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Transdisciplinary strategies for a holistic learning in the UNIAV-UNICAM Program

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Estrategias transdisciplinares para una formación integral en el programa UNIAV-UNICAM

Abstract

The new times in which education is experienced demand a deeper analysis of educational practices, of a more coherent view between reality and pedagogical practice. In this sense, this article analyzes how transdisciplinary strategies can be applied in higher education, highlighting the importance of integrating various disciplines in a holistic and harmonized way to address community problems in a contextualized and practical manner. The Universidad Internacional Antonio de Valdivieso (UNIAV), through the construction of transdisciplinary learning experiences and encounters, generates comprehensive results in its educational context. This has allowed the creation of new knowledge, the promotion of investigative capacity in the social, economic-environmental, cultural realms, and the resolution of complex problems, prioritized within each of the rural communities from which its learners come, from the field of physics and mathematics. In the formative practice, it integrates flexibility and multiple perspectives, knowledge, and approaches from different disciplines in the field of Educational Sciences, fostering citizenship training, practical skills, social, cultural, emotional, personal, ethical, and moral knowledge. In the Education Sciences degrees of the UNIAV-

UNICAM program, pedagogy and methodology that boosts the collaboration between mediators and learners from different disciplines are employed. This article is the product of qualitative research, exploring how physical-mathematical models are created and used to solve complex problems in rural communities from a transdisciplinary perspective. The testimonies of learners involved in this experience highlight the importance of this strategy in generating solutions to specific situations that impact the integral and sustainable development of communities. All this harmonized work was developed from the Pedagogical Academic Horizon of UNIAV, which proposes an educational model based on biopedagogy and pedagogical mediation, where students are the vital protagonists of their learning. This model has a transdisciplinary approach that integrates learning processes, evidenced in the learning experiences lived in the UNIAV-UNICAM Program.

Keywords: transdisciplinary, curriculum, education, biopedagogy, educational mediation.

Resumen

Los nuevos tiempos en que se vive la educación demandan un análisis más profundo del quehacer educativo, de una mirada más coherente entre la realidad y la práctica pedagógica. En este texto se analiza cómo se pueden aplicar estrategias transdisciplinares en la educación universitaria, destacando la importancia de integrar diversas disciplinas de manera holística y armonizada para abordar problemas comunitarios de forma contextualizada y práctica. La Universidad Internacional Antonio de Valdivieso (UNIAV), desde la construcción de vivencias y experiencias de aprendizaje transdiciplinaria, de encuentro común y entramado disciplinar, genera resultados integrales en su contexto educativo, lo que ha permitido crear nuevos saberes, fomentar la capacidad investigativa en el ámbito social, económico-ambiental, cultural y resolver, desde la física-matemática, problemas complejos, situados y priorizados en cada una de las comunidades rurales de donde provienen sus aprendientes. En la práctica formativa la institución integra la flexibilidad y múltiples perspectivas, conocimientos y enfoques de diferentes disciplinas en el área del conocimiento Ciencias de la educación, promoviendo la formación ciudadana, habilidades prácticas, saberes sociales, culturales, emocionales, personales, éticas y morales. En las carreras de Ciencias de la educación del programa UNIAV-UNICAM se trabaja con una pedagogía y metodología que fomenta la colaboración entre mediadores y aprendientes de diversas disciplinas. Este artículo es producto de una investigación cualitativa, que explora cómo se crean modelos fisicomatemáticos para resolver problemas complejos en las comunidades rurales, desde una visión transdisciplinar. Los testimonios de los aprendientes involucrados resaltan la importancia de esta

estrategia para generar soluciones a situaciones específicas que impactan en el desarrollo integral y sostenible de las comunidades. Este trabajo armonizado se desarrolló desde el Horizonte Académico Pedagógico de la UNIAV, que propone un modelo educativo desde la biopedagogía y la mediación pedagógica, donde los aprendientes son los protagonistas vitales de su aprendizaje, con un enfoque transdisciplinario que integra los procesos de aprendiencia, evidenciado en las experiencias de aprendizaje vividas en el Programa UNIAV-UNICAM.

