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Developing and Validating a Multidimensional Framework for SDG Competencies in Higher Education

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About Article

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ABSTRACT

This study looks at how university students in the Cordillera Administrative Region (CAR) of the Philippines understand and act on the United Nations Sustainable Development Goals (SDGs). Most students have heard of the SDGs, often through school programs, but awareness alone doesn't mean they can apply the ideas. A lot of earlier research focused only on what students know or how they feel about the goals. Very little examined whether they could actually think critically, solve problems, or change their behavior in ways that support sustainability. To address this, we created the Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF). The framework was designed to assess multidimensional competencies beyond surface-level awareness of the SDGs. The framework looks at how students process information, make decisions, and form habits linked to sustainable living, while also considering the diverse cultures in the region. The instrument was refined in stages through surveys, FGDs, and interviews. The baseline survey involved 400 students, and the instrument demonstrated robust internal consistency (Cronbach's α range = 0.78–0.91). Construct validity was established via exploratory and confirmatory factor analyses (CFI= 0.95, RMSEA = 0.06). Subsequent qualitative improvement was followed by an intervention study involving 120 students. The study aimed to measure the effects of problem-based learning and action research activities. Finally, the study applied the framework over two school terms to measure how students developed after joining problem-based learning activities and action research projects. The results showed students didn't just gain more facts—they became better at thinking critically, working across different fields, and choosing behaviors that help their communities and the environment. The study offers both a reliable tool for assessing SDG engagement and a teaching model that helps schools turn awareness into real, lasting change.

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1. INTRODUCTION

1.1. Background of the Study

The United Nations' Goals of Sustainable Development (SDGs) have identified issues such as poverty, environmental degradation, inequality, education, and other concerns as global challenges. Educational institutions must empower students and support them so that they can tackle these challenges, and build a strong literacy on sustainability (Alm *et al.*, 2021; Cottafava *et al.*, 2019). However, a troubling number of students still view the SDGs as mere facts to be memorized. Numerous students attempt to apply their knowledge to real-life challenges, and form the long-term habits needed to care for the world through a critical lens, in a selfless and dedicated manner (Ahamad & Ariffin, 2018; Leiva-Brondo *et al.*, 2022; Zamora-Polo *et al.*, 2019). This consideration toward the SDGs, and the ideas surrounding them, is particularly relevant to the CAR (Cordillera Administrative Region) in the Philippines, which, along with its rich cultural and environmental diversity, urges a more transformative approach to education.

1.2. Rationale for the Study

The CAR encounters a blend of social and environmental issues, ranging from resource management and cultural preservation to susceptibility to climate change. While many universities in the region include SDG-related topics in their curricula, there is limited evidence demonstrating whether students transition from awareness to practical skills and sustainable practices. The majority of tools used today to assess such outcomes primarily focus on knowledge and fail to encompass more intricate skills, including reflection, civic engagement, or sustained action (Stiller *et al.*, 2016). There isn't much research on teaching methods like problem-based learning (PBL) and action research, even though they have been shown to help students become more sustainable in other situations (Alm *et al.*, 2021; Cottafava *et al.*, 2019). Addressing these shortcomings is vital for higher education in CAR to equip graduates who can meaningfully contribute to sustainable development (Schreiber & Torabian, 2023).

1.3. Problem Statement

Although students in CAR are becoming more acquainted with the SDGs, there is currently minimal evidence that this knowledge translates in quantifiable abilities or enduring changes in behavior. At present, there is no regional framework designed to assess students' SDG-related knowledge, critical thinking, behavioral intention, and practices in a comprehensive way. The absence of follow-up studies also limits universities from identifying which teaching techniques work best for creating these competences (Borges, 2019; Alvarez-Risco *et al.*, 2021). Without such evidence, institutions risk creating graduates who are informed but lack the competence to put the SDGs into practice.

