

Neurodiversity in the academic iniverse. STEAM as the spaceship and comics as the compass

Neurodiversidad en el universo académico: STEAM como nave y el cómic como brújula

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Abstract

Current times demand an educational prism that is transformative for true inclusion in university spaces where neurodivergent students coexist. This social commitment is addressed through hermeneutic research of theoretical-philosophical content, framed within the research line: Integrative and Inclusive Educational Strategies from a Trans-complex Kaleidoscope. The metaphor of the "Knowledge Universe" conceives the university as a multidimensional cosmos where each student is an explorer with unique cognitive abilities. The STEAM approach constitutes the spaceship for this journey, offering multiple points of entry to knowledge through its interdisciplinary nature. Complementarily, the comic functions as a visual navigation chart, providing a sequential structure that facilitates the decoding of complex content, reduces anxiety, and clarifies academic expectations. The proposal transcends the adaptive model to redesign the learning ecosystem based on the appreciation of cognitive diversity, allowing for the construction of collective knowledge. It concludes by highlighting the need for institutional policies that strengthen this inclusive approach, essential for contemporary higher education.

Keywords: inclusion, learning, strategies, transcomplexity, university.

Resumen

Los tiempos actuales exigen un prisma educativo transformador para una verdadera inclusión en los espacios universitarios donde conviven estudiantes neurodivergentes. Este compromiso social se aborda mediante investigación hermenéutica de contenido teórico-filosófico, enmarcada en la línea de investigación: estrategias educativas integradoras e inclusivas desde un caleidoscopio transcomplejo. La metáfora del "Universo del Conocimiento" concibe la universidad como cosmos multidimensional donde cada estudiante es un explorador con capacidades cognitivas únicas. El enfoque STEAM constituye la nave espacial de este viaje, ofreciendo múltiples puntos de entrada al conocimiento mediante su carácter interdisciplinario. Complementariamente, el cómic funciona como carta de navegación visual, proporcionando estructura secuencial que facilita la decodificación de contenidos complejos, reduce la ansiedad y clarifica expectativas académicas. La propuesta trasciende el modelo adaptativo para rediseñar el ecosistema de aprendizaje desde la valoración de la diversidad cognitiva, permitiendo la construcción del conocimiento colectivo. Se concluye destacando la necesidad de políticas institucionales que fortalezcan este enfoque inclusivo esencial para la educación superior contemporánea.

Palabras clave: aprendizaje, estrategias, inclusión, universidad y transcomplejidad.

Introduction

Contemporary higher education faces the imperative to move beyond a homogenizing paradigm toward a learning ecosystem that recognizes and values cognitive diversity. Neurodivergent students—those with conditions such as Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), or specific learning difficulties—often encounter significant barriers within traditional instructional approaches, which can limit their full participation and academic success. This reality calls for educators to develop new competencies and adapt their teaching practices, acknowledging that each brain processes and learns at its own pace.

In the Latin American context, the inclusion of neurodivergent students in university settings presents an even greater challenge. Institutions have been slow to respond to growing social demands for more inclusive practices, often attempting to “normalize” students rather than embracing and valuing their differences (Amador et al., 2021).

In response to this need, this article proposes a holistic, integrative, and complementary strategic framework based on the metaphor of the “Knowledge Universe.” Within this framework, the STEAM methodology (Science, Technology, Engineering, Arts, and Mathematics) functions as the spacecraft, while the comic serves as a stellar navigation chart. Together, these tools are designed to empower neurodivergent students throughout their academic journey.

It is essential to move beyond labeling and instead foster classroom practices that address individual learning needs. As noted by Judy Singer, who originally coined the term neurodiversity, this concept was not intended as a mere diagnostic category, but rather as a political and social construct grounded in the principles of biodiversity and intersectionality. Drawing from her personal experience as a neurodivergent woman with autistic traits and ADHD, Singer emphasizes that neurodiversity represents a natural variation in human brain functioning, analogous to biological diversity. She challenges interpretations that reduce it to a euphemism for “normality” or confine it within a deficit-based medical framework.

This perspective supports the reconceptualization of the university as a cognitively diverse ecosystem, where each student’s unique mental architecture does not require “correction,” but rather an educational design that values diverse ways of processing and contributing to knowledge. Furthermore, Singer’s critique of the commodification of the neurodiversity movement—and its appropriation by corporate interests—highlights the risk of institutions adopting neurodiversity as an empty slogan, without implementing meaningful transformations in their pedagogical structures.