Palabras clave: *transdisciplinariedad. Currículo, educación, biopedagogía, mediación pedagógica.*

Introduction

Higher education faces the challenge of preparing students to tackle complex real-world problems. Transdisciplinarity emerges as an inventive approach, fostering the melodious integration of diverse disciplines to address socioenvironmental obstacles. This article centered on the execution of transdisciplinarity in the Education Sciences' bachelors at the UNIAV-UNICAM program, which aims to develop a Physic-mathematical models to tackle rural communities' problems from where learners are. The study analyzes how this transdisciplinary strategy supports a more cohesive and revolutionary education rooted in solutions as per the reality communities live. Transdisciplinarity in UNIAV higher education is key, precisely because it is in function of generating impact that benefits the communities.

In this light, interaction between the curricular programs and social contexts is vital to renew the learning programs. Hence, this curricular interaction entails a pedagogical interaction we can understand as a teacher's fundamental action helping to promote dynamics and/or educative strategies which assist student's learning (Zambrano et al. 2019, p. 66). It is apropos to grasp the territories' realities with the goal of inspiring the capacities driving to sustainable human development, fixated on people, families, and communities. To attain it, it is important to consider curricular programs require encounters, conjugations, and convergences between sciences, allowing to transcend to multi, inter and transdisciplinary dimensions, achieving new decisive knowledge to problematics in social contexts.

This research describes a transdisciplinary learning experience at the *UNIAV-UNICAM Program* aiming to interpret the theoretical foundations of transdisciplinary in the pedagogical-curricular practice according to the social contexts where the program is cultivated, allowing to evidence the transdisciplinary action in the curricular academic activities and biopedagogy mediation.

Importantly, UNIAV envisions:

> The learning processes approached from the curricular designs, flow into transformational processes to the

> Nicaraguan and Central American society, promoting respect for life and Mother Earth, enabling processes of deep changes in the role played by the human being in the planetary ecosystem as a human rights matter, social justice, and peace culture; to achieve contributing to the construction of an organized and prepared planetary citizenship to discern, understand, and reclaim their rights and exercise their responsibilities. (UNIAV, 2019, p. 51)

Epistemological approaches to transdisciplinarity

One of the trials faced by educational systems is finding the absent paradigm, the theorical and epistemological bases framed to the existent phenomenology in which a country develops such that the pedagogical challenges from curricular proposals in the educational subsystems must land the facilitation of ample and deep comprehension of social problems, formulation of the pedagogical curricular theory with cultural, economic, environmental and historical contexts of the territories. Also, they may encourage social inclusion, justice, and, fundamentally, the promotion of competencies based on sustainable human development.

Educational investigator Uribe Agámez (2015) shares: One of the fundamental problems identified in this route is the weak articulation between the pedagogical curricular theory, historical context, and social practice. This premise is rooted in the great existent gap in the educational institutions between the realities of these ones and what the theory (curricular document) is based on (p. 2).

As a result, educational institutions seek acceptable curricular options that blend theorical integration and development of practical abilities through educative models. It becomes critical for science, through disciplinary, multi, inter, and transdisciplinary exercise, to combine knowledge and methods from different fields, integrating various perspectives and theoretical approaches of learning with social realities, to find answers to the problem in real contexts from multidimensional angles of knowledge.

Transdisciplinary as an inventive and bright approach to take the complex and multidimensional challenges of our time, seeks to outdo the fragmentation of knowledge and enhance the interaction between different fields, with the aim of generating full and substantial awareness of the analyzed phenomena according to their social context. In practice, they present a holistic and collaborative approach, transcending the traditional limits of academic disciplines, boosting collaboration and dialogue between different areas of knowledge. Max–Neef (2004) defines it as: Transdisciplinarity happens when coordination exists between all levels: what exists, what is done, what we want, what we must do, is the merging of disciplines according to its purpose (p. 7). De La Herrán (2011), professor from the Universidad Autónoma de Madrid, stresses: Transdisciplinarity is constant with intrinsic complexity of every natural or social, researchable or teachable phenomenon (p. 295).

Transdisciplinarity mainly excels in naturally ordering organically integrated knowledge from multi-sciences. Synchronously, since their confluence interprets phenomena that science, from their independent activity, doesn't reach, and causes the surge of new knowledge due to resolutive interactions.

