LEARNING ANALYTICS FOR SUSTAINABLE MANAGEMENT AT THE UNIVERSITY OF MOA

ANALÍTICAS DE APRENDIZAJE PARA UNA GESTIÓN SOSTENIBLE EN LA UNIVERSIDAD DE MOA

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ABSTRACT

Environmental conservation is a global challenge, maily in regions with strong industrial impact such as the city of Moa, Cuba, where extractive practices significantly deteriorate natural resources. In this context, the University of Moa faces the dual challenge of aligning its institutional management with the Sustainable Development Goals (SDGs) while simultaneously training professionals committed to sustainability. However, a gap persists between the faculty's commitment to principles of equity and the limited awareness of the SDGs, as well as the absence of formal metrics to evaluate sustainable practices. Therefore, this study aims to propose a system of actions and indicators to integrate sustainability into the university management, supported by learning analytics (LA) and the 3E's+1 model (Ecology, Economy, Equity, and Education) as a theoretical framework. A mixed methodology was applied, including semi-structured interviews, documentary analysis, and systematic literature review for identifying institutional strengths and challenges. The proposal shows that

integrating Learning Analytics and the 3E’s+1 model can guide decision-making toward more sustainable university management aligned with the SDGs.

KEYWORDS: sustainability; learning analytics (LA); 3E’s+1 model (Ecology, Economy, Equity + Education); Sustainable Development Goals (SDGs).

RESUMEN

La conservación del medio ambiente es un desafío global, intensificado en regiones con fuerte impacto industrial como la ciudad de Moa, Cuba, donde las prácticas extractivas deterioran significativamente los recursos naturales. En este contexto, la Universidad de Moa (UMoa) enfrenta el reto de alinear su gestión institucional con los Objetivos de Desarrollo Sostenible (ODS) y, al mismo tiempo, formar profesionales comprometidos con la sostenibilidad. Sin embargo, persiste una brecha entre el compromiso del claustro con principios de equidad y la limitada concienciación sobre los ODS, además de la ausencia de métricas formales que evalúen las prácticas sostenibles. Por tanto, este estudio tiene como objetivo proponer un sistema de acciones e indicadores para integrar la sostenibilidad en la gestión de la UMoa, apoyado en analíticas de aprendizaje (AA) y en el modelo 3E’s+1 (Ecología, Economía, Equidad y Educación) como marco teórico. Se empleó una metodología mixta que incluyó entrevistas semiestructuradas, análisis documental y revisión bibliográfica sistemática para identificar fortalezas y desafíos institucionales. La propuesta muestra que la integración de AA y del modelo 3E’s+1 puede guiar la toma de decisiones hacia una gestión universitaria más sostenible y alineada con los ODS.

PALABRAS CLAVES: sostenibilidad; analíticas de aprendizaje (AA); modelo 3E's +1 (Ecología, Economía, Equidad + Educación), Objetivos de Desarrollo Sostenible (ODS)

INTRODUCTION

Nowadays, significant importance has been placed on environmental conservation, aiming to prevent human actions in the social, economic, and cultural spheres from degrading water, soil, and air resources.

Despite efforts to conserve natural resources, environmental degradation continues, potentially due to a lack of awareness and respectful attitudes towards nature, as well as a shortage of effective tools to quantify and optimize sustainable practices.

The city of Moa, located in Holguín province, Cuba, is known for its mining and metallurgical activity, which significantly contributes to the national economy but also generates critical environmental impacts, such as deforestation, soil contamination, and the degradation of watersheds.

According to DE CUBA (2003), 40% of soils in the region are degraded due to unsustainable extractive practices, and 60% of industrial waste is not managed properly. In this context, the University of Moa (UMoa), as an institution responsible for training professionals, faces the challenge of aligning its management with the Sustainable Development Goals (hereafter SDGs), not only to mitigate its environmental tread but also to train change agents capable of addressing these issues from a comprehensive perspective.

Although progress has been made in integrating learning analytics (hereafter LA) for sustainability in higher education, most studies focus on high-resource contexts. For instance, they address how learning analytics can contribute to achieving SDG4 (Quality Education) in universities, highlighting their underutilized potential. Plasencia (2018) analyzed sustainable management models without incorporating technological tools. This paper contributes a novelty approach by proposing the application of the 3E's+1 Model (Ecology, Economy, Equity + Education) through LA in an environment with financial and technical constraints, a gap identified in recent literature.