Finally, Singer’s vision of a well-being system centered on individual needs rather than labels aligns directly with the proposed flexible STEAM–comic model. This approach enables each “cognitive explorer” to navigate the universe of knowledge through tools and scaffolding that honor their uniqueness, moving beyond rigid categorical frameworks.

Neurodivergent students can be understood as epistemic agents with differentiated cognitive capacities within the academic cosmos. Their engagement with knowledge follows legitimate neurofunctional patterns rather than pathological ones. From the philosophical perspective of Judy Singer (1998), who introduced the concept of neurodiversity, these differences represent another expression of natural human variation, analogous to ecological biodiversity.

For instance, a student with ADHD may exhibit what can be described, in Deleuzian terms, as rhizomatic cognition—an ability to establish transversal connections across disciplinary domains. At the same time, such learners may benefit from temporal and structural scaffolding to sustain executive attention (Jordán & Vergara, 2020). Similarly, autistic students often demonstrate a remarkable hermeneutic capacity to decode complex systems and abstract patterns; however, they may experience uncoded social interactions as disruptive semiotic interference. Consequently, their development is better supported through predictable environments and visual supports that function as cognitive-social prostheses (Lobos et al., 2024).

The social model of disability, reinterpreted through the lens of liberation philosophy proposed by Enrique Dussel (2011), shifts the focus from the “remediation” of the student toward a decolonial redesign of the educational ecosystem. Within this framework, pedagogical tools, pathways, and structures must be configured to enable a plurality of cognitive styles to flourish and co-construct knowledge, in line with the principles of the pedagogy of autonomy advanced by Paulo Freire (1997).

This perspective also resonates with the epistemologies of the South articulated by Boaventura de Sousa Santos (2010), which recognize the value of subaltern knowledges and diverse forms of embodied consciousness. From this standpoint, neurodiversity is not framed as a limitation, but rather as a condition of possibility for educational innovation, particularly within a Latin American perspective.

Methods

This study adopts a theoretical–philosophical hermeneutic approach as its central method, aimed at uncovering the deeper meanings and conceptual structures underlying neurodivergent inclusion in the university context. Rather than limiting itself to a conventional literature review, this approach advances toward a dialectical interpretation that connects the analyzed theoretical frameworks with lived educational experience. It is situated within the research line Integrative and Inclusive Educational Strategies from a Transcomplex Perspective.

Transcomplexity, understood as an epistemological horizon, enables the study to move beyond fragmented views of knowledge and to conceive education as a dynamic, interdependent system in constant reconfiguration. From this standpoint, the research does not seek linear answers; instead, it aims to weave meaningful relationships among neurodiversity, the STEAM approach, and the use of comics as tools for cognitive and affective mediation.

The hermeneutic process was carried out in three interrelated phases:

1. Contextual immersion phase: A comprehensive review of specialized literature was conducted, focusing on neuroeducation, inclusive pedagogies, STEAM education, and visual narratives, with particular attention to the Latin American context. This phase enabled the identification of key tensions, gaps, and potentialities in the theoretical and practical articulation of neurodivergent inclusion.
2. Relational interpretation phase: Through an emergent categorical analysis, connections were established among authors, pedagogical approaches, and documented experiences. The aim was not merely comparative, but interpretive—building conceptual bridges that deepen the understanding of the educational phenomenon under study.
3. Transcomplex synthesis phase: The partial interpretations were integrated into a coherent and theoretically grounded proposal, in which the metaphor of the “Knowledge Universe” operates as an integrative meta-model capable of embracing the diversity of voices, knowledges, and cognitive modalities present in the university classroom.

This methodological pathway does not seek generalization; rather, it aims for an in-depth and nuanced understanding of a complex educational phenomenon. It assumes that all interpretation is situated, partial, and open to future reinterpretations. From a transcomplex perspective, hermeneutics thus emerges as a guiding compass for navigating the multidimensional nature of educational inclusion in the 21st century.