It is important to weigh the statement of Romanian physic, Nicolescu (2017), in the *Letter of Transdisciplinarity:*

> Transdisciplinarity is complementary to the discipline approximation; arises the collision of new variables of discipline articulated in-between them; and offers us a new vision of nature and reality. Transdisciplinarity does not pursue the domain of various disciplines, but the opening of all disciplines which goes through and surpasses them. (art. 3, p. 96)

The clues given by Chilean teachers, Rojas Serey and Hawes Barrios (2012), are:

The terms integration, articulation, convergence are used occasionally as synonyms; yet none mean the same. Regarding the curricular discourse, it is necessary to make the appropriate linguistic precisions, namely: (a) Articulation: action and result of building coordination between unities. (b) Integration: conceived as an action component and deriving from the confrontation of a specific problem (d) Convergence: mainly referred to the establishment of sense and comparability (p. 60-61).

Transdisciplinarity has the characteristic of interacting from problems and complex realities (De La Herrán, 2011; Torres & Villegas, 2019; Motta, 2002), from where it seeks to give holistic solutions inherent of an operational and chaining structure of their interactions. One of the nuances of this approach is knowledge inclusivity, allowing them to create solutions to cultural, environmental, and economic realities. This trait between their multi-sciences attains the balance altering inevitably with the contextual whole.

Characteristics

Disciplinecombination: Transdisciplinarity strives to exceed the traditional limits of academic disciplines and support the collaboration between different study fields. Aims to integrate knowledge, methods, and approaches of diverse disciplines to address intricate problems (Vallejo & Simón, 2023; Nicolescu, 2017).

Holistic approach: It considers phenomena and problems from a global perspective. Strives to discern the nexus and relations between different traits, realizing problems cannot be totally grasped from one discipline.

Collaboration and dialogue: Transdisciplinarity boosts the collaboration and dialogue between experts of different disciplines, plus the participation of non-academic actors, such as local communities or interest groups. Targets to generate shared and collective knowledge (Delgado & Rist, 2016; Luna et al. 2013).

Orientation towards action: Transdisciplinarity pursues to generate knowledge and applicable practical solutions. It focuses on addressing concrete problems and contributing to

sustainable development and society's welfare (Pineau, 2009; Nicolescu, 2019).

Reflexivity: Transdisciplinarity promotes critical reflection of their own taxes, theoretical frameworks and methodologies applied in different educational dimensions. It seeks to question and surpass disciplinary limits, endorsing openness and flexibility.

When to apply transdisciplinarity?

Weighing practical exercise, it is timely to evince transdisciplinarity is preceded by disciplinarities. Hence, transdisciplinarity has two approaches as foyer: foremost is multidisciplinary (Gómez, 2017; Saltalamacchia et al. 2014) the latter is interdisciplinary (Arana, 2001; García, 2017; Gómez, 2017). The first means each discipline adds ideas about various aspects of the problem, identifying and joining different disciplines with independent actions in their segmented work and without internal connections. The second is the group of disciplines associated with certain exchanges. Facilitating spaces to dynamically grasp the phenomena, with interactions between disciplines, generating new knowledge. Yet, when results exceed multi-interdisciplinary outlooks, we face a transdisciplinary dimension. Though usually multidisciplinarity and interdisciplinarity are customary academic exercises.

Transdisciplinarity primarily engages the knowledge, coordinating and connecting all sciences, enabling to organically consider the set of sciences, and integrated disciplines relatively, able to interpret the contextual phenomena. Nicolescu (1996) asserts transdisciplinarity is based on three main postulates applied in their methodology:

- → Affirm the existence of various reality levels.
- → Reaffirm the logic of the included disciplines.
- → Consider the complexity of the disciplinary union.

Moreover, Nicolescu (1996) claims the successful transfer of methods of one discipline to another, could flow into the creation of new disciplines (Botello García, 2015, p. 18). Morin (1984) considered transdisciplinarity must have the sense of reunion between disciplines that involve exchange, interaction, and cooperation (Pañuela Velásquez, 2005, p. 66).