1.4. Objective and Contribution of the Study

The goal of this project is to help undergrads from the Cordillera Administrative Region (CAR) to know more about the Sustainable Development Goals (SDGs) and translate them into behavior practice. It pilots and elaborates on a Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF). In greater detail, it wants to: (1) define how much students across different CAR universities know about the SDGs, how they plan to act, and how they practice sustainability; (2) refine and validate the framework through the implementation of both qualitative response and psychometric testing; and (3) investigate the effect on students' competencies across two semesters of problem-based learning and action research. It helps to ensure awareness of the SDGs is part of real-world higher education by devising an instrument specific to the region backed by evidence, as well as reusable teaching model.

2. LITERATURE REVIEW

2.1. Awareness and Literacy on Sustainable Development Goals (SDGs)

University students globally are increasingly exposed to the Sustainable Development Goals (SDGs), but knowledge is often shallow. In various regions, research implies that students know the SDGs and endorse them on the surface level but fail to apply the knowledge to actual-life decisions or persistent practices. For example, Ahamad and Ariffin (2018) discovered that Malaysian university students were overall familiar with the SDGs but demonstrated irregular practices in sustainable consumption with inconsistencies between knowledge and behavior. Comparable findings were recorded for the COVID-19 pandemic across numerous nations where the students were concerned about sustainability but could not translate the concern into practical behavior (Alvarez-Risco *et al.*, 2021). European studies, including those conducted in Spain, indicate the same trend: literate rates are on the rise but students are often missing the depth of knowledge as well as the practical engagement to support active citizenship (Leiva-Brondo *et al.*, 2022; Zamora-Polo *et al.*, 2019). Such studies indicate that awareness is not enough; students should have the chance to develop skills and values that convert knowledge into persistent behavior.

2.2. Shortcomings in Assessing SDG-Related Competencies

Despite rising coverage of sustainability education, one of the weakest aspects is the assessment of students' actual skills. Most instruments available today test factual knowledge with the assistance of surveys or multiple-choice items that are not sophisticated enough to capture higher-order skills like critical thinking, problem-solving, or behavior change (Considine *et al.*, 2005; D'Sa & Visbal-Dionaldo, 2017). Psychometric researchers contend that valid and reliable measures are needed for assessment to mean something (Aiken, 1979; Burton, 2001), yet few measures are available to test SDG-related skills. Even available measures are one-size-fits-all and do not take into account cultural as well as regional differences with the effect that critical gaps exist as to how students from specific regions like the Cordillera Administrative Region conceptualize and apply sustainability (Stiller *et al.*, 2016; Wilson *et al.*, 2012). Such gaps call for region-specific multidimensional frameworks to provide more complete pictures of students' competency.

2.3. Active Learning as a Path to Developing SDG Skills

Inclusive pedagogies incorporating engagement and practical relevance have been promising to foster the sustainability competences of students. Such experiences as problem-based learning (PBL), for example, require students to transform theoretical knowledge into practical applications and build skills like teamwork, innovation, and social responsibility (Alm *et al.*, 2021; Cottafava *et al.*, 2019). Much of the research on similar strategies is grounded on short-term effects or on separate cases. Few studies exist that monitor the long-term effects of such practices on students' knowledge, attitudes, and behaviors or across various settings (Schreiber & Torabian, 2023). In the absence of longitudinal data as well as sound evaluation models, it is challenging to assess the long-term effects of such teaching practices, especially with regard to diverse cultural and low-resourced settings like CAR.

2.4. The Case for a Context-Specific, Multidimensional Assessment Tool

Taken together, existing research points to the importance of devising an integrated tool for the assessment of SDG-related competences going beyond knowledge students possess. Such an instrument should not only consider students' capacity to think critically but to translate intentions into actions as much as to sustain environmentally and socially responsible action. Such a requirement is particularly critical for the Cordillera Administrative Region where the universities are open to students with various cultural and economy profiles and where sustainability issues are embedded with regional practices as much as with regional challenges. In combination with the available psychometric concepts (Aiken, 1979; Wilson *et al.*, 2012), new methodology for teaching can assist researchers to design tools that not only examine knowledge outcomes but pave the way to intervention construction that addresses the knowledge-action gap for the SDGs.