UMoa, lacking formal sustainability metrics, represents an emblematic case to demonstrate how educational innovation can overcome structural limitations through data-driven strategies.

One of the greatest challenges for higher education in this new era is to achieve students´ retention and graduation in a sustainable manner, which demands innovative evidence-based strategies. This document aims to propose a system of actions and indicators to integrate sustainability into the management of UMoa, supported by learning analytics (LA) and the 3E's+1 model (Ecology, Economy, Equity, and Education).

According to Cuesta, Madrigal & Pecorari (2024), corporate sustainability refers to the ability of companies to manage their social, economic, and environmental impacts, both internal and external, and to contribute positively to the well-being of communities and society at large. This concept reaches a wide range of aspects, such as ethical labor practices, respect for human rights, investment in community development, promotion of diversity and inclusion, transparency, accountability, and, in the educational context, the adoption of technologies as learning analytics to measure and optimize its impact.

Among those who have studied this concept evolution, Plasencia (2018) identifies four of its characteristics: Multiperspective or Multidimensional Nature—due to the number of elements that must be considered in an integrated manner for its achievement; Strategic Focus—as it must be integrated into the objectives and indicators defined in the organization's strategic projection; Evolutionary and Progressive Nature—because achieving it requires the continuous improvement of systems in both strategy and processes; and Value Creation for Stakeholders. Within this framework, learning analytics emerges as a cross-cutting axis, enabling the integration of real-time data to assess progress in each dimension.

Despite attempts by both international and national institutions to promote sustainable development, actions taken by organizations, including universities, remain insufficient, partly due to the lack of systems that translate principles into actionable metrics. This situation persists because many of us have not incorporated this global need into our daily responsibilities as citizens, highlighting the need to incorporate data-driven approaches into the daily responsibilities of organizations.

Therefore, this work aims to evaluate the integration of LA and, based on this analysis, propose systems of concrete actions for incorporating sustainability into the University of Moa management, grounding the proposal in the principles of the 3Es + 1 and the SDGs.

At the University of Moa, a gap persists between the faculty's commitment to equity and educational quality and the absence of formal metrics to evaluate and guide sustainable practices, hindering the alignment of institutional management with the Sustainable Development Goals in a context of significant environmental impacts. In response to this problem, the study aims to propose a system of actions and indicators to integrate sustainability into UMoa's management, supported by learning analytics (LA) and the 3E's+1 model (Ecology, Economy, Equity, and Education) as a theoretical framework. To achieve this objective, the selected theoretical approach and the reasons for its choice are described, the current sustainability performance of UMoa is evaluated by identifying strengths and areas for improvement, and specific actions for integrating institutional sustainability are defined, specifying their implementation levels and expected results in the ecological, economic, social, and educational dimensions, supported by contributions from Segado et al. (2020) and Calles (2020) on incorporating SDGs into university teaching.

MATERIALS AND METHODS

It was done an exhaustive bibliographic search to update knowledge related to this topic. The research development employed theoretical methods of analysis and synthesis, complemented by the empirical method, based on obtained experience. The analysis method allowed for the breakdown of conceptual approaches to sustainability, identifying its foundations and essential relationships. El método de análisis permitió desglosar los enfoques conceptuales sobre sostenibilidad, identificando sus fundamentos y relaciones esenciales. The synthesis method enabled the integration of results, allowing the development of a coherent theoretical framework. Similarly, the empirical method was applied to contrast theoretical foundations with practice, evaluating the model applicability in the educational context. After examining different approaches, the «3E's + 1» Model was selected as the working framework for its capacity to articulate the economic, ecological, ethical, and educational components of sustainability.

The 3E's +1 Model

According to Edwards (2005), sustainability is a diverse, multicultural, multiperspective, and worldwide revolution, built around three dimensions: ecological, economic, and equity; the author adds that a fourth dimension is necessary: education. This is precisely the basis of the «3E´s +1» model.

Plasencia (2018) states that that the author of this model refers to sustainability as contemporary, with environmental concern at its core (E: ecology/environment), from which natural capital emerges, providing material resources for economic development (E: economy/employment). Subsequently, economic development and access to natural resources must be achieved in an equitable manner due to issues of social justice (E: equity/equality).