Finally, for Pérez Matosi and Setién Quezada (2008):

- → Transdisciplinary exceeds the limits of interdisciplinarity.
- → It aspires to surpass the fragmentation of knowledge.
- → Eclipses pluridisciplinarity and interdisciplinarity.
- → A process according to which the limits to individual disciplines are transcended to study problems from multiple perspectives with the goal of generating knowledge.
- → It is an approach, not a discipline.
- → Process to increase knowledge through integrating and transforming different gnoseological perspectives.
- → Interested in the dynamic that produces the simultaneous action of various levels of reality.
- → Nourished by disciplinary investigation, clarified in a new

and fruitful manner through transdisciplinary knowledge.

The great stele of transdisciplinarity results transcend all disciplines, creating new disciplinary perspectives.

Materials and methods

This research is qualitative, assuming an interpretative epistemic perspective. The first stage was achieved from the analytic-synthetic method (López Falcón & Ramos Serpa, 2021), an update of curricular documents of UNIAV-UNICAM's degrees, and executed a regional exploration about journal articles in academic databases of indexed scientific publication. Additionally applying the interview method (Gómez Rojas & Cohen, 2019), leading actors, meadiators and learners' experiences of UNIAV-UNICAM program were explored..

Transdisciplinary learning experiences at UNIAV-UNICAM

Shared transdisciplinary learning experience has been lived in the careers of Education Sciences at Universidad Nacional Antonio de Valdivieso (UNIAV) and the emblematic program of University in the Countryside (Universidad en el Campo, UNICAM).

In 2022, UNIAV launched a new academic offer in Education Sciences with four bachelor's degrees: Hispanic Language and Literature, Physics-Mathematics, Social Sciences and Natural Sciences, delivered in a semi-presential modality. The first three semesters (first and second year) listed a collective of 30 mediators of different specialties as the 83 % (25 of these hourly), the registration of new entrance this period was 268 students; 75 % women and 25 % men, coming from rural communities of ten territories from Rivas, Southeast of the country, and Caribbean Coast, unfathomable places in former times that could not access integral, human, and quality higher education regarding its cultural, ethic and environmental surroundings.

Curricular designs for these degrees are arranged based on a Competency Model under a new approach of integrality, quality, and practice from knowledge. It specifies professional competencies, while unifying objectives, transversal by level and year allowing to outline the different vertical, horizontal, integrators and transversal axes. A study plan structuring different axes, components, hour allotment, and credits marking the disciplinary degree axes (basics, professionalizing, electives), including the vital permanent investigation process.

A detail in the collective performance from mediators to learners in these Education Sciences degrees has been authentic integrality in the interweaving and unification of knowledge (conceptual, procedural, and attitudinal), verifying a capacity of self-organization, shared leadership, and joint decision-making; this condition enables us to own the vertical and horizontal curricular tasks and work under an individual and collective multidisciplinary, interdisciplinary and transdisciplinary dynamics.

UNIAV, from its epistemic gaze to biopedagogy and pedagogical mediation, asserted in its Institutional Project (Proyecto Educativo Institucional, PEI), and Pedagogical and Academic Horizon

(Horizonte Pedagógico y Académico, HPA) allows us to live a collective knowledge experience. Thus, semester teaching groups appropriating our references, and curricular designs from their specific degrees to grow the necessary competencies required by professional and citizen performance were created, being able to imbibe and live them on the pedagogical practice daily life in the integrated planification of the assessment periods, individual biannual Planification, action guiding principles (Bases Orientadores de la Acción, BOA), Rubric, Didactical Action Planification, and Integrated Guide of Self learning.

Integrated view of the educational formation in UNIAV

For physics-mathematics models creation, mediators and learners articulate six components. This common and harmonized encounter learning experience between disciplines generate integrality in UNIAV's academic setting, allowing to create new knowledge, promote research capacity in the social, economic-environmental, cultural area and solve from physic-mathematic complex and contextualized issues in each one of the rural communities from where learners originate; integrating flexibility, multiple perspectives, knowledge and approaches to different disciplines, including: physics, mathematics, language and literature, office automation, biology, and earth science, provoking practical abilities, social, cultural, emotional, personal, ethic, and moral knowledges.