Results

The implementation of the STEAM–comic neuroinclusive model generates measurable transformations that extend beyond academic outcomes, reconfiguring the university ecosystem through a logic of cognitive navigability and affective educational mapping. These results can be interpreted as milestones within the exploratory journey of the “Knowledge Universe”:

1. Increased participation of neurodivergent students

The STEAM “spacecraft,” with its multiple entry points and modes of interaction, enables a greater number of neurodivergent students to actively engage in the academic journey. Multimodal strategies function as systems of cognitive alignment, recognizing and valuing diverse styles of mental navigation.

As demonstrated by Zavala and Becerra (2024), “a multimodal approach can facilitate the integration of technologies in teaching, thereby improving educational quality and teaching performance” (p. 17). This finding highlights how the universal design of the “STEAM spacecraft” responds to the diversity of “cognitive vessels” undertaking the educational journey.

From a philosophical perspective, this aligns with the ethics of recognition proposed by Axel Honneth (1995), where inclusive education represents a form of reciprocal affirmation of cognitive differences. In this regard, Espiter Villa (2021, p. 3), drawing on Honneth’s framework, explains that reification can be understood as a forgetting of recognition grounded in three interconnected dimensions. From a Heideggerian perspective, it emphasizes the primacy of the precognitive, where interactive experiences constitute the condition of possibility for cognitive development. From the standpoint of developmental psychology, it argues that subjectivity is formed through symbiotic relationships with significant others who demand recognition, and whose disregard produces moral fractures. Finally, experiences of dispossession, violence, or dishonor give rise to social struggles aimed at constructing an ethical framework that enables individual self-realization within a universal normative order based on mutual recognition.

Therefore, the multimodal STEAM design not only accommodates but also epistemically celebrates the diversity of minds, positioning itself as a practice of cognitive justice (De Sousa Santos, 2014). In this regard, Mandujano (2015, p. 194), drawing on the work of Boaventura de Sousa Santos, highlights that his central claim is grounded in a dual conviction: first, that the understanding of the world extends far beyond the limits imposed by Western epistemology; and second, that human diversity manifests in infinitely plural ways of being, thinking, and feeling. This includes alternative conceptions of time, relationality, and knowledge production, thereby validating multiple ways of inhabiting the “universe of knowledge.”

The Theory of Mind (ToM), understood as the capacity to infer the mental states of others, finds in comics an especially effective medium for its development and application in educational contexts. Graphic narratives, by visually representing characters’ intentions, emotions, and beliefs through facial expressions, gestures, and sequential action, function as visual scaffolds that externalize typically implicit mental processes.

This is particularly valuable for neurodivergent students who experience challenges related to ToM—such as some individuals on the autism spectrum—since they can decode these mental states through the explicit visual cues that comics provide in a structured manner (Zapata-Téllez et al., 2021).

The STEAM approach further expands this potential by integrating Theory of Mind (ToM) and comics within a multidimensional learning ecosystem. For example:

- Arts (A) and Sciences (S): The creation of comics based on scientific concepts enables students not only to understand disciplinary content, but also to engage ToM by representing the perspectives of different actors (e.g., a historical scientist or a character addressing an environmental issue).
- Technology (T) and Engineering (E): Designing interactive digital comics, where user decisions influence the narrative, fosters perspective-taking and the anticipation of others' reactions—key competencies associated with ToM.
- Mathematics (M): Presenting mathematical problems in comic format can incorporate characters with motivations and conflicts, thereby integrating logical reasoning with socio-emotional understanding.

The intersection of Theory of Mind (ToM), comics, and STEAM thus creates a pedagogical space in which cognitive diversity becomes an asset. In this context, students not only acquire disciplinary knowledge but also develop socio-emotional competencies through a medium that respects diverse processing styles, while simultaneously promoting educational inclusion from a multimodal and neuroaffirmative perspective.

