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Tesis Doctoral por Compendio de Artículos

El impacto de los determinantes de la brecha y sesgos de género sobre la inteligencia colectiva en carreras universitarias STEM: Hacia un trabajo colaborativo inclusivo.

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"*The world breaks everyone, and afterward, some are strong at the broken places.*"
— Ernest Hemingway.

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Resumen

Los estereotipos de género influyen en la cognición y el comportamiento en disciplinas STEM, generando brechas que impactan la captación de talento femenino y el desempeño colaborativo, fundamentales para el desarrollo de la inteligencia colectiva. Esta tesis, compuesta por diez artículos, tiene como objetivo general analizar los efectos de los determinantes de la brecha y los sesgos de género en el comportamiento de estudiantes de STEM en universidades públicas y privadas de Chile. Se plantea la hipótesis de que estos determinantes influyen negativamente en las interacciones grupales, subrayando la importancia de la inteligencia colectiva para superar dichas barreras. Este enfoque es relevante para avanzar en los Objetivos de Desarrollo Sostenible (ODS) de la Agenda 2030, que promueven la igualdad de género y la educación inclusiva. Este trabajo científico emplea diversas metodologías (cualitativas, cuantitativas y mixtas), entre las que se incluyen: una revisión sistemática sobre la brecha de género en STEM; análisis de los factores que contribuyen a esta brecha en la educación superior y su impacto en las trayectorias académicas; el diseño y validación de un instrumento psicométrico para medir factores asociados a la brecha de género; un estudio sobre los desafíos de salud mental en la educación superior; modelado de ecuaciones estructurales para analizar la resiliencia académica; estudios sobre factores psicosociales que influyen en estas carreras, como la autoeficacia, la sabiduría y la salud mental; investigaciones sobre sesgos implícitos de género utilizando el Test de Asociación Implícita; y estudios sobre la influencia de los estereotipos de género en la inteligencia colectiva. Los resultados destacan barreras estructurales y culturales que afectan las interacciones grupales y trayectorias académicas, indicando la necesidad de intervenciones que promuevan la equidad de género y el bienestar en la educación superior, en apoyo a políticas de educación de calidad y desarrollo sostenible.

Palabras clave: STEM, cognición, brecha de género, salud mental, factores psicosociales, inteligencia colectiva.

Abstract

Gender stereotypes influence cognition and behavior in STEM disciplines, creating gaps that affect the recruitment of female talent and collaborative performance, which are crucial for the development of collective intelligence. This thesis, composed of ten articles, aims to analyze the effects of gender gap determinants and biases on the behavior of STEM students in public and private universities in Chile. The hypothesis is that these determinants negatively influence group interactions, highlighting the importance of collective intelligence in overcoming these barriers. This approach is relevant for advancing the Sustainable Development Goals (SDGs) of the 2030 Agenda, which promotes gender equality and inclusive education. This scientific work employs various methodologies (qualitative, quantitative, and mixed methods): a systematic review of the gender gap in STEM; analysis of the factors contributing to this gap in higher education and their impact on academic trajectories; design and validation of a psychometric instrument to measure factors associated with the gender gap; a study on the challenges of mental health in STEM higher education; structural equation modeling to analyze academic resilience in STEM students; studies on various psychosocial factors influencing these fields, such as self-efficacy, wisdom, and mental health; research on implicit gender biases using the Implicit Association Test (IAT); and studies on the influence of gender stereotypes on collective Intelligence. The results highlight structural and cultural barriers affecting group interactions and academic trajectories, indicating the need for interventions that promote gender equity and well-being in higher education, supporting policies for quality education, and sustainable development.

Keywords: STEM, cognition, gender gap, mental health, psychosocial factors, collective Intelligence.

Introducción

Esta tesis cumple con las directrices del Doctorado en Educación de la Universidad Metropolitana de Ciencias de la Educación, que exige un mínimo de 3 artículos científicos, con al menos 1 aceptado en una revista indexada en WoS o Scopus (UMCE, 2023). El texto presenta un compendio de 10 artículos (2 publicados, 1 aceptado y 7 en revisión), que examinan, desde múltiples perspectivas, la problemática de la brecha de género en las disciplinas STEM (ciencia, tecnología, ingeniería y matemáticas), con un enfoque específico en el ámbito de la educación superior.

Los artículos presentados son el fruto de más de dos años de investigación rigurosa, participación en conferencias nacionales e internacionales y colaboración con diversas instituciones de Educación Superior en Chile. La colaboración permitió un enfoque interdisciplinario y diverso, esencial para abordar las complejidades inherentes a la brecha de género en el ámbito de la educación STEM. Este proyecto fue diseñado y ejecutado con un fuerte compromiso hacia la ética y la integridad académica, siendo sometido y aprobado por el Comité de Ética de la Universidad de Santiago de Chile (USACH). Dicha aprobación garantiza que todos los procedimientos involucrados en la recolección de datos y en la interacción con los participantes cumplieron con los más altos estándares éticos, asegurando la confidencialidad, el consentimiento informado, y el respeto a los derechos de todos los involucrados.

De los 10 artículos que componen esta tesis, dos se han publicado en revistas indexadas en WoS y Scopus (Q1 y Q2), y uno ha sido aceptado para su publicación (Q1). Los siete restantes están actualmente en proceso de revisión por pares, todos en inglés. En esta tesis se detallarán los tres artículos que ya han pasado la revisión por pares (dos publicados y uno aceptado), cumpliendo ampliamente con los requerimientos del Doctorado en Educación de la Universidad Metropolitana de Ciencias de la Educación. Por otro lado, debido a las estrictas políticas de confidencialidad de las revistas y la importancia de resguardar la integridad del proceso de revisión, se presentarán los resúmenes de los siete artículos en evaluación, destacando lo esencial de su contenido sin revelar detalles específicos hasta que concluya el proceso de evaluación y aceptación (introducción, metodología, resultados y discusión).

La brecha de género en STEM constituye un fenómeno complejo y multifacético(Chan, 2022), que no solo limita el acceso y la participación equitativa de las mujeres en estas áreas(Hall et al., 2022; Speer, 2023; van den Hurk et al., 2019), sino que también impacta negativamente en el desarrollo de

competencias clave para la innovación y el progreso social(Alam et al., 2021; Dost, 2024). Este compendio se inscribe dentro de la necesidad imperiosa de abordar estas desigualdades, conforme a los principios y objetivos de desarrollo sostenible delineados en la Agenda 2030(World Economic Forum, 2024). En el marco de este proyecto de tesis, se han desarrollado una serie de artículos que abordan distintos aspectos relacionados con la brecha de género en la educación superior, especialmente en el contexto de las carreras STEM(Schmader, 2023).

El primero de los artículos se titula "*STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022)*". Este artículo que se encuentra publicado presenta una revisión sistemática que analiza la evolución y las tendencias en la investigación sobre la brecha de género en STEM durante la última década. La metodología empleada incluye un análisis bibliométrico en las bases de datos WoS, Scopus y ERIC.

El segundo paper "*Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education*", que se encuentra aceptado y próximo a ser publicado, realiza un análisis exhaustivo de los factores que contribuyen a la brecha de género en la educación superior STEM, así como su impacto en las trayectorias académicas. El estudio se basa en metodología cualitativa, con un diseño de teoría fundamentada para identificar y analizar estos factores.

El tercer paper "*Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education*", se enfoca en la creación y validación de un instrumento psicométrico diseñado para evaluar los factores que contribuyen a la brecha de género en la educación superior. Este estudio emplea una metodología cuantitativa con un diseño transversal, proporcionando una herramienta robusta y confiable para la medición de variables críticas en el contexto de la equidad de género en el ámbito académico.

El cuarto paper "*The challenges of mental health in Chilean university students*", explora los desafíos de la salud mental entre los estudiantes universitarios en Chile, con un enfoque en las diferencias de género. Este artículo, ya publicado, constituye un análisis teórico que ofrece un diagnóstico exhaustivo de la situación de la salud mental entre los estudiantes universitarios. A través de este trabajo, se identifican los principales desafíos en este ámbito, proporcionando una base sólida para el desarrollo de estrategias de intervención y políticas educativas que aborden estos retos.

El quinto paper "Academic Resilience and Its Relationship with Anxiety and Depression in STEM Students: A Structural Equation Modeling Approach", presenta un análisis de la relación entre la resiliencia académica y los niveles de ansiedad y depresión en estudiantes de carreras STEM, utilizando un modelo de ecuaciones estructurales (SEM). Este estudio ofrece una comprensión profunda de cómo la resiliencia académica puede influir en la salud mental de los estudiantes en contextos académicos exigentes.

El sexto paper "*What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors*." Este estudio examina los factores psicosociales que influyen en el desarrollo de la sabiduría, enfocándose en variables como la autoeficacia, el bienestar psicológico y el bienestar social dentro del contexto de la educación superior en disciplinas STEM. La investigación, a través de un diseño no experimental de corte transversal, se utilizó un path analysis para examinar cómo las variables interrelacionadas influyen en el desarrollo de la sabiduría en estudiantes universitarios.

El séptimo paper "*Structural Equation Model to Explore the Association between Gender Gap, Mental Health, Self-Efficacy in STEM Higher Education*." En este artículo, se presenta un modelo de ecuaciones estructurales que explora la asociación entre la brecha de género, la salud mental (depresión, ansiedad), estados emocionales y la autoeficacia en estudiantes de STEM.

El octavo paper "*A Decade of Insights: The Cognitive Impact of Stereotype-Driven Biases on Language Processing*", presenta una revisión sistemática sobre el impacto de los estereotipos de género en el procesamiento del lenguaje, analizando investigaciones de la última década. El estudio examina cómo estos sesgos afectan la comprensión y distorsionan la interpretación, influyendo en el desempeño individual y las dinámicas comunicativas en contextos académicos.

El noveno paper "*STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes*." Se investiga el papel de la inteligencia colectiva en la superación de barreras individuales impuestas por los estereotipos de género en la educación superior en STEM. El estudio midió la inteligencia colectiva y la comparó con la inteligencia individual, diferenciando los resultados según sexo y género. Utilizando una metodología mixta con un diseño paralelo convergente, el artículo ofreció una comprensión integral de cómo las dinámicas de grupo pueden mitigar las limitaciones impuestas por los estereotipos de género, y a su vez, cómo estos estereotipos pueden influir y afectar dichas dinámicas.

El décimo paper "*Gender Stereotypes and Career Choices in STEM: The Role of Implicit Associations among University Students*." Este estudio emplea un diseño experimental transversal, utilizando el Implicit Association Test (IAT) para examinar cómo las asociaciones implícitas entre conceptos como género, y carrera profesional influyen en las decisiones de estudiantes universitarios de STEM. Al medir estas asociaciones automáticas, el estudio busca revelar cómo los sesgos implícitos pueden afectar las elecciones profesionales, aportando una comprensión más profunda de las barreras cognitivas que limitan la participación equitativa en STEM.

Este compendio de artículos ofrece una visión comprensiva y crítica de las múltiples dimensiones de la brecha de género en STEM, con implicaciones directas tanto para la formulación de políticas educativas como para la implementación de prácticas que promuevan la equidad de género y el bienestar de los estudiantes en la educación superior. La integración de enfoques metodológicos cualitativos, cuantitativos y mixtos permite un análisis profundo, proporcionando un marco teórico robusto y un cuerpo empírico que contribuye sustancialmente al campo de estudio. Teóricamente, este trabajo amplía el entendimiento sobre cómo los estereotipos de género y los sesgos implícitos afectan el desarrollo académico y profesional en STEM, subrayando la importancia de la inteligencia colectiva y los factores psicosociales en la superación de barreras estructurales. En el plano práctico, los hallazgos de este compendio sirven como base para diseñar intervenciones y políticas educativas más inclusivas, orientadas a mitigar las desigualdades de género y a fomentar un ambiente académico que favorezca el desarrollo integral y la equidad para todos los estudiantes.

El texto se organiza de la siguiente manera: comienza con el planteamiento del problema de la tesis, aprobado por la comisión en noviembre de 2022 y por el Comité de Ética en enero de 2023, junto con los objetivos de la investigación. A continuación, se subraya la relevancia y originalidad del estudio, resaltando su contribución teórica y práctica en el ámbito de la educación superior en STEM. Un capítulo introductorio conecta los objetivos de la investigación con cada artículo, seguido por los resúmenes en inglés. Finalmente, se presenta una sección de conclusiones que sintetiza las aportaciones generales de la tesis, acompañada de las referencias bibliográficas y los anexos, que incluyen cartas de aceptación de revistas, evidencia de participación en congresos en 2024, el certificado de la pasantía realizada en la University of Florida y la convalidación del segundo avance de tesis por el Comité del Doctorado UMCE.