The «3E's + 1» model´s author expresses that education is the catalyst to help everyone understand the nature of the three previous dimensions´ relationships. Through this dimension, the necessary knowledge is gained to overcome and understand the problems affecting society. With this dimension, sustainability can be firmly established in society's value system, while enabling the discovery of more viable long-term approaches to solving global problems (Edwards, 2005; Plasencia, 2018).

Within this context, learning analytics (LA) emerge as a key tool to materialize the catalytic role of education. Their application translates educational data into concrete actions that reinforce sustainability, aligning with SDG4, which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, regardless of sex, age, race, ethnicity, vulnerability, and people with disabilities or migrants, applied to education at all levels—primary, secondary, tertiary, technical and vocational training—and also from early childhood to adulthood (Boeren, 2019; González, Colomo & Cívico, 2020).

Sustainable quality education is a major challenge even for developed countries where LA is gradually expanding as a solution in response to the emerging demand for real-time data processing to provide feedback to the educational ecosystem (Verma et al., 2021).

In this sense, there is no doubt that LA provide a massive improvement in the education quality, and therefore, it is advisable for Higher Education Institutions (HEIs) to begin using them (Patel & Desai, 2016). The main objective of LA is to become raw data into actionable insights that enable better decision-making related to teaching and learning processes to improve the education quality through the implementation of interventions based on the provided data (Hooda & Rana, 2020).

Regarding the LA importance, the use of predictive models that provide actionable information for decision-making at the teacher, university, and educational policy levels is highlighted (Avella et al., 2016). From my point of

view, this is a significant strength, as it is crucial to have tools that enable educational leadership, thereby strengthening the response to current challenges to guarantee quality education.

Indeed, there are widely recognized benefits of LA in the education area. Researchers specify advantages at the student level (academic performance improvement, engagement, and learning outcomes; enables personalized learning; helps decision-making regarding his study process); at the teacher level (allows understanding of study behaviors, enabling course content adjustment to align with student learning characteristics; improves the feedback process; permits teacher performance improvement; personalized teaching and effective teacher decision-making); at the institutional level (predicts defection rates; helps the identification of key courses that response to needs, deployment of early intervention systems; increases retention; identifies employment opportunities for graduates and helps align education with labor market needs; allows better evaluation of learning programs for occupational compatibility; useful for evidence-based decision-making); and at the research level (allows identification of gaps in education so research can determine how to overcome problems for achieving quality education and decision-making that guides new research challenges) (Avella et al., 2016; Hernández et al., 2022).

This approach was chosen due to its relationship with the Four Pillars Model, which includes a conciliatory and integrative dimension of the Triple Bottom Line three dimensions. This makes it a comprehensive and integrative approach to the fundamental elements of the sustainability concept, since achieving sustainability requires establishing a culture of training and development across all human resources in the organization, aligning with the model by considering education as a fundamental pillar for integrating the other dimensions.

RESULTS AND DISCUSSION

UMoa is not unaware of the importance of sustainability; however, it is recognized that work remains to be done on this topic. Although there are

spontaneous actions driven by a faculty committed to educational quality, social equity, and socialist principles, these lack systematization and objective measurement. This is where learning analytics can make a difference.

Currently, the data generated in academic activities is not leveraged to identify patterns, evaluate the impact of sustainable practices, or arrange key materiality topics. It cannot be said that no actions supporting sustainability objectives have been taken, but they have been spontaneous, due to having an excellent and conscious faculty dedicated to imparting quality education, instilling equality, following the principles of a socialist system, advocating for social equity, and teaching subjects related to organizational administration. Inclusivity is fulfilled because everyone has a vote and our opinions are considered in the work we do, but we lack work on the principles of materiality, responsibility, and impact because sustainability topics are not clearly identified, so we do not act with transparency, much less monitor, measure, and report on them.

Based on the above, after conducting an internal analysis of the university, the following are defined as:

Strengths

- ✓ Teaching professionals aware of the need for sustainability and the potential of data analytics.
- ✓ Our main task is the tuition-free training of future professionals free and with high quality, enhanced by data analytics.
- ✓ We are governed by national resolutions which respond to the objectives of the 2030 Agenda.
- ✓ Internal control is maintained, which can be leveraged for checking actions related to corporate sustainability and achieving continuous improvement through learning analytics.
- ✓ An audience interested in listening and acquiring knowledge, an ideal base for implementing a sustainability culture through learning analytics.

Weaknesses

- ✓ Insufficient preparation of the faculty; some professors require greater knowledge of the 2030 Agenda objectives, the national and university-level strategy.
- ✓ Insufficient analysis of risks related to the topic.
- ✓ Lack of financial resources.