2. Comics as a Multimodal Narrative Technology

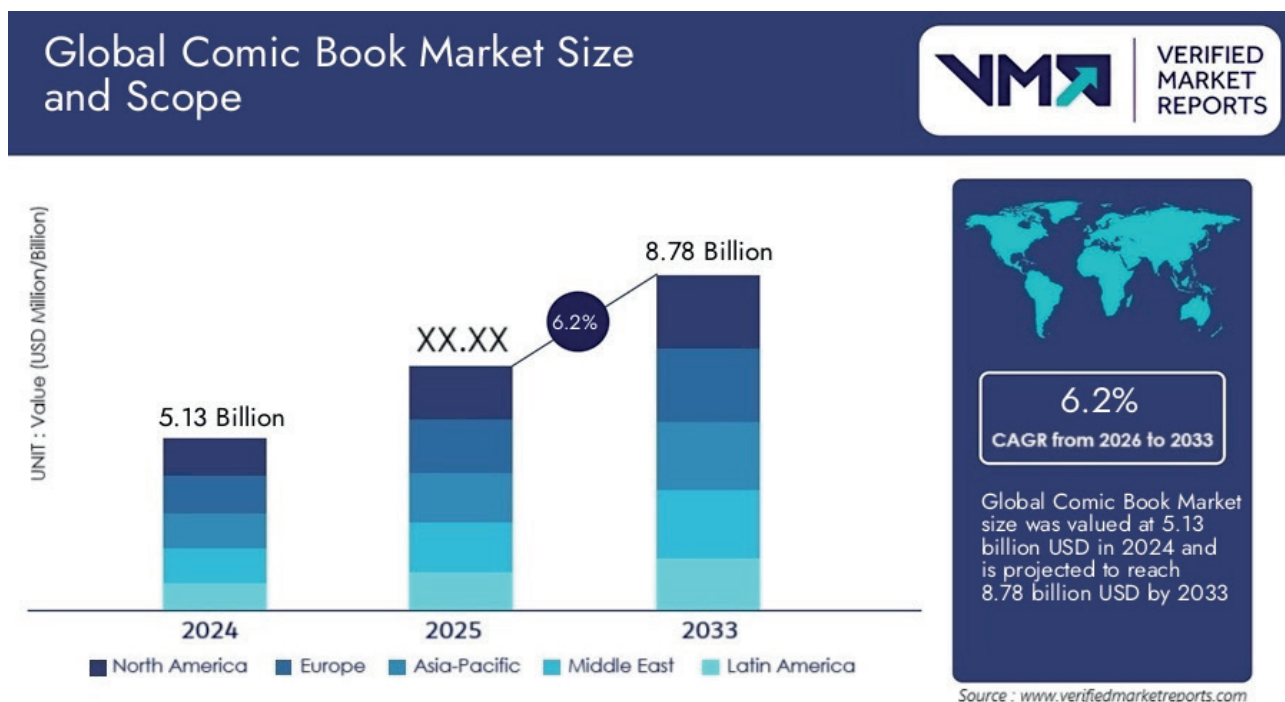
Comics have moved beyond their traditional perception as a form of entertainment to become a strategically valuable educational tool within higher education. As demonstrated by Becerra-Romero et al. (2023) in their study on the implementation of the “Comic Corner” at the Library of Education Sciences of the ULPGC, comics possess “broad potential for the development of key competencies and direct applications in teaching and research” (p. 2).

This study highlights how the integration of comics into higher education settings responds to their capacity to structure knowledge in a visual and sequential manner, thereby facilitating complex learning processes through a dialectical synthesis of image and text that functions as cognitive scaffolding. The versatility of comics as a multimodal narrative technology extends beyond the educational sphere, positioning them as impactful resources in communicative and therapeutic contexts.

The report by Verified Market Reports (2023) documents this multifaceted expansion, noting their growing application in “education, marketing, and mental health” as evidence of their sociocultural relevance (see Figure 1). This cross-sector applicability reinforces the argument advanced by Becerra-Romero et al. (2023) regarding the semiotic value of images as an “essential element in the creation and transmission of information” (p. 1), now extended to new contexts of use.

Figure 1

Market research report on comics (comic books) by type, application, region, and forecast, 2023–2030



Source: Verified Market Reports. (2023)

The convergence of these sources—academic and market-based—reveals the consolidation of comics as a hermeneutic device with transdisciplinary scope. In this regard, the experience of University of Las Palmas de Gran Canaria (ULPGC) demonstrates their effectiveness as a structured didactic resource within formal educational settings, while market data confirm their adaptability across diverse social domains. Together, these perspectives validate the conceptualization of comics as tools for cognitive mediation and complex communication in contemporary society.