Planteamiento del Problema

La igualdad de género en la educación es un desafío global en el presente siglo XXI, dado que aún persisten las brechas entre hombres y mujeres(Gottlieb et al., 2024). Se perpetúa una cultura que diferencia en cuanto a expectativas, habilidades y proyectos de vida, basados en el género de las personas(Jergins, 2023). El limitado acceso de las mujeres al ámbito de las disciplinas científicas como ciencia, tecnología, ingeniería y matemáticas, usualmente llamadas *STEM*, es una situación preocupante para educadores y formuladores de políticas públicas en todo el mundo (OECD, 2021; World Economic Forum, 2024), ya que evidencia un escenario de desigualdad social, en que se delimitan tareas socialmente aceptadas a un género, lo que conlleva a consecuencias cognitivas (Dunlap & Barth, 2023), y no propende al desarrollo mancomunado del trabajo colaborativo entre hombres y mujeres(Woolley et al., 2023).

Por ello, es de suma relevancia lo planteado en la Agenda 2030, aprobada en septiembre de 2015 por la Asamblea General de las Naciones Unidas, que incluye 17 Objetivos de Desarrollo Sostenible (ODS). El cuarto hace referencia a una educación de calidad, inclusiva, y equitativa, que promueva oportunidades de aprendizaje permanentes. Mientras que el quinto apunta a la igualdad y empoderamiento femenino (ECLAC, 2019). Estos objetivos se han visto seriamente perjudicados por la pandemia de COVID-19 afectando el bienestar de las mujeres y aumentando las desigualdades sociales(ONU, 2021). Con respecto a ello, el informe del Foro Económico Mundial sobre la Brecha de Género 2021, estimaba que se demoraría 135,6 años en cerrar la brecha entre hombres y mujeres a nivel global (World Economic Forum, 2021). Sin embargo, en un reciente estudio sobre el estado de avance de los ODS se estima que, al ritmo actual de progreso, pueden pasar 286 años para eliminar las brechas existentes (United Nations Women, 2022). Se debe avanzar en el logro de las metas porque el brindar educación para todos aumenta la resiliencia social, movilidad y progreso económico(Mahajan et al., 2022).

En el marco de los desafíos estipulados para el año 2030, se debe potenciar el desarrollo de las habilidades del siglo XXI, las que se enmarcan en el contexto de la cuarta revolución industrial o Industria 4.0(Schwab, 2017). Se requiere de habilidades tales como la comunicación, creatividad, trabajo colaborativo, habilidades sociales, resiliencia, resolución de problemas, flexibilidad y liderazgo(UNESCO-IBE, 2017). Asimismo, se debe promover el desarrollo emocional que les permita

a las personas comprender que hoy existe una interdependencia global entre los individuos (Hargreaves, 2003). En razón de esto, es esencial que los equipos de trabajo interdisciplinares pongan en juego estas habilidades que contribuyen a la inteligencia colectiva en la generación de conocimientos que permitirán el desarrollo de políticas públicas enfocadas a solucionar las necesidades de la población(Bates & Gupta, 2017). No obstante, la brecha y sesgos de género entorpecen dichas metas, además de contribuir a una pérdida importante del talento(Speer, 2023). En este contexto, se levanta un desafío adicional y es que no son del todo claro los elementos que generan la brecha y existen limitaciones con las herramientas que intentan medir los determinantes de la brecha de género. De este modo, se levantan dos desafíos; el desarrollo de constructos de determinantes de género que puedan ser medidos, como también determinar el impacto tanto de la brecha como del sesgo de género sobre la inteligencia colectiva(Gupta & Woolley, 2020). Esto va en línea con la necesidad de atraer y retener a las mujeres en la fuerza laboral en *STEM*, maximizando la innovación, creatividad y competitividad (Hill et al., 2010), aportando en forma significativa al desarrollo sostenible de Chile.

En las universidades, los hombres lideran con fuerza los campos relacionados en *STEM*. Al respecto, Chile ocupa el penúltimo lugar de los países de la OCDE, en orden decreciente de la distribución de mujeres que ingresan a estudiar carreras relacionadas a ciencias, tecnologías, ingenierías y matemáticas y solo el 7% de ellas se titulan, siendo el país con el porcentaje más bajo de la organización(OECD, 2021). Asimismo, según el Departamento de Evaluación, Medición y Registro Educacional (2022) se evidencia el aumento de la brecha de género en comparación con el año 2021, en los puntajes de admisión universitaria de las evaluaciones vinculadas a *STEM*, como lo son ciencias y matemáticas. Igualmente, a nivel de pregrados en las carreras *STEM*, las mujeres solo representan un 22% de la matrícula versus el 78% de hombres (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, 2022), viéndose la mayor brecha en las Facultades de Ingeniería en que el estudiantado masculino alcanza un promedio de 65,5% y sus pares mujeres un 34,7% (CUECH, 2022). Esto plantea la necesidad de situar la mirada sobre este escenario, y en especial en el caso de Chile, ya que el desarrollo sostenible solo se puede lograr con el aporte del talento femenino distribuido en forma equitativa.

La sociedad chilena tiene instalados estereotipos de género, que configuran un conjunto compartido de creencias, acerca de los atributos, que son característicos de los miembros de una

categoría social (Greenwald & Banaji, 2017). En ese sentido, el ser humano registra estereotipos generalizados relacionados con determinadas áreas disciplinares desde temprana edad, como una parte integrante obligatoria de su sistema de desarrollo(Fine, 2018), influye en su identidad, sus intereses, autoeficacia, motivación para aprender en entornos de aprendizaje formales e informales (Charlesworth & Banaji, 2022; Meltzoff & Cvencek, 2019). De este modo, la problemática de la brecha en la educación en *STEM* plantea enormes desafíos al género femenino, ya que se ven perjudicadas por concepciones erradas sobre su propia capacidad de creación y eso limita sus opciones de acceso a carreras vinculadas a las áreas de ciencia, tecnología, ingeniería y matemáticas(Dunlap & Barth, 2019; Guo et al., 2022). El contexto universitario no es una estructura social neutral, sino que da lugar a interacciones entre hombres y mujeres que reproducen una violencia simbólica al reforzar los estereotipos (Bourdieu & Passeron, 2018; Philipp, 2022). Los estereotipos describen y proscriben, tienen un efecto sobre el comportamiento y bienestar del ser humano(Asghar et al., 2024; Etheridge & Spantig, 2022), pues este se adapta constantemente a las normas que le atribuye la sociedad, dándose interacciones grupales que potencian o inhiben el trabajo colaborativo en ambientes sesgados(Woolley et al., 2015; Woolley & Gupta, 2024).

El contexto nacional demanda una medición integral de los factores que determinan la brecha de género, abordando variables psicosociales como la salud mental, la autoeficacia, la sabiduría y el bienestar psicológico y social, que modulan la vulnerabilidad frente a esta brecha. En el siglo XXI, el trabajo colaborativo es esencial(Maeda & Socha-Dietrich, 2021), especialmente en carreras STEM, donde los sesgos de género pueden afectar significativamente la inteligencia colectiva y las interacciones sociales(Lacoviello et al., 2024). Desarrollar herramientas que evalúen estos determinantes es crucial para informar políticas de igualdad de género que impulsen la productividad e incluyan plenamente el talento femenino, contribuyendo a un desarrollo más equitativo y sostenible(Assouline et al., 2023).

La pregunta de investigación que guía el presente estudio es: ¿Cómo influyen los determinantes de la brecha y los sesgos de género en el trabajo colaborativo entre estudiantes, tanto mujeres como hombres, de carreras universitarias en STEM en Chile? La hipótesis planteada sostiene que los determinantes de la brecha y los sesgos de género afectan significativamente el comportamiento de los estudiantes universitarios en STEM, repercutiendo de manera directa en sus interacciones grupales y en la dinámica del trabajo colaborativo.

Objetivos de la Investigación

Objetivo General

- Analizar los efectos de los determinantes de la brecha y sesgos de género sobre el trabajo colaborativo de estudiantes universitarios/as en carreras de educación *STEM* de universidades públicas y privadas de Chile.

Objetivos Específicos

1. Desarrollar un constructo sobre los determinantes de la brecha de género en base a las dimensiones cognitiva, psicológica, sociocultural, contextual y colaborativa para establecer los factores probables del comportamiento asociados a la brecha de género de estudiantes universitarios en carreras de *STEM.*
2. Diseñar y validar un instrumento para medir los determinantes de la brecha de género que influyen en el trabajo colaborativo de estudiantes de carreras *STEM*.
3. Evaluar la asociación entre los determinantes de la brecha de género y los niveles de autoeficacia, salud mental, sabiduría, y bienestar psicológico y social que influyen en los estudiantes universitarios *STEM*.
4. Evaluar el impacto de los determinantes de la brecha y sesgos de género sobre el comportamiento de estudiantes universitarios *STEM* reflejado en el desempeño de una tarea de inteligencia colectiva.

Relevancia y Originalidad

La presente investigación se inscribe en un contexto global en el que la equidad de género en las disciplinas STEM (ciencia, tecnología, ingeniería y matemáticas) se ha convertido en un objetivo crítico para el desarrollo sostenible, tal como se establece en la Agenda 2030 de las Naciones Unidas (World Economic Forum, 2023). A pesar de los avances en la representación de mujeres en educación superior, persisten importantes disparidades de género, particularmente en STEM, donde los estereotipos de género explícitos y los sesgos de género implícitos continúan limitando el acceso y la participación equitativa (Buckley et al., 2019; Cvencek et al., 2023).

La originalidad de esta tesis por compendio de artículos radica en su enfoque multidimensional para abordar la brecha de género en STEM, integrando perspectivas teóricas y metodológicas diversas. A través de un compendio de artículos que abarcan desde una revisión sistemática de la literatura hasta el diseño y validación de un instrumento psicométrico, esta investigación ofrece una comprensión más profunda y matizada de cómo los estereotipos de género y los sesgos implícitos afectan tanto las trayectorias académicas, como el bienestar y la salud mental de los estudiantes en STEM (Awais et al., 2024; Jones et al., 2021).

Además, esta tesis es relevante porque examina la interacción entre la inteligencia colectiva y los estereotipos de género en contextos educativos, un área que ha recibido poca atención en la literatura existente. Estudios previos han señalado la importancia de la inteligencia colectiva para el éxito en entornos colaborativos (Hogan et al., 2023; Malone & Woolley, 2020), pero la forma en que los sesgos de género pueden influir en estos procesos sigue siendo un área de investigación emergente(Petzel et al., 2024). Al explorar esta intersección, la presente investigación no solo contribuye al conocimiento teórico, sino que también ofrece implicaciones prácticas para el diseño de intervenciones y políticas educativas que promuevan la equidad de género y el desarrollo sostenible en la educación superior(Sertyesilisik, 2023).

Este trabajo se destaca por su enfoque interdisciplinario, al combinar herramientas y análisis desde la psicología social y la educación para proporcionar una visión integral de la problemática de género en STEM. La incorporación de diversas metodologías no solo enriquece el análisis, sino que también fortalece la validez de los resultados. Esta combinación permite una comprensión más profunda y matizada de las dinámicas de género, al tiempo que refuerza los hallazgos y recomendaciones presentadas en esta tesis compuesta por un compendio de artículos.

Capítulo Introductorio

Este capítulo contextualiza la importancia de los artículos que integran esta Tesis Doctoral, destacando su contribución fundamental al logro de los objetivos específicos planteados en la investigación.

El primer conjunto de artículos, que aborda los fundamentos teóricos y metodológicos sobre la brecha de género en STEM, responde a los objetivos 1 y 2 de la tesis e incluye tres papers clave. El primer artículo, "STEM and Gender Gap: A Systematic Review in WoS, Scopus, and ERIC Databases (2012–2022)", cumple con el Objetivo 1 de la investigación al proporcionar un análisis exhaustivo de la literatura sobre la brecha de género en STEM, estableciendo una base teórica sólida para investigaciones posteriores. En la misma línea, el segundo artículo, "Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education", también se alinea con el Objetivo 1, examinando los factores que perpetúan la brecha de género en la educación superior y sus impactos en las trayectorias académicas de los estudiantes. Por otro lado, el tercer artículo, "Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education", responde al Objetivo 2, centrándose en el desarrollo y validación de un instrumento psicométrico diseñado para medir los factores que contribuyen a la brecha de género en la educación superior.