Proposed actions for UMoa based on Sustainability

Normative Level

- ✓ Establish a regulatory framework that promotes the adoption of sustainable practices in all university areas, including environmental management, curriculum, research, and community engagement.
- ✓ Conduct workshops with predictive diagnostics for the faculty to raise awareness that higher education in Cuba must consider its relationship with the new sustainability educational paradigm, education for sustainable development.
- ✓ Design and apply a diagnostic survey with advanced analytics to assess faculty knowledge and the level of importance assigned to the SDGs.

Operative Level

- ✓ Establish partnerships with local organizations and develop applied research projects that address environmental challenges and promote sustainable solutions in the community.
- ✓ Planning of teaching activities and didactic components with the inclusion of the SDGs. Understanding how faculty proposes to consider the SDGs in the didactic components of the Teaching-Learning Process.
- ✓ Apply teaching methodologies with real-time feedback for sustainability.

- ✓ Define the most important SDGs for the students´ comprehensive training, focusing on their profession.

Strategic Level

- ✓ To raise awareness among professors and students about the positive and negative impacts of economic growth on society and the environment. Promote the adoption of responsible and sustainable consumption practices, as well as foster local and community development (Economic dimension).
- ✓ To foster a deep understanding of the role of social institutions in societal transformation and development. Promote social justice, gender equality, human rights, democracy, and healthcare (Social dimension).
- ✓ To develop greater awareness of environmental fragility and the biodiversity importance. Reflect on the consequences of human activity on the environment, including climate change, and actively promote evidence-based environmental protection and conservation (Environmental dimension).
- ✓ To integrate these dimensions into the teaching-learning process as an essential part of quality education. Educating goal for sustainability becomes a cross-cutting approach with integrated analytics to achieve the other objectives (Educational dimension).

Indicators to evaluate sustainability associated with the criteria or dimensions of the 3E's+1 approach (economic, social, environmental, and educational) for the University of Moa:

Economic dimension:

- ✓ Percentage of the budget allocated to sustainable projects and activities.
- ✓ Income generated by sustainable economic projects at the university.
- ✓ Number of jobs created through sustainable projects.

- ✓ Economic equity index: measurement of the fair distribution of economic benefits within the university community.

Social dimension:

- ✓ Percentage of students and teaching staff involved in projects with positive social impact.
- ✓ Number of gender equality programs implemented at the university.
- ✓ Rate of participation in volunteer and community service activities.
- ✓ Diversity and inclusion index within the university community.
- ✓ Number of partnerships established with local organizations to address social challenges.

Environmental dimension:

- ✓ Energy and water consumption.
- ✓ Percentage of solid waste recycled or properly managed.
- ✓ Number of green areas and protected natural spaces on campus.
- ✓ Percentage of academic and research programs related to environmental sustainability.

Educational dimension:

- ✓ Percentage of academic programs that incorporate education for sustainability.
- ✓ Number of students and teaching staff trained in sustainability topics.
- ✓ Percentage of research projects related to sustainability.
- ✓ Number of sustainability-focused events or conferences organized by the University of Moa.

The study demonstrates that integrating Learning Analytics (LA) into the institutional management of the University of Moa (UMoa) constitutes a strategic opportunity to advance towards corporate sustainability, even in contexts with financial and technical limitations. By applying the «3E's +1» Model, it is established that education serves as a catalytic axis for articulating the environmental, economic, and social dimensions, aligning university management with the Sustainable Development Goals (SDGs).

The results reveal a faculty committed to principles of equity and educational quality, but also highlight relevant challenges: absence of formal metrics to evaluate sustainable practices, low awareness of the SDGs, and lack of systematization in environmental and social creativities. LA emerge as a transformative tool by converting educational data into strategic actions, prioritizing areas such as waste reduction, social inclusion, and resource optimization. However, limited access to quantitative historical data was identified and the need to strengthen faculty training in analytical technologies.

CONCLUSIONS

The study settles that adopting Learning Analytics strengthens institutional sustainability by intelligently integrating educational processes with university strategic management. It is proposed to advance towards designing sustainability indicators based on the principles of Materiality, Responsibility, and Impact, to measure the real contribution of academic work to the SDGs. Future researches should evaluate the scalability of the model in other higher education institutions and analyze the long-term impact of LA on student retention and the university's environmental tread.

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