fitriati & Prayudi, 2021; Kurniawan et al., 2019; Larson & Miller, 2011).

Recent research on university geography fieldwork reveals a consistent tension between the rich learning opportunities afforded by field experiences and the extent to which those outcomes are explicitly designed, documented, and assessed. Although fieldwork is widely regarded as central to undergraduate geography, its curricular integration can remain uneven, with learning outcomes and purposes for data collection not always clearly specified (Arı, 2020). At the same time, studies of skills development suggest that fieldwork does not produce uniform gains across competencies: improvements are more apparent in critical thinking, problem solving, adaptability, communication, and interpersonal learning, while other attributes are less consistently demonstrated and may vary according to how learning is evidenced (Ito & Igano, 2021; Praskievicz, 2023). This problem is reinforced by evidence that transferable skills can operate as a “hidden curriculum,” recognized by instructors but not consistently articulated in module documentation or assessment guidance (Peasland et al., 2024). Taken together, these studies suggest that the central question is no longer simply whether fieldwork can foster broader competencies, but how convincingly those competencies are made visible through assessment. Across this literature, comparatively less attention has been given to whether different assessment forms within the same fieldwork programme—particularly observable individual performance versus collaboratively produced projects and portfolios—provide equally interpretable evidence of individual competence. The present study addresses this issue by examining how performance, project, and portfolio assessments relate to students’ critical thinking, creativity, innovation, collaboration, communication, and IT literacy.

This distinction creates a level-of-attribution problem when group scores are used to explain individual competencies. Performance assessment can be linked to an individual's observable participation, whereas project and portfolio assessment may be attached to shared products. The distinction matters because an assessment can be authentic as a task but still provide weak evidence about a particular student's competence if individual contributions are not visible. Extending current discussions of

authentic assessment in tertiary outdoor education, therefore, requires attention not only to what assessment tasks are used, but also to the validity and interpretability of the evidence they generate (Polley et al., 2025).

Outdoor assessment also presents practical constraints that differ from conventional classroom assessment. Instructors cannot continuously observe every student while groups are dispersed across a field site, interacting with residents, handling equipment, mapping, or collecting data. Assessment may consequently depend on episodic observations, collective artifacts, and retrospective evidence. Such conditions increase the importance of transparent criteria, repeated observation where feasible, and complementary evidence that can distinguish individual learning from group performance (Ferns & Moore, 2012; France & Haigh, 2018).

The skills themselves are also multidimensional and context-dependent. Collaboration may be visible in role negotiation and task coordination; communication in presentations and community interactions; and IT literacy in digital mapping, data processing, and information management. Critical thinking and creativity are less directly observable unless tasks require students to justify methodological choices, evaluate conflicting information, develop alternatives, and defend interpretations. Consequently, no single assessment product is likely to represent the full range of learning that occurs during fieldwork.

Against this background, this study developed and evaluated a fieldwork assessment model across two annual iterations of an undergraduate geography fieldwork program in Indonesia. It asked: (1) how performance, project, and portfolio assessments are associated with students' 21st-century skills; (2) which skills are most strongly represented in the two fieldwork iterations; and (3) what implementation strategies are identified by supervisors and student leaders as important for strengthening fieldwork learning? The study contributes to outdoor and environmental education research by examining whether assessments based on individual performance and collective products provide comparable evidence of competence, and by identifying practical strategies to make individual learning more visible in collaborative fieldwork.

Conceptual Background

Geography fieldwork as outdoor and place-based learning

In this article, fieldwork refers to structured learning outside the conventional classroom in which students investigate geographical phenomena directly. The program examined here is closer to a short residential field course than to a brief excursion: students prepare research plans and instruments, spend several days collecting primary data in communities and field settings, process the data, and produce maps, reports, posters, and presentations. This structure reflects the long-standing role of fieldwork in geography as a bridge between conceptual knowledge and direct investigation (France & Haigh, 2018; Lambert & Reiss, 2016).

Fieldwork also creates a setting in which disciplinary and transferable skills are intertwined. Students must coordinate tasks, communicate with community members and peers, adapt to field conditions, and translate raw observations into systematic evidence. Kandamby (2018), for example, found that the field study supported teamwork through task organization, knowledge sharing, discussions with field personnel, and the completion of time-bound targets. Outdoor and place-based learning can therefore provide the contextual conditions in which students enact, rather than merely describe, the skills expected in academic and professional practice.

Assessment and 21st-century skills

Assessment determines which fieldwork processes become visible as evidence of learning. Performance assessment emphasizes what students do during authentic tasks, such as data collection, discussion, presentation, and field coordination. Project assessment evaluates the planning and production of a substantial output over time, while portfolio assessment assembles products or evidence intended to represent learning. In fieldwork, these approaches can complement one another, but they do not necessarily operate at the same level. A performance score may be individual, whereas a project report or map may be produced and graded collectively.