El segundo bloque de artículos se centra en la salud mental, la resiliencia académica y los factores psicosociales que influyen en el contexto de las carreras STEM, alineados con el objetivo 3 de la tesis. El cuarto artículo, "The Challenges of Mental Health in Chilean University Students", aborda los desafíos de salud mental en estudiantes universitarios en Chile, con un enfoque particular en las diferencias de género. El quinto artículo, "Academic Resilience and Its Relationship with Anxiety and Depression in STEM Students: A Structural Equation Modeling Approach", investiga la relación entre la resiliencia académica, la ansiedad y la depresión en estudiantes de STEM diseñando un modelo de ecuaciones estructurales. El sexto artículo, "What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors", analiza cómo los factores psicosociales, como la autoeficacia, el bienestar social y el bienestar psicológico, contribuyen al desarrollo de la sabiduría académica en STEM. Finalmente, el séptimo artículo, "Structural Equation Model to Explore the Association between Gender Gap, Mental Health, and Self-Efficacy in STEM Higher Education",

examina la asociación entre la brecha de género, la salud mental y la autoeficacia en estudiantes de STEM, ofreciendo un análisis integral de estas interacciones.

En el tercer bloque de artículos, todos alineados con el objetivo 4 de la tesis, se explora cómo los estereotipos de género influyen en los procesos cognitivos y en las decisiones académicas dentro del ámbito STEM, con un énfasis particular en la colaboración académica. El octavo artículo, "A Decade of Insights: The Cognitive Impact of Stereotype-Driven Biases on Language Processing", analiza cómo los sesgos de género afectan el procesamiento del lenguaje. El noveno artículo, "STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes", investiga cómo la inteligencia colectiva puede superar las barreras de género en STEM, subrayando la importancia de la colaboración. Finalmente, el décimo artículo, "Gender Stereotypes and Career Choices in STEM: The Role of Implicit Associations among University Students", examina la influencia de las asociaciones implícitas en las decisiones de carrera en STEM.

Estos artículos brindan una perspectiva integral sobre la brecha de género en STEM, subrayando cómo la colaboración puede ayudar a superar las barreras impuestas por los estereotipos. Además, presentan implicaciones importantes para el diseño de políticas educativas que fomenten la equidad y el bienestar en la educación superior. Aunque todos los artículos incluidos en esta tesis fueron liderados y desarrollados íntegramente por el autor, algunos recibieron el valioso asesoramiento y colaboración de investigadores del Centro de Investigación en Psicología, Educación y Familia de la Universidad Finis Terrae y del Centro de Neurociencia Social y Cognitiva de la Universidad Adolfo Ibáñez, lo que permitió integrar enfoques y metodologías interdisciplinarias.

Artículos

1. STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022).
2. Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education.
3. Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education.
4. The challenges of mental health in Chilean university students.
5. Academic Resilience and Its Relationship with Anxiety and Depression in STEM Students: A Structural Equation Modeling Approach.
6. What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors.
7. Structural Equation Model to Explore the Association between Gender Gap, Mental Health, Self-Efficacy in STEM Higher Education.
8. A Decade of Insights: The Cognitive Impact of Stereotype-Driven Biases on Language Processing.
9. STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes.
10. Gender Stereotypes and Career Choices in STEM: The Role of Implicit Associations among University Students.

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STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022).

***Publicado

Beroíza-Valenzuela and Salas-Guzmán.

Abstract

Introduction: This article offers a thorough examination of relevant literature in the WoS, Scopus, and Eric databases for the period 2012–2022, utilizing the PRISMA model (2020) to address STEM and gender gap factors.

Method: A comprehensive search of the Web of Science, Scopus, and Eric databases spanning the years 2012 to 2022 was conducted. Employing the PRISMA (2020) model, inclusion and exclusion criteria were applied to identify pertinent studies that examined the relationship between STEM education and the gender gap. After rigorous evaluation, 24 articles that adhered to the established criteria were selected. These articles were thoroughly analyzed to extract relevant information pertaining to the factors contributing to the gender gap in STEM fields and educational interventions designed to alleviate these disparities.

Results: This analysis hinged on two fundamental dimensions. The first addresses the factors that contribute to the gender gap in STEM fields, whereas the second focuses on crafted educational interventions to mitigate bias. These interventions include activities aimed at enhancing skills in science, mathematics, engineering, and technology, as well as fostering a growth mindset. The findings of this review suggest that research on gender and STEM predominantly emphasizes key issues using quantitative methodologies.

Discussion: The practical implications of this research relate to identifying critical areas in need of attention to address the identified gap and recognizing the necessity of diversifying the methods and tools used for gathering information to explore new factors that could account for gender biases in scientific fields. The study's limitations lie in its exclusive focus on the binary gender gap between women and men without considering other relevant factors. Future analyses should incorporate the intersectionality perspective.

Keywords: Stereotypes, STEM, Gender Gap, Education, Academic Performance.

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STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022)

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Introduction: This article offers a thorough examination of relevant literature in the WoS, Scopus, and Eric databases for the period 2012–2022, utilizing the PRISMA model (2020) to address STEM and gender gap factors.

Methods: A comprehensive search of the Web of Science, Scopus, and Eric databases spanning the years 2012 to 2022 was conducted. Employing the PRISMA (2020) model, inclusion and exclusion criteria were applied to identify pertinent studies that examined the relationship between STEM education and the gender gap. After rigorous evaluation, 24 articles that adhered to the established criteria were selected. These articles were thoroughly analyzed to extract relevant information pertaining to the factors contributing to the gender gap in STEM fields and educational interventions designed to alleviate these disparities.

Results: This analysis hinges on two fundamental dimensions. The first addresses the factors that contribute to the gender gap in STEM fields, while the second focuses on educational interventions crafted to mitigate bias. These interventions include activities aimed at enhancing skills in science, mathematics, engineering, and technology as well as fostering a growth mindset. The findings of this review suggest that research on gender and STEM predominantly emphasizes key issues using quantitative methodologies; however, it is recommended to explore other methodologies as well.

Discussion: The practical implications of this research relate to identifying critical areas in need of attention to address the identified gap and recognizing the necessity of diversifying the methods and tools used for gathering information to explore new factors that could account for gender biases in scientific fields. The study's limitations lie in its exclusive focus on the binary gender gap between women and men without considering other relevant factors. Future analyses should incorporate the intersectionality perspective.

KEYWORDS

stereotypes, stem, gender gap, education, academic performance

Introduction

The promotion gender equality in education is an ongoing global challenge in the twenty-first century, due to persistent disparities between men and women (Fernandez et al., 2023). Unfortunately, a gender-based culture that differentiates expectations, skills, and life projects continues to prevail. One area of particular concern is the limited access given to women in

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scientific disciplines such as science, technology, engineering, and mathematics, collectively referred to as STEM (OECD, 2016). This situation reveals a troubling scenario of social inequality that educators and policymakers worldwide must address.

According to a recent report by UN Women, at the current pace of progress, it may take 286 years to eliminate existing gaps (United Nations Women, 2022). Advancing toward achieving these goals is crucial because providing education for all increases social resilience, mobility, and economic progress. For this reason, the agenda 2030, approved by the United Nations General Assembly in September 2015, is of utmost relevance. It includes 17 Sustainable Development Goals (SDGs), among which Goal 4 stands out, referring to quality, inclusive, and equitable education that promotes lifelong learning opportunities for all. Additionally, SDG 5 addresses gender equality, empowering women, and ending all forms of violence (Economic Commission for Latin America and the Caribbean, 2020). In this regard, according to OECD Indicators (2021), men strongly dominate STEM-related fields, highlighting the need to focus on this issue as it demonstrates the loss of talent by not effectively including women.

STEM is an interdisciplinary approach that emerged in the United States after World War II, driven by the need for technological progress. Its development was further propelled by the historical context of the Cold War, particularly with the launch of the R-7 rocket carrying the Sputnik 1 satellite, which had a significant impact on American politics (Razi and Zhou, 2022). Its educational orientation was established by the National Science Foundation (NSF) and subsequently promoted and adopted worldwide. Its objectives are to provide students with critical thinking skills for creative problem-solving and, ultimately, to make them more marketable in the workforce (White, 2014). In this way, the STEM approach contributes to higher-order skills and provides a foundation for innovation, influencing the economic well-being of nations (Barakos et al., 2012).

However, women have been relegated from STEM objectives due to societal gender stereotypes, which shape a shared set of beliefs about the attributes that are characteristic of members of a social category (Greenwald and Banaji, 2017). These beliefs can be implicit or explicit in individuals. By implicit we state thoughts and beliefs that are not commonly recognized but influence our explicit actions toward these objectives. This situation influences the expectations that humans have about their own capabilities. Lippmann (1922) defined stereotypes as mental images of different social groups, with their utility lying in simplifying perception and cognition. One of the most widely accepted definitions is provided by Ashmore and Del Boca (1981), who conceive stereotypes as a set of beliefs about the personal attributes of a group of individuals.

Human beings develop generalized stereotypes related to specific disciplinary areas from an early age, which become an integral part of their developmental system (Fine, 2018). These stereotypes influence their identity, that is, what they believe about themselves, their future, their interests, and their motivation to learn (Meltzoff and Cvencek, 2019). In this regard, women encounter stereotypes with negative consequences for their interest and academic performance, necessitating efforts to attract and retain them in the STEM workforce to maximize innovation, creativity, and competitiveness (Hill et al., 2010; Gaweł and Krstić, 2021). Thus, the educational space, as a socializing agent, is a structure that gives rise to interactions contributing to the reinforcement of stereotypes, which leads to the reproduction of symbolic violence (Bourdieu and Passeron, 2018). Stereotypes describe and proscribe, inducing behavior as individuals conform to the norms attributed to them by society, which are further reinforced through educational institutions. The issue of the STEM education gap presents significant challenges for women, as they are hindered by stereotypes imposed by educational contexts regarding their own creative abilities (Rippon, 2019), thereby limiting their access to careers in these fields.

When investigating the potential causes of the gender gap and biases in STEM, one can explore the most relevant theories and approaches that explain behaviors related to gender stereotypes, providing a suitable theoretical and empirical foundation for the study. These are summarized in Figure 1.

In the first group of the so-called "conventional" theories, we have Spence's gender identity theory (Spence, 1993), which presents a multifactorial approach to gender-associated attributes. Individuals adopt interests and behaviors expected of their gender, conforming to conventional roles. Additionally, the stereotype threat theory by Steele and Aronson (1995) reinforces and introduces new elements. It highlights the risk of confirming a negative stereotype about one's own group, which can affect performance on specific tasks. In line with this, women are often associated with weaker mathematical skills compared to men, which influences their performance and interest. However, this does not align with their actual level of ability, as studies indicate that women achieve higher grades in this area (Perez-Felkner et al., 2017; Lundberg, 2020).

In the group of established theories, we have Tajfel and Turner's social identity theory of intergroup behavior (Tajfel and Turner, 1979), which highlights the impact on individuals' behavior when they perceive themselves as members of social categories. This theory involves three psychological processes: social categorization, identification, and social comparisons. Another theory in this group is the social cognitive career and academic interest theory (SCCT) proposed by Lent et al. (1994). SCCT focuses on self-efficacy, outcome expectations, goal mechanisms, and how they can interact with gender, contextual support systems, and experiential learning factors (Lent et al., 1994). Eccles and Wigfield's expectancy-value theory (Eccles and Wigfield, 2002) is a theoretical model that introduces other relevant variables. It addresses the theoretical pathway through which stereotypes affect students' academic outcomes, choices, and the role of motivation as a change agent (Wigfield et al., 2015). While it emphasizes the role of motivation in addressing the gender gap, it overlooks contextual barriers. It is not only through motivation and elevated expectations that individuals achieve their goals, but social, economic, and personal interferences also play a role. In this regard, identity emerges as a crucial aspect. Finally, we have Eagly and Wood (2012), which aims to explain the behavior of women and men, as well as the relevant stereotypes, ideologies, and attitudes related to sex and gender.