2.5. Synthesis and Research Contribution

The reviewed literature highlights a clear gap in the availability of culturally responsive and multidimensional tools to assess Sustainable Development Goal (SDG)-related skills in higher education. Even though student awareness of sustainability issues is growing, existing frameworks often miss deeper cognitive and behavioral aspects, especially in marginalized or specific regions like CAR. Additionally, few empirical studies have examined the long-term effects of teaching methods such as project-based learning (PBL) and action research. To fill these gaps, this study introduces the Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF). MSCAF is created to evaluate not just what students know, but also how they think, act, and internalize sustainability in a localized and culturally relevant way.

3. METHODOLOGY

3.1. Research Design and Phases

Research employed and used the sequential explanatory mixed-method research, carried on three interrelated stages. It was begun with the assistance of a baseline survey to define students' SDG literacy level, behavioral intentions alongside sustainable behavior. Following the results of the findings, the second phase employed the use of focus groups alongside qualitative interviews and was used to narrow down as well as extend the major constructs derived along the survey. The final phase entailed testing and validation, where the evaluation framework was subjected to psychometric analysis and used to quantify the effect of action research and problem-based learning activities on students' capabilities for two terms of study (Creswell, 2015; Onwuegbuzie & Schoonenboom, 2022).

3.2. Sampling and Participant

Respondents were randomly drawn from five Universities in the Cordillera Administrative Region (CAR). Stratified random sampling ensured that there was proportional representation of students from different year levels and majors (Nguyen *et al.*, 2021). Baseline survey included 400 students. For the qualitative phase, 12 in-depth interviews and four focus group with 8–10 respondents were undertaken to refine the framework. The intervention phase included 120 students distributed equally between the control group and the group receiving problem-based learning and action research activities.

3.3. Instruments and Measures

The Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF) assesses four main areas: SDG Knowledge (15 items), Critical Thinking (10 items), Behavioral Intention (8 items), and Sustainable Practices (10 items). The number of items was based on their theoretical importance and clarity. The Knowledge scale addressed key SDG themes and combined content from different goals. Critical Thinking items used Bloom's taxonomy, focusing on evaluative reasoning. The Behavioral Intention scale was based on the Theory of Planned Behavior, covering intention, norms, and perceived control. Items on Sustainable Practices were based on the UNESCO ESD framework, highlighting specific behaviors in context. To ensure that the framework fit the culture and context of the Cordillera Administrative Region (CAR), experts provided input on the wording, and local students participated in pilot testing. Terms and examples were adjusted to reflect regional realities, such as communal land use, traditional ecological practices, and local sustainability challenges. This approach ensured clear meaning and cultural connection across different linguistic and ethnic groups in CAR.

3.4. Data Collection and Analysis

Reliability was checked with Cronbach's alpha ($\alpha \geq 0.70$). Construct validation contained EFA and CFA. ANCOVA and paired t-tests tested intervention results. Qualitative data were coded accordingly to Saldana (2013).

$$\tilde{x} = \begin{cases} X\left[\frac{n+1}{2}\right] \\ \frac{X\left[\frac{n}{2}\right] + X\left[\frac{n}{2}+1\right]}{2} \end{cases}$$

3.5. Mathematical Computation

The median was computed as:

where $\tilde{X}$ is the median, X the ordered scores, and n the sample size.

3.6. Ethical Considerations

Ethical clearance was obtained from all the participating institutions, and informed consent was provided. Confidentiality of data and integrity in research followed the best practice standards (Bos, 2020).