Authentic assessment is most useful when the assessment situation resembles the knowledge, skills, and judgments required beyond the assessment itself. Polley et al. (2025) argue for authentic assessment in tertiary outdoor education because outdoor fieldwork can make graduate capabilities visible in practice. For the present study, this principle is extended to the attribution of evidence: authentic group products remain educationally valuable, but claims about individual competence are stronger when evidence can be linked to a particular student's actions or reasoning.

This distinction is also important for the validity of assessment in collaborative learning. A shared product can validly represent what a group accomplished while remaining an incomplete measure of what each member knows or can do. Conversely, direct observation may capture individual participation but miss the quality of the collective product or the learning that occurs through interaction. A defensible fieldwork assessment system, therefore, benefits from multiple sources of evidence that are interpreted according to what each source can support. In practice, this means distinguishing claims about group achievement from claims about individual competence and avoiding the assumption that one automatically represents the other. Such alignment between task, evidence, and inference is especially important in outdoor fieldwork, where learning is distributed across people, places, technologies, and successive stages of activity.

The assessment model examined here combines performance, project, and portfolio evidence. It also distinguishes the 2024 initial model from the 2025 revised model because the portfolio product and the method for rating 21st-century skills changed between cycles. Performance, project, and portfolio assessments differ not only in product but also in temporal focus: performance assessments capture

actions as learning unfolds; project assessments emphasize the completion of an extended task; and portfolio assessments are intended to assemble representative evidence of learning.

Who provides the skill rating is also consequential. Peer assessment can capture how group members experience one another's participation over time, whereas self-assessment reflects students' own judgments of competence. Both can provide useful information, but they are not interchangeable measures. Differences between peer and self-ratings may reflect perspective, group dynamics, confidence, or response tendencies rather than changes in the underlying skill. Comparisons between the two annual skill profiles are therefore descriptive rather than longitudinal.

Methods

Design and participants

The study used a two-cycle research-and-development design informed by Borg and Gall's (1983) staged model and combined quantitative and qualitative methods. The first cycle in 2024 tested an initial assessment model, while the second cycle in 2025 implemented a revised model. The research population comprised approximately 200 students enrolled in undergraduate programs in geography education and geography at a public university in Indonesia. Purposive sampling was used because participation was tied to enrollment in the annual fieldwork program.

The quantitative sample comprised 30 students in the 2024 cycle and 100 students in the 2025 cycle. The 2024 fieldwork was conducted in the villages of Sendangsari and Sitiharjo, Garung District, Wonosobo Regency, Central Java. The 2025 fieldwork was conducted in Rempoah Village, Baturraden District, Banyumas Regency, Central Java. The qualitative component involved two fieldwork supervisors as key informants and two student fieldwork leaders as supporting informants.

Fieldwork program and assessment model

The fieldwork program lasted approximately five days and was organized around socio-economic inquiry and mapping. Student groups investigated themes including mapping, livestock, village leadership, family education, tourism, population dynamics, disaster management, women's roles, formal education, agriculture and plantations, and micro-, small-, and medium-sized enterprises. The program was structured into three stages. Before fieldwork, students prepared proposals, research instruments, and presentations. During fieldwork, they presented plans and collected field data. After fieldwork, they processed data and produced posters or maps, final reports, and presentations.

Three assessment forms were examined. Performance assessment (X1) captured student performance during data collection, meetings, discussions, and presentations. Project assessment (X2) was based on the final group report. Portfolio assessment (X3) used a poster in the 2024 cycle; in the 2025 revised cycle, it was changed to a mapping product more closely aligned with geography program outputs. The

outcome construct (Y) represented six 21st-century skills: critical thinking, creativity, innovation, collaboration, communication, and IT literacy.

Measures and data collection

In 2024, 21st-century skills were rated using peer assessment: students evaluated other members of their group, and the resulting ratings were averaged. In 2025, the same six skill domains were retained, but the rating method was changed to self-assessment. This change was part of the model revision and is important when interpreting differences between the two cohorts. Performance observations were supported by a review of recordings from meetings, presentations, and group discussions so that individual participation could be evaluated beyond a single observation. Qualitative data were collected through in-depth interviews with the two supervisors and two student leaders. Interview content addressed the strengths of the fieldwork program, opportunities for improvement, aspirations for future implementation, and perceived outcomes in knowledge, skills, attitudes, and work readiness.