In the emerging approaches, the contributions of Greenwald and Banaji (1995) are noteworthy. They had already introduced the concept of implicit social cognition to address the influences of stimuli that impact individuals outside of conscious control. Later, Baron et al. (2014) incorporated this concept and focused on social cognition to address stereotypes, emphasizing that it is a cognitive process that develops throughout an individual's life, including elements such as social association, the assigned gender identity, and self-concept (Meltzoff and Cvencek, 2019). In a similar vein, the nascent proposal of Master and Meltzoff (2020), called STEMO (Stereotypes, Motivation, and Outcomes), integrates aspects of educational research, human development, and social psychology to understand the mechanisms contributing to gender gaps. Their hypothesis describes the ways in which female STEM students encounter negative stereotypes, leading

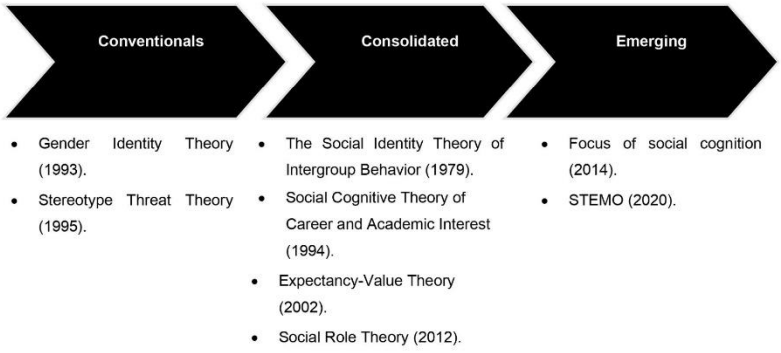


FIGURE 1
Theoretical models explaining stereotyped behaviors.

to biased self-representations regarding their group membership and consequent effects on their interest and academic performance.

The current debate in empirical studies on gender stereotypes in STEM revolves around the differences in preferences and interests between men and women. In this regard, findings indicate that stereotypical images persist and apply to all areas. Given the limited number of studies, it is still risky to make comparisons or inferences (Master and Meltzoff, 2020). On the other hand, some lines of research have focused on the preschool stage and the effect of math stereotypes on teacher-student interaction networks (Ortega et al., 2021). Similarly, research on the role of implicit and explicit beliefs related to mathematics in primary school students, in connection with the influence of parents on their behavior, is noteworthy (Siani and Dacin, 2018). From another perspective, studies have focused on considering the socioeconomic and cultural profiles of female high school students who intend to pursue STEM careers (Kızılay et al., 2020). Meanwhile, recent research addresses the experiences of female graduate students in STEM careers regarding gender gaps and the challenges they face (Lim et al., 2021).

Studies on STEM education have progressively increased in recent years, delineating different scientific trends (Bogdan and García-Carmona, 2021). Therefore, it is essential to identify the approaches that have been developed and envision research gaps for the advancement of new perspectives. Hence, this systematic review follows the PRISMA 2020 guidelines (Page et al., 2021) and aims to describe the scope of research on STEM and the gender gap in primary, secondary, and tertiary education between the years 2012 and 2022. The following questions will help us address this objective:

- What are the most frequently addressed research topics? (Q1).
- What are the most widely used theories that guide research? (Q2).
- How are the topics addressed in the studies? (Q3).
- What is the most developed research method in the studies? (Q4).

The following section delineates the methodological criteria and search strategies employed in this study. After this, the systematic review's findings are elucidated, leading into discussions, conclusions, and the acknowledgment of limitations, ultimately culminating in a comprehensive compilation of bibliographic references utilized in this study.

Methods

This Systematic Review follows the PRISMA (2020) criteria. The research incorporates empirical scientific articles published in open access journals from 2012 to 2022, using the search engines Scopus, Eric, and WoS, recognized as those that compile the highest number of multidisciplinary scientific publications. The purpose is to gather knowledge advancement in a specific subject. The search date for this review was June 21, 2022, and the following English keyword combinations were used: STEM Education AND gender gap, STEM AND gender gap, and STEM AND education AND gap AND gender.

This study is structured based on pre-established criteria for selection/exclusion on this matter, such as the temporal dimension and the object of study. Additionally, the scientific mapping considered five stages: (1) study design, (2) data collection, (3) data analysis, (4) data visualization, and (5) interpretation. In the study design stage, the guiding question was: "What were the results of publications on STEM education and the gender gap indexed in the Scopus, Eric, and WoS databases for the period 2012–2022. The data collection stage consists of three sub-stages: (1) data gathering, (2) data screening, and (3) data cleaning. Table 1 condenses the research protocol criteria that represent the search filters.

Before proceeding with the selection of articles, the following inclusion and exclusion criteria were defined:

Inclusion criteria

1 Open-access empirical scientific articles that are available in databases, and peer-reviewed, published in the last 10 years.
2 Studies that link the analysis of standardized assessment databases with other attitudinal, cognitive, and social variables from governmental and non-governmental entities.
3 They must be empirical studies with educational implications and case studies.
4 The studies that address STEM and the gender gap in primary, secondary, or tertiary education.

Exclusion criteria

1 Book chapters, conferences, theoretical articles, systematic reviews, and meta-analyses.

TABLE 1 Research protocol summary.

Item	Description
Topic	STEM and gender gap
Keywords	STEM, education and gender gap
Temporal dimension	Last 10 years (2012–2022)
Spatial dimension	National e international
Selection criteria	Open-access empirical scientific articles published, available in databases, and peer-reviewed
Language	English and Spanish
Methodological procedure for article search	Three scientific databases are defined: WoS, Scopus, and Eric. The keywords associated with the Boolean operator "AND" are entered. Repetitions of articles from the WoS and Scopus databases are removed using R software. Duplicates from Eric are eliminated through a manual procedure in the Excel suite program of Microsoft Office software.

2 Studies only focused on the database analysis published, prior to 2012 of this systematic review, on standardized assessments.
3 Database studies on academic performance analysis without linkage to other attitudinal, cognitive, and social variables from governmental and non-governmental entities.
4 Studies focused on the topics of ethnicity, race, graduate students, and practicing professionals in STEM.
5 Studies that mainly address the implementation of other guidelines, with STEM and gender gap not being their focus of analysis.
6 Once the systematic review protocol outlined in the PRISMA model (2020) proposed by Page et al. (2021) was applied to the WoS, Scopus, and Eric databases, a total of 24 scientific articles that met the inclusion and exclusion criteria were obtained, corresponding to the primary units of analysis for the research. The process is presented in the following flowchart (Figure 2).

Results

A synthesis of the selected research results is presented in the following table organized by authors, theory, sample, methodology, and results. The analysis that will be conducted next follows the

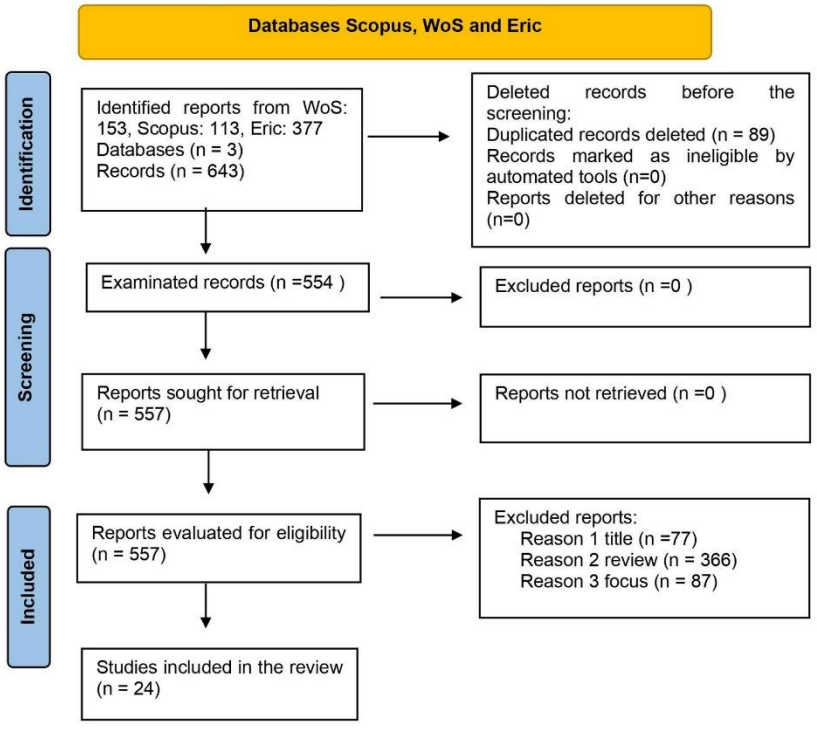


FIGURE 2
Flowchart of scientific article search.

projected order that is most relevant for facilitating understanding and integration of the findings. Table 2 shows a summary of the analyzed studies.

The results have been organized into two dimensions derived from the analysis of the articles found: factors influencing the gender gap in STEM and learning experiences to overcome the gender gap in STEM. Under the factors influencing the gender gap in STEM, categories such as self-efficacy, motivation, expectations, social support, gender roles, identity, teaching roles, anxiety, skills, interests, goals, confidence, stereotype attribution bias, value beliefs, occupational aspirations, burnout, well-being, academic performance, self-perceived skills, influence of the job market, and peer influence emerge. In this regard, four factors that dominated the reviewed research are highlighted: beliefs, self-efficacy, motivation, and expectations. In the realm of learning experiences to overcome the gender gap in *STEM*, a growth mindset is emphasized.

Similarly, the quantitatively most studied focus has been the discipline of mathematics, even though STEM also encompasses other areas such as chemistry, physics, biology, engineering, astronomy, among others.

Discussion

Gender gap in STEM is a challenge that involves combined factors such as stereotypical beliefs, self-efficacy, expectations, and motivation. Overcoming biases should be directed toward various aspects, such as university and government support, financial assistance, assertive teacher interaction (Wang, 2013), and, of course, meaningful scientific learning experiences (Rundgren et al., 2019).

The analysis of factors and strategies to address and detect inequalities imposed by biases is limited and should consider other variables. It has mostly focused on studies that gather personal perceptions from each subject, without examining the underlying relationship that governs gender social inequalities between men and women, such as power dynamics and collaborative work. Exploring these aspects would provide alternative perspectives to the issue and contribute to the retention of individuals in STEM fields.

Research has focused on the use of the social cognitive career theory, as there is an interest in understanding the social, cognitive, and psychological factors that influence women's choices in STEM fields. However, they have not considered the brain structures involved in the adoption of stereotypes.

Furthermore, although significant progress has been made in research on STEM and the gender gap (Le Thi Thu et al., 2021), studies have predominantly focused on the development of quantitative methodologies, highlighting the limited presence of qualitative and mixed methods studies. Moreover, surveys and databases have been commonly used as research tools. The use of database analysis reveals serious issues due to the lack of familiarity and control over the data structure (Bryman, 2016). Therefore, it would be advisable to diversify the methods and tools for gathering information in order to explore new factors that could explain gender biases in scientific fields.

Factors that affect the gender gap in STEM

Gender stereotypes are unconscious and conscious beliefs that underpin the gender gap in STEM and are in line with the *status quo*, as they depend on who is stereotyping and who is being stereotyped to generate an implicit and explicit response in their cognition that translates into social behavior. The factors influencing the gender gap in STEM education are addressed in various studies and can be grouped into three types: psychological, contextual, and sociocultural. However, the boundaries between these factors are blurred, as there is an interactive and dynamic relationship among them.

Within the most investigated factors, one can identify self-efficacy, motivation, expectations, social support, gender roles, identity, aspirations, family background, attitudes, socioeconomic context, teaching role, anxiety, skills, interests, goals, confidence, stereotype attribution bias, values beliefs, external support, masculinity, occupational aspirations, burnout, well-being, academic performance, self-perceived skills, influence of the job market, and classmates (Legewie and DiPrete, 2014; Lauermann et al., 2017; Master et al., 2017; Siani and Dacin, 2018; Vázquez and Blanco, 2018; Makarova et al., 2019; Çiftçi et al., 2020; Cotner et al., 2020; He et al., 2020; Lundberg, 2020; Salmela-Aro, 2020; Stearns et al., 2020; Alam et al., 2021; Ashlock et al., 2021; Ayuso et al., 2021; Demir et al., 2021; Mitsopoulou and Pavlatou, 2021; Moè et al., 2021; Anaya et al., 2022; Chan, 2022; Cuevas et al., 2022). In this sense, four gender gap factors stood out from the reviewed research: beliefs, self-efficacy, motivation, and expectations. These factors were quantitatively addressed the most and the study conclusions indicated them as critical elements mediating biases.