Furthermore, it is important to highlight that contemporary Hispano-American comics have moved beyond their traditional role as entertainment, establishing themselves as a medium for narrative experimentation and sensory experience. This evolution expands their pedagogical potential within inclusive educational environments. Research compiled in the monograph indicates that comics are no longer confined to classical sequentiality, but instead explore formats that engage multisensory and embodied dimensions (Hague, 2014; Szép, 2020, as cited in Cabero & González, 2024). These authors further argue that:

Within experimental comics, the use of narrative multilinearity, the disruption of sequential structure, and the creative use of the page—through form, layout, color, and visual elements—as a representational resource invite readers to reconsider how graphic narratives are approached. These features challenge conventional reading practices by blurring the boundaries between artistic and literary forms (p. 10).

Building on the above, this perspective aligns with the creation of diversified neurocognitive pathways within the classroom. In addition, there is a growing body of academic interest in comics as a medium for representing marginalized experiences and non-hegemonic identities, reinforcing their value as tools for epistemic justice and identity recognition in university contexts. This capacity of comics to give voice to situated and diverse experiences makes them particularly well suited for designing learning environments that celebrate—rather than merely accommodate—neurodiversity.

Finally, formal experimentation with narrative multilinearity, the disruption of sequential structures, and the expressive use of the page offers flexible scaffolding that can reduce anxiety associated with extended linear tasks, particularly benefiting students with ADHD or ASD. This confirms that comics are not merely a didactic resource, but a versatile narrative technology with the potential to pedagogically redesign the “Knowledge Universe.”

3. Reducing Evaluation Anxiety through Visual Scripts in the Latin American University Context

In the Latin American university context, where pedagogical transitions from traditional models to inclusive approaches often generate uncertainty among neurodivergent populations, comics function as technologies of participation. They embody the principle of problem-posing education proposed by Paulo Freire (1970), transforming assessment from a mere instrument of measurement into a tool for cognitive dialogue.

From the perspective of the ecology of knowledges advanced by Boaventura de Sousa Santos (2018), visual scripts can be understood as a form of intercultural translation between hegemonic academic languages and the diverse cognitive processing styles present in Latin American university classrooms. This approach aligns with the principles of the pedagogy of autonomy (Freire, 1996), where the clarification of expectations through graphic narratives strengthens student agency and reduces the asymmetry inherent in traditional assessment processes.

Los organizadores gráficos constituyen herramientas de mediación cognitiva que permiten procesar, estructurar y priorizar información compleja mediante operaciones mentales como la clasificación, comparación y detección de patrones conceptuales. Estas herramientas se convierten en andamios neurocognitivos fundamentales para la práctica docente, al facilitar que el estudiante construya conocimiento de manera sintetizada, accesible y significativa (López-Martínez, 2023).

En el contexto de la neurodiversidad universitaria, estas herramientas operan como sistemas de decodificación visual que se alinean perfectamente con la metáfora del “Universo del Conocimiento.” Así como el cómic funciona como brújula narrativa, los organizadores gráficos actúan como cartografías cognitivas que permiten a estudiantes neurodivergentes navegar territorios académicos complejos mediante representaciones espaciales que reducen la carga cognitiva y potencian la metacognición.

This approach is closely aligned with the principles of Universal Design for Learning (UDL), in which multimodal representation—particularly through visual structures—provides alternative entry points to knowledge. These are especially valuable for students with ADHD, autism, or dyslexia, who often process information predominantly through visual-spatial channels.

It is important to emphasize that graphic organizers function as tools of cognitive mediation, enabling learners to process, structure, and prioritize complex information through mental operations such as classification, comparison, and the identification of conceptual patterns. As such, these tools become essential neurocognitive scaffolds in teaching practice, facilitating the construction of knowledge in ways that are synthesized, accessible, and meaningful (López-Martínez, 2023).

Within the context of neurodiversity in higher education, these tools operate as systems of visual decoding that align closely with the metaphor of the “Knowledge Universe.” Just as comics function as a narrative compass, graphic organizers act as cognitive maps that enable neurodivergent students to navigate

complex academic territories through spatial representations that reduce cognitive load and enhance metacognition. This approach is also consistent with the principles of Universal Design for Learning (UDL), where multimodal representation—particularly through visual structures—provides alternative entry points to knowledge. These are especially valuable for students with ADHD, autism, or dyslexia, who tend to process information predominantly through visual-spatial channels.