Data analysis

For the 2024 cycle, multiple linear regression was used to examine associations between the three assessment variables and the 21st-century skill outcome. The source analysis reports tests for normality, multicollinearity, heteroscedasticity, and autocorrelation before interpreting the regression model. For the 2025 cycle, the revised model was analyzed using structural equation modeling in AMOS. Path coefficients and global model-fit statistics were examined. Because model fit is necessary for interpreting structural relations with confidence (Kline, 2016), the 2025 paths were interpreted with caution when global fit was weak. Interview data were organized using the Strengths, Opportunities, Aspirations, and Results (SOAR) framework, a strengths-based approach to strategic inquiry (Stavros & Hinrichs, 2009). Supervisor and student responses were compared to identify areas of convergence and implementation priorities.

Results

2024 initial assessment model

The 2024 initial model showed a consistent pattern across individual predictors. Performance assessment was significantly associated with the 21st-century skills outcome ($p < .001$), whereas project assessment ($p = .500$) and portfolio assessment ($p = .160$) were not statistically significant (Table 1).

Table 1
Significance of individual predictors in the 2024 multiple regression model

Model	Sig.
Performance	.000
Project	.500
Portfolio	.160

The overall regression model was statistically significant ($p < .001$). The multiple correlation was $R = .788$, and the coefficient of determination was $R^2 = .621$ (Table 2), indicating that the three assessment variables jointly accounted for 62.1% of the variance in the 2024 skills outcome. The adjusted R^2 was .577 and the Durbin-Watson statistic was 2.062. These statistics describe the association within the 2024 sample and should not be interpreted as evidence of causal effects.

Table 2
Model summary for the 2024 multiple regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.788[a]	.621	.577	4.44436	2.062

Figure 1 **21**st-century skill profile in the 2024 fieldwork cycle based on peer assessment

The 2024 skill profile placed IT literacy highest, followed by creativity, communication, collaboration, innovation, and critical thinking (Fig. 1). Critical thinking was the lowest-ranked domain in this cycle. Because the 2024 outcome was based on peer assessment, the profile should be interpreted as peers' evaluations of competence within group-based fieldwork rather than as an independent standardized test of each skill.

2025 revised assessment model

The revised model was implemented during the 2025 fieldwork in Rempoah Village. Performance assessment remained tied to observable field and presentation activities. The project component continued to use the final report, while the portfolio output was changed from a poster to a map. The six skill domains were retained, but the rating method changed from peer assessment to self-assessment. The 2025 data were analyzed in AMOS (Fig. 2).

The reported global fit of the 2025 structural model was weak: $\chi^2(249) = 1154.524$, $p < .001$; $\chi^2/df = 4.637$; GFI = .568; AGFI = .480; NFI = .623; CFI = .675; TLI = .639; and RMSEA = .192. These indices do not support a strong claim that the proposed structural model fits the data well. The path estimates are

therefore interpreted as exploratory relationships within this sample rather than as evidence that the revised model was fully validated.

Table 3
Regression weights for the 2025 revised model

			Estimate	S.E.	C.R.	P	Result
21st - century Skills	**←**	**Performance Assessment**	**,734**	**,123**	**5,988**	**,000**	**Significant (Influential)**
21st - century Skills	←	Project Assessment	,011	,012	,929	,353	Not Significant (Not Influential)
21st - century Skills	←	Portfolio Assessment	,168	,067	2,502	,012	Significant (Influential)

Performance assessment showed the strongest positive association with 21st-century skills (C.R. = 5.988, $p < .001$), while the project assessment path was non-significant (C.R. = .929, $p = .353$) (Table 3). The portfolio path was statistically significant ($p = .012$), but the supplied AMOS outputs are internally inconsistent in direction: Table 3 presents a positive unstandardized estimate (.168), whereas the structural diagram and source narrative depict a negative standardized path of approximately − .21. For that reason, only the statistical significance of the portfolio path is retained in the interpretation, without assigning a direction to the relationship. The 2025 self-assessment profile is shown in Fig. 3.

Self-assessment in 2025 produced a different ranking from the 2024 peer-assessment profile. Collaboration was highest, followed by IT literacy, communication, critical thinking, innovation, and creativity (Fig. 3). Because both the cohort and the rating method changed, the figures should be used to describe the skill pattern within each cycle rather than to infer improvement or decline between years.

Qualitative SOAR findings

The SOAR analysis indicated substantial convergence between supervisors and student leaders (Table 4). Respondents emphasized direct field practice, contextual learning, primary data collection, mapping, problem-solving, and operational support, such as equipment and permits. Opportunities centered on collaboration, independence, community interaction, stronger guidance for final outputs, and external partnerships. Aspirations included varied sites, improved scheduling, collaboration with other universities and government, and research outputs that could be published or used by communities. Reported results included direct knowledge, data-processing and presentation skills, communication, teamwork, responsibility, confidence, discipline, decision making, and problem solving.