Self-efficacy is the mechanism that assist individuals determine their activity and environmental choices (Bandura, 1982). It contributes to the persistence and regulation of emotions, behaviors, and interest in entering or persisting in STEM disciplines (Rundgren et al., 2019). However, self-efficacy is influenced by a multitude of factors, among which learning experiences stand out, whether in primary, secondary, or tertiary education, which, in turn, are influenced by various contextual elements such as social, cultural, and economic factors, and are directly related to stereotypical beliefs (Chan, 2022).

Both motivation and interest in STEM among women are directly related to beliefs about their skills, leading to demotivation and self-doubt, which in turn affects career choices (Chan, 2022). However, what enables women to become interested and motivated in choosing other careers? According to the social cognitive career theory, both supports and barriers influence interests and motivations. Studies indicate that greater interests are expressed by males (Vázquez and Blanco, 2018; Çiftçi et al., 2020). In this regard, according to Mitsopoulou and Pavlatou (2021), the combination of outcome expectations and self-efficacy levels results in interest in STEM. However, beliefs play a crucial role as girls have a lower perception of their skills compared to boys from an early age (Perez-Felkner et al., 2017). Girls may not choose engineering, even if their STEM scores are high (Cuevas et al., 2022), as they are confined to spaces imposed by society through symbolic violence. This situation is further exacerbated by the fact that students' interest in STEM subjects decreases during secondary education (Bailey et al., 2017; Ballen et al., 2018). Therefore, constant opportunities and motivating learning experiences are required.

TABLE 2 Characteristics of the reviewed studies.

Authors	Theory	Methodology	Results
Legewie and DiPrete (2014)	SCCT (Social cognitive career theory).	Quantitative. National education longitudinal study and high school effectiveness study databases. Longitudinal study. High school students.	The high school context reinforces or weakens gender stereotypes
Lauermann et al. (2017)	EVT (Expectancy-Value theory).	Quantitative. Data from the childhood and beyond (CAB) study Longitudinal study. Elementary, high school, and university students.	There are gender differences regarding beliefs related to career and career achievement.
Perez-Felkner et al. (2017)	Stereotype threat theory	Quantitative. Data from the education longitudinal study (ELS) of the USA. Longitudinal database studies of 2002, 2004 and 2012 from 16.200 tenth grade and high school students.	Women have less belief in their math skills compared to men.
Ballen et al. (2018)	SCCT (Social cognitive career theory).	Quantitative. University students.	Class size does not reduce performance gaps in STEM.
Vázquez and Blanco (2018)	SCCT (Social cognitive career theory).	Quantitative. Self-efficacy scale, outcome expectations, aspirations, interests, and social supports and barriers scale. 1,465 non-parametric tests of high school students.	Gender differences in favor of men in all variables
Rundgren et al. (2019)	SCCT (Social cognitive career theory).	Quantitative. Database of the interest and recruitment in science (IRIS) project. 2.372 answers of higher education students.	Male students value informal learning experiences more and exhibit higher levels of STEM interest and self-efficacy than females.
He et al. (2020)	Gender Identity theory.	Qualitative. Semi-structured interview. 6 students from high school.	Factors such as social and cultural norms, teachers, parents, the labor market, media, and peers, as well as the curriculum, influence expectations.
Siani and Dacin (2018)	SCCT (Social cognitive career theory).	Quantitative. Questionnaire on attitudes toward STEM disciplines in high school students. Cohort of students of 11 y 12 years old.	Extension skills play a crucial role in promoting participation in STEM. The educational level of parents influences students' intention to pursue STEM studies.
Makarova et al. (2019)	SCCT (Social cognitive career theory).	Quantitative. Perception questionnaire on masculinity using semantic differentials. Transversal. Study of 1,364 students from high school.	Men in mathematics have the attribution of masculinity. Gender stereotypes can influence the aspirations of men and women.
Stearns et al. (2020)	SCCT y EVT (Social Cognitive Career theory and Expectancy-Value theory).	Mixed. Roots of STEM success database. Interviews. 16.710 *STEM* graduated students. 173 university students on their last year.	Gender differences in first-year university grades do not explain the gender gap in the selection of a STEM major.
Lundberg (2020)	Social identity theory of intergroup behavior.	Quantitative. Sub-sample of Wave Add Health survey.	Concerns about gender identity can influence and undermine the educational prospects of women and men through masculinity norms that discourage academic performance.
Çiftçi et al. (2020)	SCCT (Social cognitive career theory).	Quantitative. STEM attitude scale and career interest survey. 774 high school students.	There is a stronger correlation between attitudes and interest in STEM among men than among women.
Cotner et al. (2020)	SCCT (Social cognitive career theory).	Quantitative. Test anxiety scale and confidence with classroom performance. Academic Performance Data. 400 university students.	Women expressed more test anxiety than men, and the anxiety they experienced negatively predicted their classroom performance.

(Continued)

TABLE 2 (Continued)

Authors	Theory	Methodology	Results
Salmela-Aro (2020)	EVT (Expectancy-Value theory).	Quantitative. Mind the gap database. FinEdu longitudinal study database. Longitudinal study. High school students from 9° to 11° grade.	Interest in STEM subjects decreases during secondary education.
Demir et al. (2021)	SCCT (Social cognitive career theory).	Quantitative. STEM-oriented attitude scale. 408 high school students of 6°,7° y 8° grade.	Student attitudes toward STEM vary depending on whether they are female or male.
Mitsopoulou and Pavlatou (2021)	SCCT (Social cognitive career theory).	Quantitative. Questionnaire on students' attitudes toward higher education. 301 high school students, between 14 to 16 years old.	Six factors of interest in STEM: gender, learning experiences, expectations, social support, family background, and self-efficacy. Expectations plus self-efficacy generate STEM interest.
Ayuso et al. (2021)	Stereotype threat theory.	Quantitative. Questionnaire on factors influencing students' experience with mathematics. 2.137 Elementary students and 143 elementary teachers.	Gender differences in self-efficacy become more pronounced as students grow older, and test anxiety increases. Women perceive themselves as worse than men in mathematics.
Alam et al. (2021)	SCCT (Social cognitive career theory).	Quantitative. Scales on self-concept, self-efficacy, attitudes, gender stereotypes, teacher stereotypes, intentions, and expectations. 211 high school students.	Attitudes, gender, and expectations of career outcomes are positive and significant predictors of STEM attitudes, while gender stereotypes and teaching roles are negative predictors.
Master et al. (2017)	STEMO (Stereotypes, Motivation and Outcomes).	Quantitative. Laboratory test, experimental group, and control group. 6-year-old children within a total of 96.	Men held gender stereotypes that they were better than women in robotics and programming. Women who received programming experience reported higher technological interest and self-efficacy compared to women without experience.
Ashlock et al. (2021)	EVT and STEMO (Expectancy-Value theory and Stereotypes, Motivation and Outcomes).	Mixed. Self-reported academic performance in mathematics and science. Survey on academic efficacy, computer skills, sociodemographic variables, self-conceptualizations. Focus groups. 3,902 high school students.	Sociopsychological processes can disadvantage women because they are not consistent with them.
Moè et al. (2021)	SCCT (Social cognitive career theory).	Quantitative. Self-report questionnaires. Mental Rotation and Verbal Fluency tests. 138 women and 120 men, current university students.	Women in STEM reported higher incremental beliefs than non-STEM women. Men outperformed women, and STEM students outperformed non-STEM students in mental rotation, while women outperformed men in verbal fluency.
Anaya et al. (2022)	SCCT (Social cognitive career theory).	Quantitative. Data from the child development supplement (CDS) and transition to adulthood (TA) projects in the panel study of income dynamics (PSID). Longitudinal study. From 0 to 18 years old.	There are significant gender differences in math test scores and self-perceived skills during childhood. Having a parent who works in a science-related field influences these differences.
Chan (2022)	SCCT (Social cognitive career theory).	Quantitative. Self-efficacy, interest, and academic and professional aspirations scale in STEM. 3.020 High school students.	Gender differences in self-efficacy, interest, and educational aspirations in STEM are more evident in students who endorse gender stereotypes.
Cuevas et al. (2022)	SCCT (Social cognitive career theory).	Quantitative. Questionnaire on factors influencing the decision to pursue a STEM career. 338 High school students.	Factors that influence men and women not to study STEM: self-efficacy, gender stereotypes, family background, and environment. Women perceive themselves as incapable of pursuing an engineering career compared to men.

Learning experiences in overcoming the gender gap in STEM education

Based on the reviewed research, the relevance of learning experiences that foster interest in STEM among women can be concluded. These experiences include extracurricular activities focused on scientific enrichment (Master et al., 2017; Siani and Dacin, 2018; Rundgren et al., 2019; Demïr et al., 2021). Within this framework, the absence of connections with scientific activities in teaching and learning practices in educational institutions is detrimental to overcoming the gap, as it not only hinders engagement in STEM careers but also hampers innovation, creativity, critical thinking, and student autonomy. Studies indicate that learning experiences are essential for entering and persisting in these fields (Maltese and Tai, 2011; Wang, 2013). Overall participation in several types of scientific education experiences, including informal, every day, and school-directed experiences (DeWitt and Archer, 2017), is significant for developing scientific capital among female students.

The growth mindset (Perez-Felkner et al., 2017; Moè et al., 2021) emerges from successful learning experiences, triggering positive activating emotions such as motivation and interest (Ayuso et al., 2021). In this way, it would facilitate overcoming the gender gap in these fields, which are essential for sustainable development. Implicit and explicit stereotypical beliefs about gender roles must be eradicated to progress in social, economic, and cultural advancement. This is not only beneficial for states but also for non-governmental entities in terms of providing a skilled workforce (Legewie and DiPrete, 2014), thus promoting the reduction of social inequalities.

Conclusion

This systematic review endeavors to uncover the prevailing trends in research conducted between 2012 and 2022, focusing on the factors that contribute to gender disparities in STEM fields. The insights derived from this initial exploration serve as the foundation for a comprehensive examination of our research findings and their implications for fostering gender equity in STEM education and career.

Returning to the research questions, we can indicate that:

- Q1: The most investigated topics are factors influencing the gender gap in STEM as well as educational interventions to promote interest and motivation.
- Q2: The most used theories are the social cognitive career theory, as it provides insights into the determinants that influence career choices.
- Q3: The addressed topics focus on women and are studied by considering variables that should be considered in gender gaps in STEM. Possible solutions are also emerging in the discussions.
- Q4: The most used method is quantitative, and the predominant instruments and techniques for gathering information are databases and surveys.

Ultimately, the space for research growth is evident both at the theoretical and methodological levels, due to the predominance of quantitative studies, with a minority presence of qualitative and mixed methods studies. While quantitative studies are of high quality, as they are longitudinal, experimental, and observational, it is important to explore the reality through other approaches that allow for a deeper understanding of the issue.

On the other hand, the tools used as self-report instruments and databases are insufficient for understanding the phenomenon. Subsequent studies should investigate other factors that influence the gender gap in STEM education and link them with critical perspectives on the underlying causes, rather than just focusing on the consequences or self-perceptions of those stereotypical beliefs. The combined effects and experiences across educational levels must be observed to understand academic and career choices.

The findings of this systematic review offer a comprehensive summary of the empirical research conducted within this field of study. This study aims to promote scientific knowledge from a global perspective. It is of utmost importance for researchers and policymakers to be knowledgeable about the systematization of STEM studies and the gender gap. This knowledge is crucial for understanding the methods developed to advance knowledge, raise awareness about the issue, and propose innovative solutions to address this phenomenon.