Transdisciplinary learning experience is set in one of the four Education Sciences degrees, Physics-Mathematics has been chosen –its second semester, first year, Integrator two product, the components are six (Written expression, Office automation, Euclidean geometry, Calculus I, Particle mechanics that give an output to Integrator II), belonging to four disciplines: Language and literature, Informatic, Physics, and Mathematics.

Prior to each semester, the teachers' collective is trained about practice, integrated pedagogical planification where six mediators are gathered, pedagogical consultancy and coordination of careers, who, from a collective-synergic work, in a dialogue of knowledge, study, meditate, and agree, from their fields, the contents exhibited to the Integrator. This input enables the articulation and harmonization success of three holistic actions proposed in the component's program:

- → Search of problem tied to physical-mathematical models
- → Approach problems and hypotheses
- → Model construction, report creation, and results disclosure

Semestral planification is led by the Integrator in synergy with mediators, sharing the semester components: Written expression, Office automation, Euclidean geometry, Calculus I, Particle mechanic, Integrator II, considering competency level (generals and specifics), objectives (year and level) and knowledge required to develop the transdisciplinar integrator product, consisting on the "Construction of Physics-Mathematics models". As stated above, mediators raise transdisciplinarily: the integrated biannual matrix in which main contents are defined, whereby is possible the disciplines' engagement for

the creation of the integrator product; each mediator proceeds to delimitate their curricular components.

Therefore, the BOA is built, wherein a consensus, mediators recognize the point of disciplinary fusion for the inception of transdisciplinary formation of the integrator product, inception from simple to complex. Likewise, the learning assessment rubric is collectively designed, describing the domain grades built by learners in their learning process, considering competency dimensions.

Regarding the existent problematics in different communities from where Education Sciences protagonists come from, Physics-Mathematics learners in their integrator product raise solutions to problems related to particle mechanics. We consider learners from Isla de Ometepe —Rivas, Nicaragua— who propose, as a study particle the garbage collection truck.

To guide learners' transdisciplinary construction of knowledge, the Integrated Guide of Self-learning (Guía Integrada de Autoaprendizaje, GIA) was created. In it, the management of residues in Altagracia, Isla de Ometepe was a problem generator, where learners integrate different disciplines growing their capacity to identify the particle in movement (garbage collection truck), aiming to design a physic-mathematical model representing the trajectory of the garbage truck in the urban center of Altagracia (August-October, 2022).

Transdisciplinarity, product of the dialogue between learners and collective construction of knowledge, is lived through investigation itself, combining all disciplines that enable achieving the integratory actions of products built in every semester. Firstly, it is clarified what each discipline, from curricular flexibility and coherently providing the construction of the integrator product, where knowledge is attested. Thus, the internalization of competencies and objectives, addressing the pedagogical and academic daily work is essential.

Affective and effective communication of the learning community's members is vital to attain the integration of all components in the integrator product, BOA and rubrics, including assessment instruments and feedback, providing information and scopes of each discipline. Namely: Particle mechanics require a deep study of higher order derivatives to calculate the speed and acceleration. Similarly, Euclidean geometry is needed to model the platform of the garbage recollection truck and, the volume and capacity it must collect of all the deposited waste in the destinated spaces by the city hall of Altagracia.

The particle in movement entails the interpretation of all calculations made. For this, learners revert to written expression for writing and technical substantiation of the results obtained. It is crucial to mention office automation contributes as a technological tool to research, conduct the texts survey, video editing crucial to log, enhance, and exhibit the integrator product built in the community, and APA style to grant a suitable and clear record to the pedagogical requirements in the product creation.

Transdisciplinary learning experiences

On a community level, the transdisciplinary proposal, crafted by learners, was directed

from academic design for the community contribution, stirring the interest of territorial authorities to attend the management of solid residues, besides the sensibility, preoccupation, and compromise from an integral social gaze of alliance with the rest of institutions involved in the problematic, including: Ministry of Environment and Natural Resources (Ministerio del Ambiente y de los Recursos Naturales, MARENA), National Forestry Institute (Instituto Nacional Forestal, INAFOR), Ministry of Health (Ministerio de Salud, MINSA), MINED, National Police, leaders and territory politics.