Table 4
SOAR findings from supervisors and student leaders

	Name	Supervisor	Student	Conclusion
STRENGTH	Strengths	- Sharpening problems using a geographical approach - Applying knowledge directly in the field	- Sharpening problems using a geographical approach - Directly practicing knowledge gained in lectures	- Direct field practice - Problem Solving
	Characteristics of Fieldstudy	- Direct information from the field through observation - Field-based learning that emphasizes direct experience	- Direct experience, integration of theory and practice, contextual - Data collection in the field together	- Direct experience - Contextual
	Parts of Fieldstudy that support competence	- Field observation - Primary data collection - Direct mapping on site	- Field implementation - Report writing	- Field data collection - Data processing
	Facilities or support provided by the campus	- Survey equipment - Permits	- Survey equipment - Administrative letters	- Equipment - Permits
OPPORTUNITY	Opportunities	- Cross-disciplinary collaboration	- New friends - Life lessons	- Collaboration between friends and disciplines
	Understanding the real world	- Problem solving - Language barriers - More sensitive - Interacting with the community	- Independence - Reality	- Independence - Communication
	Improvement in implementation quality	- Learning resources - Partnerships - Final report becomes an article	- Guidance in the final report	- Intensive guidance in final report

Note. Interview data were processed using the SOAR framework (2025).

	Involvement of third parties	- More structured	- Sponsorship helps with funding	- Helps with funding - More structured
ASPIRATION	Aspirations and hopes	- Implementation by professional EO - Collaboration with other campuses - Publication output	- Intensive guidance	- Intensive and collaborative guidance with other campuses
	Location selection	- Varied - Does not clash with other schedules	- New, non-commercial places - Time management so it does not clash with classes	- Varied - Time management
	Activity achievements	- Published research - Cooperation with City/District government	- Direct impact on society	- Research published and used by society
	Development focus	- Comprehensive learning experience - Output can be an ISBN book - Article presented	- Become a scientific paper	- Book or article publication - Share your research with the scientific community
	Relationship between parties	- Collaborative, communicative, and mutually supportive - Teamwork	- Coordination - Cooperation	- Cooperation - Coordination - Collaborative
RESULT	Knowledge aspect	- Student management in the field - Fostering professional attitudes in real situations	- Direct experience	- Student management in the field - Direct knowledge
	Skills aspect	- Communication with different characters - Field coordination - Adaptation to field conditions	- Obtaining data - Processing data - Presenting data	- Systematic framework - Obtaining, processing, presenting data

Note. Interview data were processed using the SOAR framework (2025).

Attitude aspect	- Discipline - Responsibility - Able to work together - More sensitive - Professional attitude	- Polite in communication - Systematic mindset	- Cooperation - Communication - Responsibility - Professional attitude
Prepare for the world of work	- Analytical skills - Problem Solving - Teamwork - Data collection	- Confidence - Discipline - Responsibility	- Responsibility - Teamwork - Problem Solving
Positive changes after the activity	- Ability to express ideas and thoughts - Confidence - Discipline - Communication	- Confidence - Discipline - Independence - Communication skills - Decision making	- Confidence - Discipline - Communication skills - Decision making - Ideas and thoughts

Note. Interview data were processed using the SOAR framework (2025).

Across the SOAR dimensions, the most consistent implementation priority was to preserve the authenticity of the field experience while making supervision and assessment more structured. Supervisors and student leaders did not describe fieldwork merely as a data-collection exercise; they viewed it as a setting in which academic, interpersonal, and professional learning occurred together.

Discussion

The most stable quantitative finding across the two cycles was the role of performance assessment. In both 2024 and 2025, performance assessment was the component most clearly associated with the 21st-century skills outcome. This result is educationally plausible because performance assessment was tied to observable behavior during meetings, discussions, data collection, and presentation. These are the settings in which communication, collaboration, problem-solving, and field decision-making are enacted. In tertiary outdoor education, authentic assessment is similarly valued when students demonstrate their capabilities in contexts that resemble professional practice (Polley et al., 2025). The present findings add that the evidentiary value of an assessment also depends on whether the performance can be attributed to the individual student whose competence is being inferred.

The weaker results for project assessment and the ambiguous portfolio result need to be understood in relation to the unit of assessment. In the program examined here, project and portfolio products were generated and scored at the group level, while 21st-century skills were interpreted as individual competencies. A high-quality group report or map does not necessarily show which student formulated an argument, solved a field problem, managed the data, or communicated with stakeholders. This mismatch can attenuate relationships between collective products and individual outcomes. The finding does not imply that reports, maps, or portfolios are educationally unimportant. Instead, it suggests that such products should be accompanied by individually attributable evidence when they are used to make claims about individual competence.