Limitations

The present systematic review concentrated exclusively on the gender gap within the binary framework of women and men. Nevertheless, it is crucial to incorporate the perspective of intersectionality in future systematic reviews, as it encompasses various categories of analysis that would significantly contribute to the investigation of disparities in STEM fields.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

FB-V: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. NS-G: Funding acquisition, Resources, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Alam, M., Sajid, S., Kok, J., Rehman, M., and Amin, A. (2021). Factors that influence high school female students' intentions to pursue science, technology, engineering and mathematics (STEM) education in Malaysia. *Pertanika J. Soc. Sci. Human.* 29, 839–867. doi: 10.47836/pjssh.29.2.06

Anaya, L., Stafford, F., and Zamarro, G. (2022). Gender gaps in math performance, perceived mathematical ability and college STEM education: the role of parental occupation. *Educ. Econ.* 30, 113–128. doi: 10.1080/09645292.2021.1974344

Ashlock, J., Stojnic, M., and Tufekci, Z. (2021). Gender differences in academic efficacy across STEM fields. *Sociol. Perspect.* 65, 555–579. doi: 10.1177/07311214211028617

Ashmore, R. D., and Del Boca, F. K. (1981). "Conceptual approaches to stereotypes and stereotyping" in *Cognitive processes in stereotyping and intergroup behavior*. ed. D. L. Hamilton (Psychology Press), 1–35.

Ayuso, N., Fillola, E., Masia, B., Murillo, A. C., Trillo-Lado, R., Baldassarri, S., et al. (2021). Gender gap in STEM: a cross-sectional study of primary school students' self-perception and test anxiety in mathematics. *IEEE Trans. Educ.* 64, 40–49. doi: 10.1109/TE.2020.3004075

Bailey, D., Duncan, G. J., Odgers, C. L., and Yu, W. (2017). Persistence and fadeout in the impacts of child and adolescent interventions. *J. Res. Educ. Effect.* 10, 7–39. doi: 10.1080/19345747.2016.1232459

Ballen, C. J., Aguillon, S. M., Brunelli, R., Drake, A. G., Wassenberg, D., Weiss, S. L., et al. (2018). Do small classes in higher education reduce performance gaps in STEM? *Bioscience* 68, 593–600. doi: 10.1093/biosci/biy056

Bandura, A. (1982). Self-efficacy mechanism in human agency. *Am. Psychol.* 37, 122–147. doi: 10.1037/0003-066X.37.2.122

Bandura, A. (1999). *Social cognitive theory of personality*. Available at: https://www.semanticscholar.org/paper/Social-cognitive-theory-of-personality.-Bandura/e9cc8502ef2ca8e4ca6c7be45e67416f8d25a947

Bandura, A. (2018). Toward a psychology of human agency: pathways and reflections. *Perspect. Psychol. Sci.* 13, 130–136. doi: 10.1177/1745691617699280

Barakos, L., Lujan, V., and Strang, C. (2012). *Science, technology, engineering, mathematics (STEM): catalyzing change amid the confusion.*: Center on Instruction Available at: https://eric.ed.gov/?id=ED534119.

Baron, A. S., Schmader, T., Cvencek, D., and Meltzoff, A. N. (2014). "The gendered self-concept: how implicit gender stereotypes and attitudes shape self-definition" in *Gender and development*. Eds P. J. Leman and H. R. Tenenbaum (Psychology Press), 109–132.

Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gend. Educ.* 17, 369–386. doi: 10.1080/09540250500145072

Bogdan, R., and García-Carmona, A. (2021). «De STEM nos gusta todo menos STEM». Análisis crítico de una tendencia educativa de moda [«of STEM we like everything but STEM». A critical analysis of a buzzing educational trend]. *Enseñanza Cienc.* 39, 65–80. doi: 10.5565/rev/ensciencias.3093

Bourdieu, P., and Passeron, J.-C. (2018). *La reproducción: Elementos para una teoría del sistema educativo*. Buenos Aires: Siglo XXI.

Breit, M., Brunner, M., and Preckel, F. (2020). General intelligence and specific cognitive abilities in adolescence: tests of age differentiat ion, ability differentiation, and their interaction in two large samples. *Dev. Psychol.* 56, 364–384. doi: 10.1037/dev0000876

Bryman, A. (2016). *Social research methods. 5th* Edn. Oxford, United Kingdom: Oxford University Press.

Cernas-Ortiz, D., Mercado, P., and Leon-Cazares, F. (2017). La varianza del método común en la relación entre la satisfacción laboral y la satisfacción con la vida. *Estudi. Geren.* 33, 321–329. doi: 10.1016/j.estger.2017.11.004

Chan, R. C. H. (2022). A social cognitive perspective on gender disparities in self-efficacy, interest, and aspirations in science, technology, engineering, and mathematics (STEM): the influence of cultural and gender norms. *Int. J. STEM Educ.* 9:37. doi: 10.1186/s40594-022-00352-0

Çiftçi, A., Topcu, M., and Erdogan, I. (2020). Gender gap and career choices in STEM education: Turkey sample. *Int. J. Progress. Educ.* 16, 53–66. doi: 10.29329/ijpe.2020.248.4

Cotner, S., Jeno, L. M., Walker, J. D., Jørgensen, C., and Vandvik, V. (2020). Gender gaps in the performance of Norwegian biology students: the roles of test anxiety and science confidence. *Int. J. STEM Educ.* 7:55. doi: 10.1186/s40594-020-00252-1

Cuevas, P., García-Arenas, M., and Rico, N. (2022). Why not STEM? A study case on the influence of gender factors on students' higher education choice. *Mathematics* 10:239. doi: 10.3390/math10020239

Cvencek, D., Meltzoff, A. N., and Greenwald, A. G. (2011). Math-gender stereotypes in elementary school children. *Child Dev.* 82, 766–779. doi: 10.1111/j.1467-8624.2010.01529.x

Cvencek, D., Meltzoff, A. N., and Kapur, M. (2014). Cognitive consistency and math-gender stereotypes in Singaporean children. *J. Exp. Child Psychol.* 117, 73–91. doi: 10.1016/j.jecp.2013.07.018

Demir, C., Önal, N., and Önal, N. (2021). Investigation of middle school students' attitudes towards science, technology, engineering and mathematics (STEM) education and determination of the predictors. *J. Sci. Learn.* 4:101. doi: 10.17509/jsl.v4i2.28859

DeWitt, J., and Archer, L. (2017). Participation in informal science learning experiences: the rich get richer? *Int. J. Sci. Educ., Part B* 7, 356–373. doi: 10.1080/21548455.2017.1360531

Eagly, A. H., and Wood, W. (2012). "Social role theory" in *Handbook of theories of social psychology: volume 2*. Eds. n P. A. M. Van Lange, A. W. Kruglanski and E. T. Higgins (SAGE Publications Ltd.), 458–476.

Eccles, J. (2011). Gendered educational and occupational choices: applying the Eccles et al. model of achievement-related choices. *Int. J. Behav. Dev.* 35, 195–201. doi: 10.1177/0165025411398185

Eccles, J., and Wigfield, A. (2002). Motivational beliefs, values and goals. *Annu. Rev. Psychol.* 53, 109–132. doi: 10.1146/annurev.psych.53.100901.135153

Economic Commission for Latin America and the Caribbean (ECLAC) (2020). The 2030 Agenda for Sustainable Development in the new global and regional context: scenarios and projections in the current crisis (LC/PUB.2020/5), Santiago. Available at: https://sustainabledevelopment.un.org/content/documents/26088ECLAC_contribution_2020.pdf

Fernandez, D., White, S., Smith, H. C. M., Connor, P. M., and Ryan, M. (2023). Gender inequality in science, technology, engineering and mathematics: gendered time disparities in perceived and actual time spent in practical laboratory-based activities. *Front. Educ.* 8:1194968. doi: 10.3389/feduc.2023.1194968

Fine, C. (2018). *Testosterona Rex. Mitos sobre el sexo, ciencia y sociedad*. Barcelona: Paidos.

Gawel, A., and Krstić, M. (2021). Gender gaps in entrepreneurship and education levels from the perspective of clusters of european countries. *J. Dev. Entrep.* 26:2150024. doi: 10.1142/S1084946721500242

Greenwald, A. G., and Banaji, M. R. (1995). Implicit social cognition: attitudes, self-esteem, and stereotypes. *Psychol. Rev.* 102, 4–27. doi: 10.1037/0033-295x.102.1.4

Greenwald, A. G., and Banaji, M. R. (2017). The implicit revolution: reconceiving the relation between conscious and unconscious. *Am. Psychol.* 72, 861–871. doi: 10.1037/amp0000238

He, L., Zhou, G., Salinitri, G., and Xu, L. (2020). Female underrepresentation in STEM subjects: an exploratory study of female high school students in China. *EURASIA J. Math. Sci. Technol. Educ.* 16:em1802. doi: 10.29333/ejmste/109657

Hill, C., Corbett, C., and St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*: American Association of University Women Available at: https://eric.ed.gov/?id=ED509653.

Joel, D., Berman, Z., Tavor, I., Wexler, N., Gaber, O., Stein, Y., et al. (2015). Sex beyond the genitalia: the human brain mosaic. *Proc. Natl. Acad. Sci. U. S. A.* 112, 15468–15473. doi: 10.1073/pnas.1509654112

Kızılay, E., Yamak, H., and Kavak, N. (2020). Development of the STEM career interest scale for high school students. *Eur. J. Educ. Sci.* 7, 1–15. doi: 10.19044/ejes.v7no3a4

Lauermann, F., Tsai, Y.-M., and Eccles, J. S. (2017). Math-related career aspirations and choices within Eccles et al.'s expectancy–value theory of achievement-related behaviors. *Dev. Psychol.* 53, 1540–1559. doi: 10.1037/dev0000367

Le Thi Thu, H., Tran, T., Trinh Thi Phuong, T., Le Thi Tuyet, T., Le Huy, H., and Vu Thi, T. (2021). Two decades of STEM education research in middle school: a Bibliometrics analysis in Scopus database (2000–2020). *Educ. Sci.* 11:353. doi: 10.3390/educsci11070353

Legewie, J., and DiPrete, T. A. (2014). The high school environment and the gender gap in science and engineering. *Sociol. Educ.* 87, 259–280. doi: 10.1177/0038040714547770

Lent, R. W., Brown, S. D., and Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *J. Vocat. Behav.* 45, 79–122. doi: 10.1006/jvbe.1994.1027

Lim, J. H., Wang, Y., Wu, T., Li, Z., and Sun, T. (2021). Walking on gender tightrope with multiple marginalities: Asian international female students in STEM graduate programs. *J. Int. Stud.* 11, 647–665. doi: 10.32674/jis.v11i3.2132

Lippmann, W. (1922). *Public opinion*. New York: Harcourt, Brace and Company.

Lundberg, S. (2020). Educational gender gaps. *South. Econ. J.* 87, 416–439. doi: 10.1002/soej.12460

Makarova, E., Aeschlimann, B., and Herzog, W. (2019). The gender gap in STEM fields: the impact of the gender stereotype of math and science on secondary students' career aspirations. *Front. Educ.* 4:60. doi: 10.3389/feduc.2019.00060

Maltese, A. V., and Tai, R. H. (2011). Pipeline persistence: examining the association of educational experiences with earned degrees in STEM among U.S. students. *Sci. Educ.* 95, 877–907. doi: 10.1002/sce.20441

Master, A., Cheryan, S., Moscatelli, A., and Meltzoff, A. N. (2017). Programming experience promotes higher STEM motivation among first-grade girls. *J. Exp. Child Psychol.* 160, 92–106. doi: 10.1016/j.jecp.2017.03.013

Master, A., and Meltzoff, A. (2020). Cultural stereotypes and sense of belonging contribute to gender gaps in STEM. *Sci. Technol.* 12:47,

Meltzoff, A. N., and Cvencek, D. (2019). How stereotypes shape children's STEM identity and learning. In: Developing minds in the digital age: Towards a science of learning for 21st century education. Eds. P. Kuhl et al. (Chapter 3, pp. 37–47). OECD Publishing.

Mitsopoulou, A., and Pavlatou, E. (2021). Factors associated with the development of secondary school students' interest towards STEM studies. *Educ. Sci.* 11:746. doi: 10.3390/educsci11110746

Moè, A., Hausmann, M., and Hirnstein, M. (2021). Gender stereotypes and incremental beliefs in STEM and non-STEM students in three countries: relationships with performance in cognitive tasks. *Psychol. Res.* 85, 554–567. Scopus. doi: 10.1007/s00426-019-01285-0

Nix, S., Perez-Felkner, L., and Thomas, K. (2015). Perceived mathematical ability under challenge: a longitudinal perspective on sex segregation among STEM degree fields. *Front. Psychol.* 6:530. doi: 10.3389/fpsyg.2015.00530

OECD (2016). *Mujeres, Gobierno y Diseño de Políticas Públicas en los países de la OCDE: Fomentar la diversidad para el crecimiento incluyente*: Organisation for Economic Co-operation and Development Available at: https://www.oecd-ilibrary.org/governance/mujeres-gobierno-y-diseno-de-politicas-publicas-en-los-paises-de-la-ocde_9789264256613-es.