Discussion

The results validate the effectiveness of the STEAM–comic neuroinclusive model as a transformative pedagogical ecosystem capable of reconfiguring the university experience through the recognition and appreciation of cognitive diversity. The metaphor of the “Knowledge Universe” is substantiated by demonstrating how the STEAM approach—conceived as a multidimensional spacecraft—facilitates multiple entry points to knowledge, acknowledging diverse cognitive styles and fostering active and meaningful participation among neurodivergent students.

Complementarily, comics—functioning as a visual compass—not only help structure complex content and reduce anxiety associated with academic tasks, but also contribute to the development of socio-cognitive skills such as Theory of Mind. At the same time, they operate as tools of epistemic justice by making visible non-hegemonic narratives.

This dual approach moves beyond mere methodological adaptation to establish a learning ecology grounded in universal design, multimodality, and reciprocal recognition, where neurodiversity is positioned as an epistemological value rather than a deficit to be compensated.

References

- Espiter Villa, V. M. (2021). La teoría del reconocimiento de Axel Honneth: un bosquejo moral de las formas de menosprecio social. Cuadernos De Filosofía Latinoamericana, 42(125). <https://doi.org/10.15332/25005375.6372>
- Freire, P. (1970). Pedagogía del oprimido. Siglo XXI Editores. Freire Paulo - Pedagogía del Oprimido.pdf
- Freire, P. (1996). Pedagogía de la autonomía. Paz e Terra. Pedagogía de la Autonomía Freire.pdf - Google Drive
- Jordán, F. R., & Vergara, C. C. (2020). Trastorno por déficit de atención con hiperactividad (TDAH) en niños y adolescentes. Una revisión clínica. Revista de Neuropsiquiatría, 83(3), 148–156. <https://doi.org/10.20453/rnp.v83i3.3794>
- Lobos, E. O., Ortega, A. A., Palacios, E. M., & Román, H. G. (2024). Inclusión de los estudiantes neurodivergentes en Educación Superior, una mirada desde la perspectiva de docentes y estudiantes. Ciencia y Educación, 5(10), 149–157. <https://doi.org/10.5281/zenodo.14046940>
- López-Martínez, S. E. (2023). Organizadores gráficos para el desarrollo de la metacognición y el pensamiento crítico. CienciaMatria, 9(17), 99-119. Recuperado <https://ve.scielo.org/pdf/crihct/v9n17/2542-3029-crihct-9-17-99.pdf>
- Mandujano, M., (2015). Epistemologías del Sur. Boaventura de Sousa Santos. (Boulder, Co., Paradigm Publishers, 2014). Boaventura de Sousa Santos y Maria Paula Meneses (coords.). (Madrid, Akal, 2014). REIS. Revista Española de Investigaciones Sociológicas, (152), 193-197.
- ReyCabero, E. del, & GonzálezHernández, G. (2024). Experimentación y experiencia en el cómic hispanoamericano del siglo XXI. Literatura y Lingüística, (50), 7-13. <https://doi.org/10.29344/0717621X.50.3918>
- Segovia, B. (2012). La adquisición de la competencia narrativa a través del cómic en la Escuela Primaria. Revista Complutense de Educación, 23(2), 375-399. DOI: 10.5209/rev_RCED.2012.v23.n2.40034
- Singer, J. (2022.). ¿Qué es la Neurodiversidad y el Movimiento de la Neurodiversidad? [Video]. YouTube. Centro de Estudios CELEI. <https://www.youtube.com/watch?v=ODqcPSmKr5o&t=2s>
- Zapata-Téllez, J., Ortega-Ortiz, H., Becerra-Palars, C., & Flores-Ramos, M. (2021). Teoría de la mente: una aproximación teórica. Cuadernos de Neuropsicología / Panamerican Journal of Neuropsychology, 15(1), 171–185. Recuperado de <https://dialnet.unirioja.es/servlet/articulo?codigo=8044703>
- Zavala Guevara, L., & Sanjuanero Becerra, R. (2024). Estrategias Digitales de Enseñanza: Evaluación de un Sistema Didáctico Multimodal: Digital Teaching Strategies: Evaluation of a Multimodal Didactic System in the Context of Higher Secondary Education. LATAM Revista Latinoamericana De Ciencias Sociales Y Humanidades, 5(5), Universidad Autónoma de Querétaro. <https://doi.org/10.56712/latam.v5i5.2853>

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