The 2025 portfolio coefficient requires particular caution. The AMOS output indicates statistical significance, but the direction differs between the supplied regression-weight table and the structural diagram, and the overall model fit is poor. In addition, the portfolio product changed from posters to maps, and the skill-rating method changed from peer assessment to self-assessment. Under these conditions, the result should not be used to claim either a beneficial or detrimental portfolio effect. A more defensible conclusion is that the present data do not provide stable evidence about how a group portfolio score represents an individual's 21st-century skills. Accordingly, a stronger interpretation is not warranted from the evidence currently documented.

The skill profiles nevertheless illustrate why fieldwork is a productive environment for broader learning. IT literacy was the highest-ranked skill in 2024 and remained among the strongest in 2025. Contemporary geography fieldwork requires students to search for information, manage digital documents, work with mapping tools, process data, and prepare digital outputs. Digital literacy is therefore embedded in the workflow rather than added as a separate classroom topic. Prior research with university students likewise emphasizes the need to combine technical access with responsible interpretation and use of information (Khoirunnisa & Habibah, 2020; Restianty, 2018).

Collaboration became the highest-ranked skill in the 2025 self-assessment profile. Fieldwork requires students to divide tasks, negotiate roles, solve logistical problems, and coordinate activities under time and place constraints. Kandamby (2018) found that field study can strengthen teamwork through task organization and knowledge sharing, while field-based and virtual field experiences can create opportunities for communication and shared problem solving (Amala et al., 2019). The SOAR interviews reinforce this interpretation: both supervisors and student leaders emphasized cooperation, coordination, independence, and communication with communities as central aspects of the program.

The lowest-ranked skills also offer useful pedagogical signals. Critical thinking was lowest in the 2024 peer assessment, while creativity was lowest in the 2025 self-assessment. These rankings should not be treated as direct comparisons because the rating method changed, but they suggest that simply placing students in an authentic environment does not guarantee higher-order thinking. Fieldwork tasks require explicit analysis: students should compare explanations, justify sampling and mapping decisions, evaluate conflicting evidence, and defend interpretations. Problem-based field activities can support this

type of reasoning when students are required to make and explain decisions rather than only collect information (Perkins et al., 2001; Sularmi et al., 2018).

The qualitative findings extend the assessment results by identifying implementation conditions. Participants valued direct experience and contextual problem solving, consistent with the experiential character of outdoor learning (Neville et al., 2023). They also emphasized permits, equipment, supervision, external partnerships, and scheduling. These operational factors matter because they determine whether field time is spent on meaningful inquiry or on avoidable logistical problems. Aspirations for publishable outputs and collaboration with universities, government, and communities further suggest that participants saw fieldwork as a bridge between learning, research, and public engagement.

For outdoor and environmental educators, the broader implication is that assessment should be designed as part of fieldwork pedagogy rather than appended after the activity. The learning environment, task design, supervision, and evidence of performance need to be aligned. A field report can remain a valuable collaborative product, but individual learning can be made more visible through structured observation, rotating roles, individual field notes, short oral defenses, reflective commentaries, or individually identified contributions to shared outputs. Such strategies retain the collaborative character of fieldwork while improving the interpretability of individual assessment evidence.

A further implication concerns feedback. If performance is the component most closely aligned with evidence of individual skill, it should not be recorded only as a final score. Observation can be used formatively during field preparation and implementation so that students receive feedback while there is still time to change how they plan, communicate, document evidence, or contribute to the group. Repeated observation also reduces the risk that a single presentation or isolated field moment disproportionately determines an individual assessment. This approach is consistent with fieldwork literature that treats supervision and reflection as integral to learning rather than as administrative additions (Ferns & Moore, 2012; France & Haigh, 2018).

The study also highlights the need to separate claims about educational value from claims about statistical validation. The qualitative findings and within-cycle skill profiles indicate that students and supervisors experienced fieldwork as a setting for collaboration, communication, professional responsibility, and contextual problem solving. Those educational findings can be discussed even though the 2025 structural model does not achieve acceptable global fit. Conversely, weak model fit and the internal inconsistency in the portfolio path mean that the structural coefficients should not be used to declare a finalized or validated assessment model. Maintaining this distinction provides a more transparent basis for model refinement and replication in other outdoor-learning contexts.

Limitations

Several limitations constrain the conclusions. First, purposive sampling was used from a single institution, so the findings should not be generalized to all geographic fieldwork programs. Second, the

two cycles involved different cohorts, different field sites, a change in portfolio product, and a change from peer assessment to self-assessment of 21st-century skills. The 2024 and 2025 profiles, therefore, describe each cycle but do not constitute a longitudinal comparison. Third, project and portfolio scores were group-level measures while the outcome represented individual competencies, creating a level-of-analysis mismatch. Fourth, the 2025 structural model showed weak global fit, and the reported portfolio path is internally inconsistent across AMOS outputs. Finally, the design was observational and did not include a control group; statistical associations should not be interpreted as causal effects. Future studies should use larger, multi-institution samples, stable measurement procedures across cycles, and assessment designs that link group products to individually identifiable evidence.