OECD (2021). *Education at a glance 2021: OECD indicators*: OECD.

Ortega, L., Treviño, E., and Gelber, D. (2021). The inclusion of girls in Chilean mathematics classrooms: gender bias in teacher-student interaction networks (La inclusión de las niñas en las aulas de matemáticas chilenas: sesgo de género en las redes de interacciones profesor-estudiante). *J. Study Educ. Dev.* 44, 623–674. doi: 10.1080/02103702.2020.1773064

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). Declaración PRISMA 2020: Una guía actualizada para la publicación de revisiones sistemáticas. *Rev. Esp. Cardiol.* 74, 790–799. doi: 10.1016/j.recesp.2021.06.016

Perez-Felkner, L., Nix, S., and Thomas, K. (2017). Gendered pathways: how mathematics ability beliefs shape secondary and postsecondary course and degree field choices. *Front. Psychol.* 8:386. doi: 10.3389/fpsyg.2017.00386

Razi, A., and Zhou, G. (2022). STEM, iSTEM, and STEAM: what is next? *Int. J. Technol. Educ.* 5, 1–29. doi: 10.46328/ijte.119

Rippon, G. (2019). *The gendered brain: the new neuroscience that shatters the myth of the female brain*. London: Bodley Head.

Rundgren, S.-N. C., Sun, Y., and Jidesjo, A. (2019). Examining gender differences in students' entrance into and persistence in STEM programs in Swedish higher education. *Eur. J. Educ. Sci.* 6, 66–94. doi: 10.19044/ejes.v6no1a5

Salmela-Aro, K. (2020). The role of motivation and academic wellbeing – the transition from secondary to further education in STEM in Finland. *Eur. Rev.* 28, S121–S134. doi: 10.1017/S1062798720000952

Sanders, M. (2009). STEM, STEM education, STEMmania. *Technol. Teach.* 68, 20–26,

Schunk, D. H., and DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemp. Educ. Psychol.* 60:101832. doi: 10.1016/j.cedpsych.2019.101832

Siani, A., and Dacin, C. (2018). An evaluation of gender bias and pupils' attitude towards STEM disciplines in the transition between compulsory and voluntary schooling. *New Direct. Teach. Phys. Sci.* doi: 10.29311/ndtps.v0i13.2966

Spence, J. T. (1993). Gender-related traits and gender ideology: evidence for a multifactorial theory. *J. Pers. Soc. Psychol.* 64, 624–635. doi: 10.1037//0022-3514.64.4.624

Stearns, E., Bottia, M. C., Giersch, J., Mickelson, R. A., Moller, S., Jha, N., et al. (2020). Do relative advantages in STEM grades explain the gender gap in selection of a STEM major in college? A multimethod answer. *Am. Educ. Res. J.* 57, 218–257. doi: 10.3102/0002831219853533

Steele, C. M., and Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *J. Pers. Soc. Psychol.* 69, 797–811. doi: 10.1037/0022-3514.69.5.797

Tajfel, H., and Turner, J. C. (1979). "An integrative theory of intergroup conflict | ALNAP" in *The social psychology of intergroup relations* (Brooks/Cole), 33–37. Available at: https://www.alnap.org/help-library/an-integrative-theory-of-intergroup-conflict

United Nations Women. (2022). *Progress on the sustainable development goals: the gender snapshot 2022*. Available at: https://data.unwomen.org/publications/progress-sustainable-development-goals-gender-snapshot-2022

Vázquez, I. M. V., and Blanco, Á. (2018). Factores sociocognitivos asociados a la elección de estudios científico-matemáticos. Un análisis diferencial por sexo y curso en la Educación Secundaria. *Rev. Invest. Educ.* 37, 269–286. doi: 10.6018/rie.37.1.303531

Wang, X. (2013). Why students choose STEM majors: motivation, high school learning, and postsecondary context of support. *Am. Educ. Res. J.* 50, 1081–1121. doi: 10.3102/0002831213488622

White, D. W. (2014). What is STEM education and why is it important? *Flor. Assoc. Teach. Educ. J.* 1, 1–9,

Wigfield, A., Eccles, J. S., Fredricks, J. A., Simpkins, S., Roeser, R., and Schiefele, U. (2015). Development of achievementmotivation and engagement. In: *Handbook of child psychology and developmental science, Vol. 3: socioemotional processes*. Eds. R. M. Lerner (Series Ed.), and M. Lamb (Vol. Ed.), (7th ed., pp. 657–700). Hoboken, NJ: Wiley.

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Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education.

***Aceptado

Beroíza-Valenzuela and Salas-Guzmán.

Abstract

Introduction: The primary objective of this research is to critically evaluate the key factors contributing to gender disparities in the Science, Technology, Engineering, and Mathematics (STEM) fields and propose creative solutions to mitigate these differences. Despite the significance of this issue, it has not received sufficient attention owing to the absence of clarity regarding the factors that exacerbate the gender gap.

Design/methodology/approach: The present study employs a qualitative methodology that combines the viewpoints of social psychology and educational research to pinpoint and evaluate essential elements. Using a grounded theory approach, semi-structured interviews were analyzed, and the obtained data were coded and categorized using ATLAS.ti software. These procedures led to the creation of a comprehensive theoretical framework.

Results: This qualitative research identified three key areas: internal and external factors influencing the gender gap, as well as strategic actions within higher education to address these disparities. The innovative contribution of this study lies in its development of a comprehensive theoretical framework that enables the diagnosis, quantification, and understanding of these factors and proposes practical measures to mitigate these gender disparities. By promoting greater gender diversity, the proposed model can contribute to more inclusive and sustainable development consistent with the 2030 agenda.

Discussion: This research underscores the importance of a holistic, multidimensional approach to understanding and addressing the gender gap in higher education. This study fills a crucial knowledge gap by comprehensively understanding the complex factors that contribute to the gender gap in higher education. This theoretical model can inform effective university policies to address the gender gap.

Keywords: gender gap, stereotyping, critical factors, STEM, higher education.

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Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education

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Abstract

Purpose

The primary objective of this research is to critically evaluate the key factors contributing to gender disparities in the Science, Technology, Engineering, and Mathematics (STEM) fields and propose creative solutions to mitigate these differences. Despite the significance of this issue, it has not received sufficient attention owing to the absence of clarity regarding the factors that exacerbate the gender gap.

Design/methodology/approach

This study employs a qualitative methodology that combines the viewpoints of social psychology and educational research to pinpoint and evaluate essential elements. Using a grounded theory approach, semi-structured interviews were analyzed, and the obtained data were coded and categorized using ATLAS.ti software.

Findings

This qualitative research identified three key areas: internal and external factors influencing the gender gap, as well as strategic actions within higher education to address these disparities. The innovative contribution of this study lies in its development of a comprehensive theoretical framework that enables the diagnosis, quantification, and understanding of these factors and proposes practical measures to mitigate these gender disparities. By promoting greater gender diversity, the proposed model can contribute to more inclusive and sustainable development consistent with the 2030 agenda.

Originality/value

This study highlights the need for a multidimensional approach to addressing the gender gap in higher education, filling a crucial knowledge gap, and providing a theoretical model to guide effective university policies.

Keywords: gender gap, stereotypes, critical factors, STEM, higher education.

Introduction

Gender equality in education remains a significant global challenge in the 21st century, as disparities between men and women persist. A culture that differentiates expectations, skills, and life projects based on gender perpetuates inequality. Women's limited access to science, technology, engineering, and mathematics (STEM) is a pressing concern for educators and policymakers worldwide(OECD, 2022). This highlights a scenario of social inequality, where socially accepted tasks are delimited by gender, leading to cognitive consequences, hindering the collaborative development of work between men and women, and creating a just society.

Therefore, what was established in the 2030 Agenda, approved in September 2015 by the United Nations General Assembly, becomes highly relevant. This agenda addresses 17 Sustainable Development Goals (SDGs). The fourth goal promotes quality, inclusive, and equitable education that encourages continuous learning opportunities for all; the fifth is oriented towards gender equality and empowerment. Similarly, the tenth goal is to reduce social inequality (ECLAC, 2019). These goals have been

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significantly affected by the COVID-19 pandemic, impacting the well-being of women and exacerbating social inequality (OECD, 2021). The World Economic Forum's Gender Gap Report 2024 estimates that it will take 134 years to close the global gender gap (World Economic Forum, 2024).

Progress must be made in achieving these goals because providing education enhances social resilience, mobility, and economic progress for nations(Schmader, 2023). Gender gaps and biases hinder these objectives, resulting in significant talent loss. An additional challenge is that the educational, social, and contextual factors that contribute to this gender gap are unclear. Addressing these issues aligns with the need to attract and retain women in the STEM workforce, maximize innovation, creativity, and competitiveness(Idrizi et al., 2023), and significantly contribute to sustainable development.

Society harbors gender stereotypes that constitute a shared set of beliefs about attributes that are characteristic of members of a social category (Greenwald & Banaji, 2017). Individuals internalize generalized stereotypes related to certain disciplinary areas from an early age as an integral part of their developmental system (Fine, 2018). These stereotypes influence students' identities, interests, self-efficacy, and motivation to learn in formal and informal learning environments (Meltzoff & Cvencek, 2019). Thus, the gender gap in STEM fields presents significant challenges for women, hindered by misconceptions regarding their creative abilities, thereby limiting their options for pursuing university careers in science, technology, engineering, and mathematics. The university context is not a socially neutral structure; rather, it facilitates interactions between men and women, which perpetuates symbolic violence by reinforcing stereotypes (Etheridge & Spantig, 2022).

A thorough analysis of various factors contributing to the gender gap is essential for an accurate evaluation in its proper context. The gender gap significantly impacts the advancement of nations, as it reduces the crucial human capital necessary for national development, thereby presenting a serious socioeconomic challenge and resulting in a less competitive global economy(Kwon et al., 2021). This situation should prompt the creation of effective actions and public policies by the dominant sectors of the state, whether private or public. It underscores social inequality by segregating a specific group of individuals by gender in labor, educational, scientific, and technological markets, resulting in a loss of potential talent and curtailing economic and social opportunities for the population (Breda et al., 2020).

Therefore, this study aimed to identify and analyze the cognitive, psychological, contextual, sociocultural, and collaborative determinants that influence gender disparity in STEM careers to construct a comprehensive theoretical model that sheds light on the behavioral patterns associated with this issue. Additionally, it seeks to identify the actions that higher education institutions must undertake to overcome the gender gap. To guide this research, the following questions were posed: What are the cognitive, psychological, contextual, sociocultural, and collaborative factors that influence gender disparity in STEM careers, and what steps can higher education institutions take to address this gap?

This research arises from the need to understand and address gender disparities and the lack of a holistic theoretical model that tackles the factors contributing to the gender gap in STEM. This study substantially addresses gender disparity, providing a comprehensive theoretical model, empirical insights, actionable recommendations, and a clear direction for future research and policy development in higher education. This study employed a qualitative methodology based on an interpretative paradigm. Specifically, the grounded theory approach was used to analyze semi-structured interviews. These contributions are vital for developing a comprehensive theoretical model based on empirical interview data. These insights are essential for crafting effective strategies to address the gender gap in STEM and support equitable academic trajectories.

This research paper is organized into five main sections: the introduction, which covers the problem, objectives, and innovative aspects; the second section presents the theoretical framework; the third details the methodology; the fourth presents the study results; and the fifth includes the discussion, followed by a final conclusions section.

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Theoretical Framework

Theoretical Models explaining the gender gap in STEM.

Theoretical frameworks have been developed to explain gender stereotype-related behaviors and understand gender disparities in STEM. Figure 1 presents a model that schematically organizes and classifies the most prominent approaches validated by theoretical and empirical evidence.