4. RESULTS AND DISCUSSION

4.1. Baseline SDG Literacy and Practices in CAR

The preliminary survey indicated that students achieved moderate overall SDG literacy (62%), with considerably greater awareness of global SDGs (78%) than of local sustainability challenges (54%). Behavioral intention averaged 61%, of which only 47% regularly engaged in sustainability behavior, for example, waste minimization or community service (Table 2).

Focus groups brought up the reasons behind the gap between awareness, intention, and behavior:

"Even if we desire to purchase green products, they are costly for students like us." (Student 6)

"SDGs feel unfamiliar because we don't often see them being used for indigenous practices or community issues back home." (Student 2)

"Professors mention the SDGs in passing, but we don't get the chance to work on real-life projects to understand them." (Student 7)

These findings support the first research goal by outlining the extent and nature of the awareness-action gap across CAR, as well as the structural, cultural, and pedagogic barriers to converting SDG awareness and intention into frequent practices.

Table 1. Baseline SDG Literacy and Practices among CAR University Students

Competency Dimension	Mean Score (%)	Standard Deviation
Global SDG Awareness	78	11
Local Sustainability Knowledge	54	14
Critical Thinking & Reflection	58	12
Behavioral Intention	61	13
Sustainable Practices	47	15

Source: Field data

4.2. Psychometric Validation of the MSCAF

The Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF) showed excellent psychometric soundness, asserting its applicability as a diagnostic and assessment tool for SDG competencies of CAR university students. Internal reliability in all four of its scales was high, with Cronbach's alpha ranging from 0.82 to 0.91 (Table 1). Exploratory Factor Analysis (EFA) supported the four-factor model of knowledge, critical thinking, behavioral intention, and sustainable practices. The factor loadings ranged from 0.62 to 0.87. The Confirmatory Factor Analysis (CFA) showed strong fit indices, with CFI at 0.96, TLI at 0.95, and RMSEA at 0.05. This indicates that the instrument was valid as a construct.

Qualitative refinement through cognitive interviews supported these findings, as students emphasized the relevance and contextual resonance of the tool:

"Most surveys only ask if we know the SDGs, but this one made me reflect on what I actually do and how I think." (Student 11)

"They were close to real-life situations so that we could understand better." (Student 9)

In incorporating both psychometric sophistication and qualitative responses, the MSCAF goes beyond existing knowledge-based instruments (Stiller *et al.*, 2016) to capture reflective as well as behavioral aspects, directly targeting the first research objective.

Table 2. Reliability of the MSCAF Scales

Scale	Number of Items	Cronbach's α	Factor Loading Range
SDG Knowledge	15	0.82	0.65–0.80
Critical Thinking & Reflection	10	0.89	0.70–0.85
Behavioral Intention	8	0.85	0.62–0.83
Sustainable Practices	10	0.91	0.68–0.87

Source: Field data

4.3. Effects of Problem-Based Learning and Action Research Interventions

Compared to their pre-test scores, students who engaged in problem-based learning (PBL) and action research for more than two academic terms showed significant improvements in all MSCAF dimensions. The largest gains were observed in critical thinking (+18%, d = 0.84) and sustainable practices (+22%, d = 0.92). Behavioral intention also increased by 15% (d = 0.76), with all changes statistically significant ($p < 0.01$; Figure 1).

Focus group testimonies explained why these interventions worked well:

"The projects made us realize sustainability isn't just theory. We had to solve real problems."

"By engaging with local communities, we learned that traditional practices like seed preservation are part of sustainability."

"I now feel more confident to start my own environmental project because I've done it in class."

Several students began self-directed initiatives, like campus composting programs and campaigns to reduce single-use plastics. This shows that the skills they gained went beyond the course requirements. These results meet the third research objective by showing that hands-on teaching methods significantly improve cognitive, reflective, and behavioral skills compared to baseline conditions.