Recommendations

Fieldwork coordinators should prioritize repeated performance assessment across preparation, field, and post-fieldwork stages rather than assessing individual competence only once. Group projects and portfolios should be retained to support authentic collaborative learning, but they should be supplemented with individual evidence, such as field logs, reflective analyses, oral defenses, role-specific products, or contribution records. Assessment criteria should explicitly connect tasks with communication, collaboration, critical thinking, creativity, and digital practice so that students understand what constitutes competent performance.

Program design should also preserve the contextual strengths identified in the SOAR analysis: direct interaction with places and communities, structured supervision, adequate field equipment and permissions, and opportunities for external collaboration. Partnerships with government, community organizations, and other universities can broaden the authenticity of the learning experience, provided that academic aims and student responsibilities remain clear. For research and quality assurance, future implementations should use consistent instruments across cohorts and report reliability, validity, and model-fit evidence in sufficient detail to support interpretation.

Conclusion

This two-cycle study indicates that fieldwork in geography can provide a rich setting for 21st-century learning, but the form and attribution of assessment evidence matter. Performance assessment was the most consistent correlate of students' reported skills because it captured observable participation during authentic field processes. Group project scores were not significant in the 2024 model, and the 2025 results do not provide stable evidence of the direction of the portfolio relationship; these findings caution against using group project scores alone as evidence of individual competence. Collaboration and IT literacy emerged as prominent skills, while the qualitative findings emphasized contextual problem solving, direct experience, structured guidance, and professional attitudes. The practical priority is therefore not to replace project and portfolio work, but to connect collaborative products with individually attributable evidence and repeated observation across the fieldwork process.

Declarations

Author Contribution

Aris Munandar: Conceptualization, methodology, investigation, data collection, formal analysis, and writing; Cahyadi Setiawan: Conceptualization, methodology, supervision, validation, and writing; Mamat Ruhimat: Supervision, validation, interpretation of results, and writing; Della Ayu Lestari: Formal analysis, interpretation of results, editing, and manuscript preparation. All authors read and approved the final manuscript.

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Data Availability

The datasets generated and analysed during the current study are not publicly available because they contain information obtained from student participants and are subject to privacy and confidentiality considerations. De-identified data supporting the findings of this study may be made available from the corresponding author upon reasonable request, subject to institutional and ethical requirements.

Clinical trial registration: Not applicable. This study was not a clinical trial.

Clinical trial number: Not applicable.