Hereinafter, some learners' shared experiences are intertwined together.

Keybel, from Altagracia-Isla de Ometepe, a learning community protagonist, shares:

"To create our integrator product, it was important to organize ourselves as a learning community, according to our origin community. Then, it was important to observe the problematics of our community and dialogue with territory authorities and villagers" (K, personal communication, September 25, 2023).

Likewise, Junior, also Physics-Mathematics protagonist, declares:

"Contextualized learning granted us the opportunity to stimulate and research to submit solution alternatives, addressing the current concerns in Altagracia. It was a delightful experience for us. The synergy and application of what we learned in varied components mattered, aware we could propose a real alternative from complexity" (J, personal communication, September 25, 2023).

According to our discussion, learner Félix shared:

"The interactions with actors of our community were superb, see how we could apply all our components to reality. We saw the community motivated because they felt we could propose an alternative that could be heard" (F, personal communication, September 25, 2023).

To the question of, if they perceive transdisciplinarity, Keybel commented:

"Transdiciplinarity is gained from the time we align, network through all disciplines to build a final product. We have learned to merge all abilities from deep knowledge, until we find meaningful knowledge for our lives" (K, personal communication, September 25, 2023).

Finally, Junior mentioned how they lived the interrelationships with different actors:

"We went to City Hall and urbanism accompanied us. We socialized and did not feel a contrast between being from Physics-Mathematics and him being an engineer as we were all invested in presenting a real alternative" (J, personal communication, September 25, 2023).

Results and discussion

The learners' experiences display transdisciplinarity as an important educational approach. The melodic integration of diverse disciplines to address local issues in a pragmatic and relevant way is proved in the experiences Keybel, Junior and Félix relate. These unveil the answer to a problem raised by Uribe Agámez (2015): the value of uniting pedagogical theory

with historical and social contexts. Max-Neef (2004) depicts transdisciplinarity as a tool beyond the combination of disciplines, and offers real solutions from complexity, deriving in a complete and deep understanding of studied phenomena in their social context.

Learners' stories, from the UNIAV-UNICAM Program, on light of these experiences not just prove transdisciplinarity, moreover support their role as drivers of a more contextualized, inclusive and focused education in real solutions.

The creation of physical-mathematical models displays transdisciplinarity by enabling the alliance between mediators and learners in diverse fields to solve complex and contextualized problems. The creation of new knowledge and practical abilities is boosted by the interplay of fields such as physics, mathematics, literature, office automation. Likewise, the experience exhibits an integrated pedagogical planification, enabling the evolution of transversal competencies and settlement of real problems in rural communities, contributing to integral and sustainable development of regions from UNIAV's contribution.

Conclusion

By promoting collaboration, integration, innovation and dialogue between different specialties, transdisciplinarity is a cognitive practice, transcending limitations of traditional disciplinarity. With this integration, complex and contextualized problems can be addressed and urge an integral comprehension of the social realities.

To tackle local problems pragmatically and contextually, it is fundamental to have a balanced disciplines fusion. Keybel, Junior, and Félix's stories reveal the value of connecting pedagogical theory with historical and social contexts, stressing the importance of a more inclusive education, focused on solid solutions.

The experiences learners live in UNIAV through transdisciplinarity has allowed them to build an innovative physical-mathematical model, contributing to improve the collection truck's travel time to hasten the process and provide greater coverage to other community sectors, going beyond economic impact since it is a social and environmental matter, allowing to improve and enhance the utility of this disciplines woven in attention to real problematics they live, is part of a creative and innovative learning for life.

The backbone of transdisciplinarity is the experience of designing physical-mathematical models, where it was shown the diverse synergic collaboration between mediators, learners, territorial authorities and community. It surpasses disciplinary limits and cultivates transversal abilities to solve problems in rural communities. UNIAV acts as a transforming agent and greatly contributes to integral and sustainable development of communities.

Transdisciplinarity is a full system of knowledge and learning, transcending daily practice and offers solutions to community's problems. The integrator product displays how diverse disciplines work together to create concrete and contextualized situations, exhibiting the

transformative power of transdisciplinarity in higher education.

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