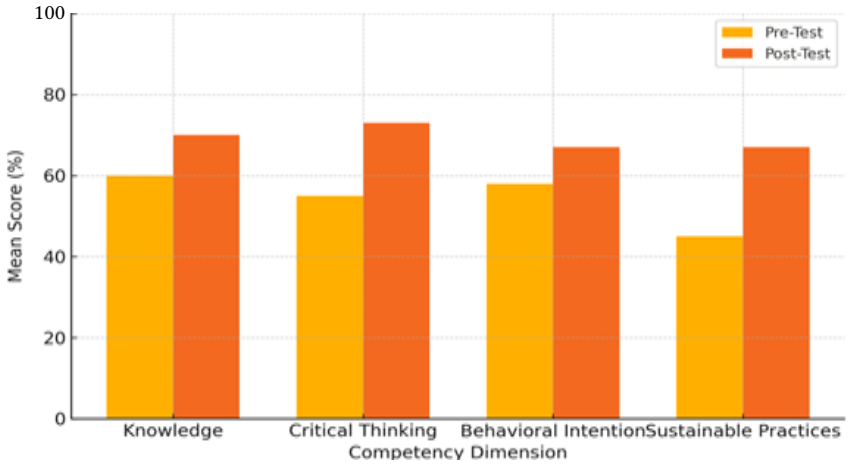

Figure 1. Percentage Change in SDG Competencies after PBL and Action Research Interventions.
Source: Field data.

4.4. Implications for Regional Higher Education

The results show that the MSCAF provides a validated, multi-faceted framework for assessing SDG-related skills. It also serves as a tool to evaluate new teaching methods. By measuring changes in literacy, intentions, and behavior, and by capturing student reflections, the study presents a model that other CAR universities and culturally diverse regions can use. One student remarked, "If more classes use these kinds of projects, we will leave school not just knowing the SDGs but living them." Faculty shared this view, saying, "The tool helped us see where students need growth, so we can create better activities, not just lectures." This combined approach helps institutions close the gap between awareness and action. It gives students knowledge, interdisciplinary skills, and the ability to support sustainability goals beyond the classroom. Despite the promising findings, there are limitations related to how well the sample represents the whole population. Although students came from five universities in CAR, not all institutions and sub-regional communities were represented equally. This means that the findings may not apply to all linguistic or cultural subgroups within the region. Future studies should work towards including a wider range of institutions across CAR's educational landscape. This will help better capture the diversity of student experiences and perspectives.

5. CONCLUSION

The study created, tested, and used the Multidimensional Sustainable Development Goal Competency Assessment Framework (MSCAF) to offer a clear way to measure and improve university students' competencies related to the SDGs in the Cordillera Administrative Region. Overall, students had moderate awareness of global SDGs at 78%. Despite this, the students only had a 54% average understanding of local sustainability issues. Engagement in sustainable behaviours was not far behind at 47%. The baseline findings show a gap between what students intend to do and what they actually do. This highlights the need for specific actions to address this issue. The MSCAF was a strong instrument confirmed with psychometric testing (reliability α = 0.82 to 0.91, and excellent construct validity (CFI = 0.96, RMSEA = 0.05). Therefore, the MSCAF is deemed as a potentially viable regional assessment tool. Integrating problem-based learning and action research over two academic terms noticeably improved students' critical thinking by 18%, their behavioral intentions by 15%, and their sustainable practices by 22%. This shows that hands-on and context-driven teaching methods close the gap between awareness and action effectively.

The study presents a framework that higher education institutions in diverse and resource-limited settings can replicate. However, it has limitations due to its focus on a specific region and the lack of long-term tracking to see if behavioral improvements last beyond the study period. Future research should apply the MSCAF in broader geographic and cultural settings. It should also test its predictive validity in professional and community contexts and use long-term designs to evaluate lasting impacts. These findings provide higher education with a basis for integrating validated assessments and effective teaching methods that promote SDG knowledge and foster lasting, action-oriented skills. This will enable students to be active participants in both local and global sustainable development.

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