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Figures

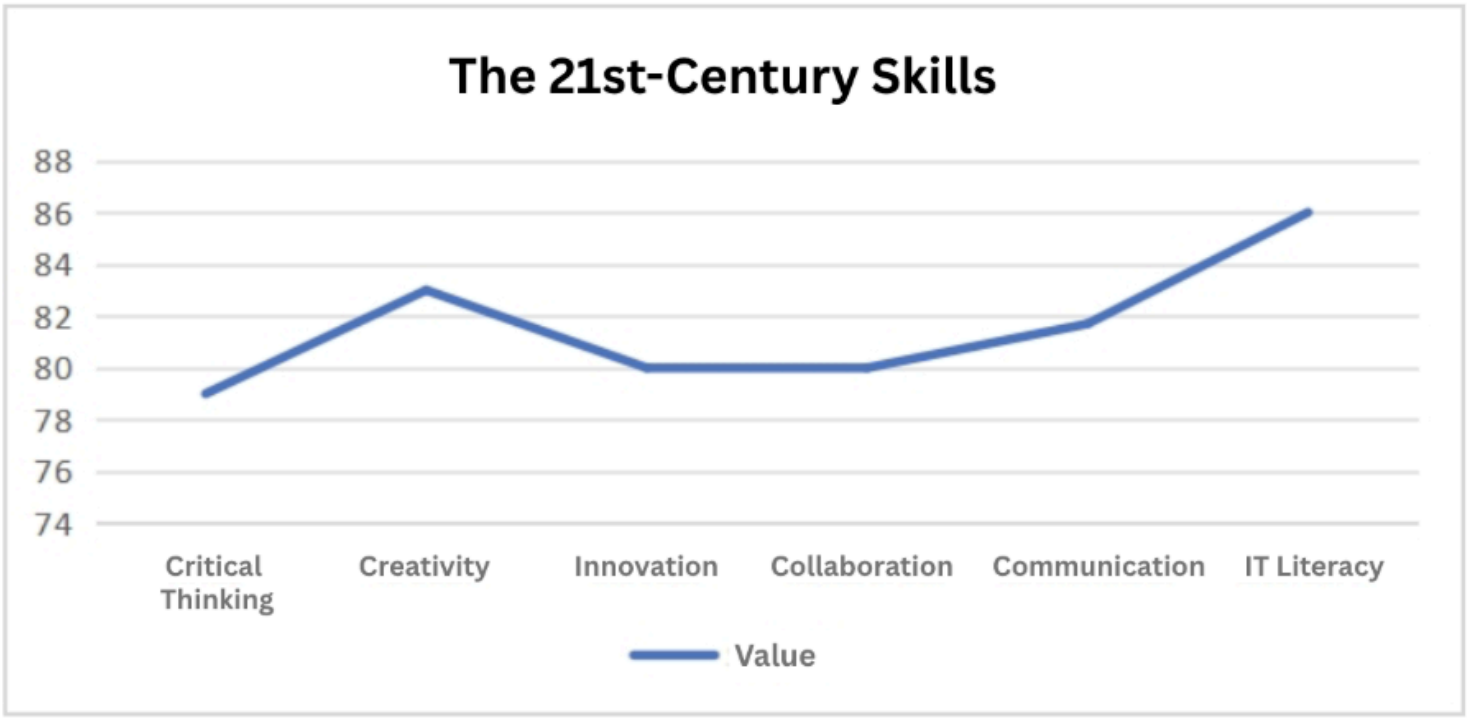


Figure 1

21st-century skill profile in the 2024 fieldwork cycle based on peer assessment

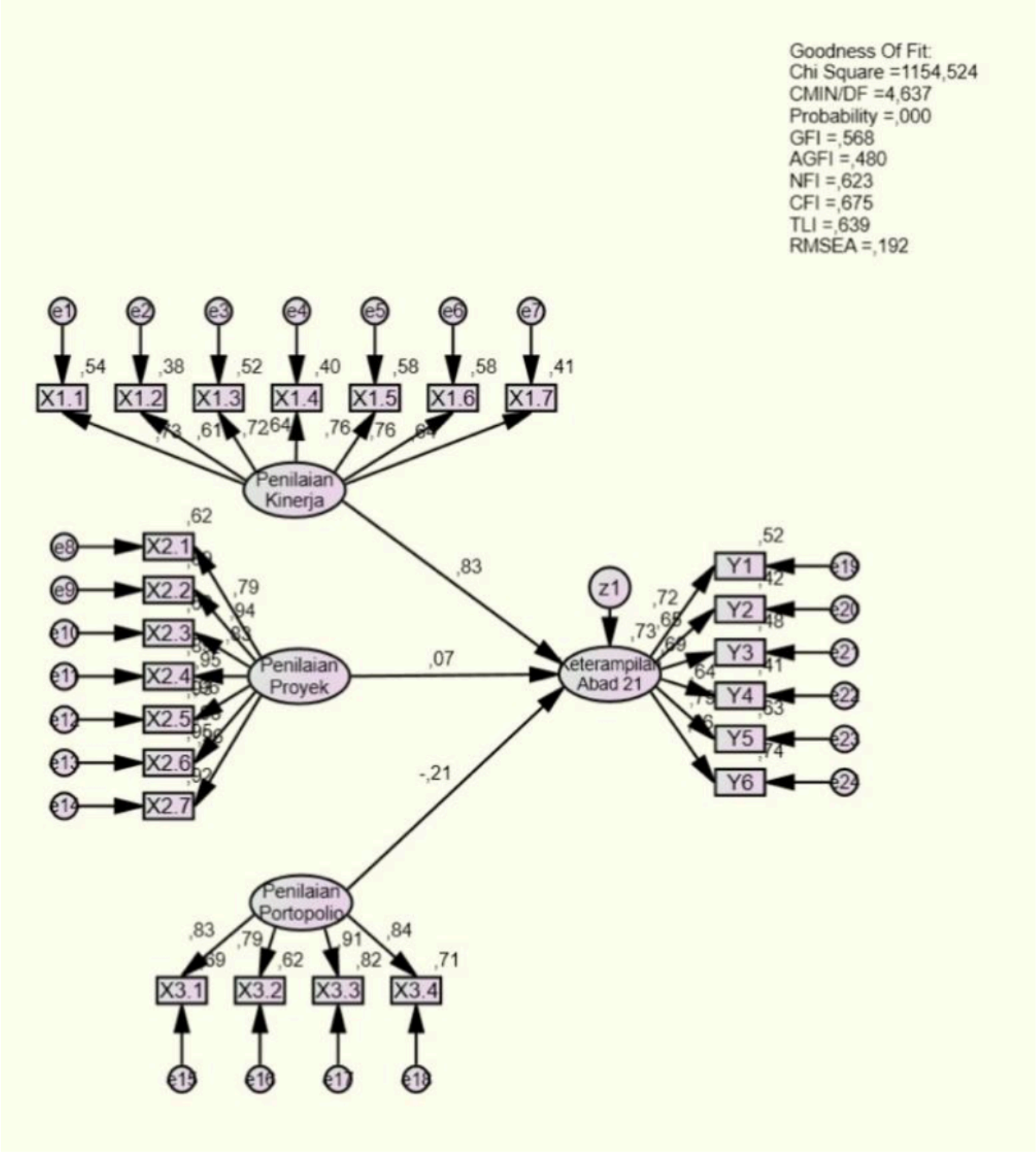


Figure 2

AMOS structural model for the 2025 revised assessment model

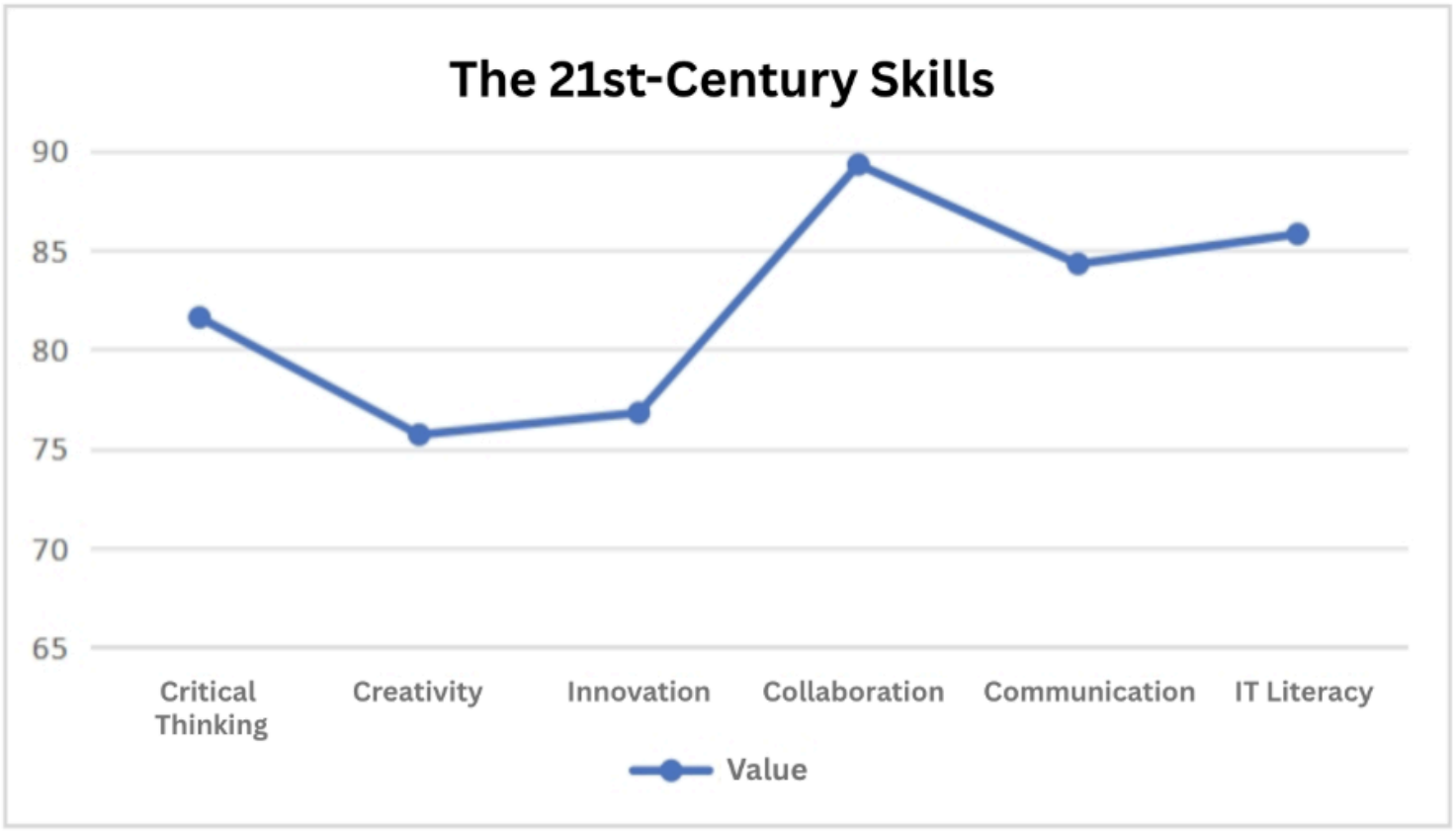


Figure 3

21st-century skill profile in the 2025 fieldwork cycle based on self-assessment