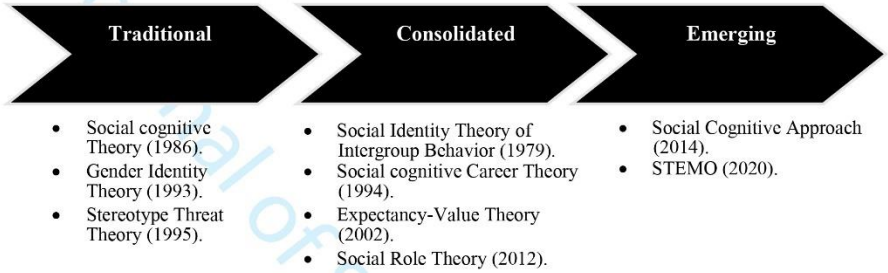


Figure 1. Theoretical models explaining stereotyped behaviors.

The first group of traditional theories includes Spence's Gender Identity Theory (1993), which posits that individuals adopt the interests and behaviors expected of their gender and their respective traditional roles. Additionally, Steele and Aronson's (1995) Stereotype Threat Theory adds new elements to the discussion by highlighting the risk of confirming negative stereotypes about the group to which one belongs, potentially affecting performance on certain tasks. Women are often associated with poorer math skills than men, which can affect their performance and interest. However, this stigma does not reflect their true competence in mathematics, as research indicates that women achieve higher grades in this field than men (Lundberg, 2020).

This generates social and economic consequences by segregating the female gender from a disciplinary area relevant to sustainable development and subtracting valuable and necessary human capital for the progress of nations that would contribute to research and innovation. In summary, one of the strengths of the approaches proposed by Spence (1993) and Steele and Aronson (1995), representatives of traditional perspectives, is that they allow us to position the research problem in the context of gender roles and how they impact women's self-perceptions of their abilities, leading to effects on productive development. While the authors of this study focused on gender roles in group settings, they did not fully address other internal variables essential for a comprehensive understanding of the phenomenon.

Bandura's (1986) Social Cognitive Theory, originally not considered a gender theory, later became integral to understanding gender gaps and biases. This theory emphasizes the reciprocal interaction between the individual, environment, and behavior, with self-efficacy as a central concept—referring to one's confidence in specific abilities, which influences performance and self-perception(Bandura, 1999). Bandura also identified three forms of human agency: personal, proxy, and collective, all of which are shaped by internal factors affecting cognitive, emotional, and environmental aspects (Schunk & DiBenedetto, 2020). Although Bandura's theory highlights the significance of motivation, self-efficacy, and triadic interactions in behavior formation, it has limitations, such as not fully addressing certain individual variables and social issues, nor providing sufficient detail on cognitive processes.

Social Cognitive Career Theory (SCCT) is a well-established theory proposed by Lent, Brown, and Hackett (1994) and derived from Bandura's general social cognitive theory (1986). SCCT emphasizes

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self-efficacy, outcome expectations, and goal mechanisms, and examines how these factors relate to gender, contextual support systems, and experiential learning. Self-efficacy pertains to individuals' confidence in their ability to achieve specific goals, whereas outcome expectations are the anticipated results of their actions. These elements are vital for understanding the gender gap in STEM, emphasizing the role of the environment in influencing choices, self-efficacy, and women's goals in bridging this gap. SCCT underscores the interconnection between personal, contextual, and experiential factors, including learning opportunities, role models, and reinforcements. Despite its limitations, SCCT does not consider cultural and collaborative aspects.

One theoretical model that introduces relevant variables to address the gender gap is Eccles and Wigfield's Expectancy-Value Theory (2002), which addresses the theoretical pathway through which stereotypes affect students' academic outcomes, choices, and the role of motivation as a change agent. This theory emphasizes the impact of expectations on the success of specific actions, the role of academic performance, and its effect on individuals' choices and academic behaviors (Eccles, 2024). While it focuses on the role of motivation in addressing the gender gap, it also overlooks contextual barriers. Achieving goals is not solely dependent on motivation and high expectations; social, economic, and personal interference must be considered. In the latter aspect, identity emerges as a crucial factor.

According to the Social Identity Theory of Intergroup Behavior by Tajfel and Turner (1979), people's behavior can be influenced by their perceptions of social categories. This leads to three psychological processes: social categorization, identification, and social comparison, which shape individuals' mental construction of their social context. Similarly, Eagly and Wood's Social Role Theory (2012) explains the behavior of men and women and the stereotypes, ideologies, and attitudes related to gender. Both theories assist in comprehending the social dynamics of roles individuals assume in response to societal demands during interactions. However, they mainly emphasize the social aspect, neglecting the personal factors influencing women's behavior.

Emerging approaches include the work of Greenwald and Banaji (2017), who introduced the concept of implicit social cognition to examine stimuli that affect individuals beyond their conscious control. Baron et al., (2014) built upon this concept, focusing on social cognition to address stereotypes and emphasizing it as an ongoing cognitive process in humans. This process involves social context, gender identity, and self-concept (Cvencek et al., 2021). Therefore, it is crucial to explore how individuals perceive themselves, others, and the social groups with which they interact because this recursive and cyclical process contributes to the generation of stereotypes. The authors highlighted the social cognitive component, stressing that internal and external factors influence individuals.

In a similar vein, the proposal by Master and Meltzoff (2020), known as STEMO[1], integrates educational research, human development, and social psychology to understand gender gaps in STEM fields. The negative stereotypes of female STEM students can lead to biased self-representation, impacting their academic performance and interest. Interventions such as fostering a growth mindset and promoting a sense of belonging are crucial. However, the proposal overlooks social barriers, such as inequality, inequity, and economic development, which are vital to address. Understanding social behavior, its context, and interactive dynamics is essential in research on the gender gap and biases in STEM. Each theoretical category offers aspects that must be considered to delineate their causes and impacts on social behavior. Figure 2 summarizes the relevant aspects.

[1] Its acronym stands for Stereotypes, Motivation y Outcomes.

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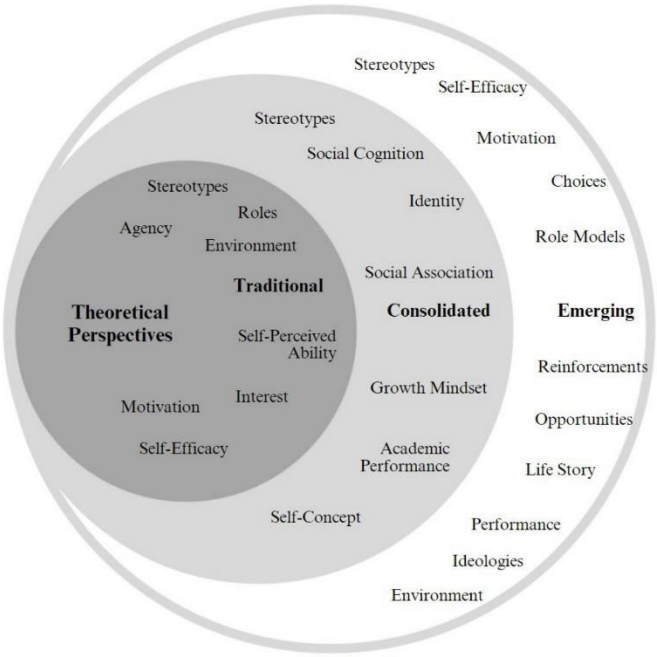


Figure 2*: Theoretical Contributions to the Gender Gap.*

The analyzed theoretical frameworks significantly contribute to delineating the determinants of the gender gap and biases in STEM. Proposals from traditional approaches, such as Bandura (1982), Spence (1993), and Steele and Aronson (1995), as well as consolidated theories, such as Tajfel (1979), Lent et al. (1994), Eccles and Wigfield (2002), Eccles (2011), and Eagly and Wood (2012), and emerging contributions, such as Greenwald and Banaji (1995), Cvencek et al. (2011), Baron et al. (2014), and Master and Meltzoff (2020) provide valuable insights. These postulates emphasize the necessity of investigating various constructs, such as cognitive aspects (performance and self-perceived abilities), psychological aspects (interest and motivation), contextual aspects (life stories and family environments), and sociocultural aspects (ideology, gender models, and roles). However, previous proposals failed to highlight the crucial role of collaboration, which the gender gap in STEM can affect, despite its significant impact on the decisions and trajectories of both men and women.

The Impact of Gender Stereotypes in STEM: Reproduction of Social Inequalities

The gender gap in STEM presents significant challenges globally, as women are disproportionately affected by biased beliefs from influential figures in education and their parents, which influence key factors such as competencies, anxiety, choice, and interest in these fields (Cvencek et al., 2021; Henderson, 2023; Tey et al., 2024). Stereotypes that assign culturally and socially prescribed roles significantly impact beliefs and guide behaviors. Men are generally associated with traits such as ambition

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and assertiveness, whereas women are linked to qualities such as solidarity and sensitivity (Sczesny et al., 2019). These stereotypes promote a hierarchy of roles, leading individuals to conform to societal expectations, which are further reinforced by educational institutions, thus limiting women's access to STEM fields(Rippon, 2019).

This situation poses significant challenges for economies seeking comprehensive development, as both human capital and talent in all forms are required to contribute to disciplines that drive innovation and technology(Tandrayen-Ragoobur & Gokulsing, 2021). Ensuring and promoting equal access to STEM careers among women is imperative for human rights, scientific perspectives, and development. From a human rights approach, all individuals are equal and should have equal opportunities, including the choice to study and work in their preferred fields. From a scientific perspective, including women promotes scientific excellence and enhances the quality of STEM outcomes(UNESCO, 2024). Thus, eliminating gender gaps and biases is relevant to building more just, inclusive, and sustainable societies.

The gender gap and biases manifest in the metaphor of the 'leaky pipeline' in STEM careers, which is associated with issues arising from reproduction, parenting, and situations of sexual harassment (Reidy et al., 2023). Implicit and explicit biases in scientific and technological careers, including societal expectations of gender roles in family and domestic responsibilities like childcare, eldercare, and household chores, affect the selection and retention of individuals in these fields, extending from undergraduate to postgraduate studies(Brockman et al., 2022). Sociocultural biases that hinder inclusivity and scientific progress by excluding individuals capable of contributing to a nation's scientific knowledge have profound and enduring effects. These biases particularly disadvantage women, resulting in their significant underrepresentation within the scientific community.

Stereotypes are deeply ingrained social patterns that shape people's realities despite their cognitive nature and influence on behavior(Chaffee et al., 2024). These patterns can differ from an individual's self-reported stereotypes because of unawareness or reluctance to reveal endorsements (Cvencek et al., 2021). Stereotypes depend on context, influencing the drive to align ascribed identity with real identity. Additionally, stereotypes are shaped by the stereotyped individual and the stereotype itself. Experience often influences beliefs, but stereotypes remain linked to context and interpretation(Gjøvik et al., 2022). Gender is deeply ingrained as a basis for social stratification in various aspects of life, including personality, cultural norms, institutions, and behaviors (Mari & Müller, 2023), acting as a system that restricts and shapes individuals' behavior.

Stereotypes can profoundly impact society by influencing behavior, productivity, and everyday actions. Women often do not perceive their abilities favorably(Ashlock et al., 2022), which affects their self-perception and ability to pursue STEM careers, such as engineering, where they are frequently considered incapable(Gagnier et al., 2024). This issue is linked to incremental beliefs in STEM, which are higher in men (Moè et al., 2021). The underrepresentation of women in senior leadership positions in corporations and governments (Tarkovska et al., 2023), as well as the limited representation of men in community roles traditionally held by women, perpetuates stereotypical gender beliefs about agency and communion(Moskos, 2020).

Research conducted in STEM disciplines and the gender gap has evinced that facile explanations are inadequate (Stearns et al., 2020); one must look beyond easily measurable academic experiences, owing to their multifactorial nature. The gender gap in STEM is a research topic that has progressively grown over the last ten years (Bogdan & García-Carmona, 2021), reflecting its centrality in understanding social behavior. However, gender-biased, hierarchical, and unequal power dynamics and group interactions are not considered(Beroíza-Valenzuela & Salas-Guzmán, 2024), which restricts and shapes individuals' behavior and response to the collaborative aspect. There is also insufficient clarity regarding a comprehensive theoretical model that includes factors that influence the gender gap in STEM.

Methodology

The current study used a qualitative methodological approach, incorporating an interpretive paradigm and grounded theory design (Corbin & Strauss, 2015). Semi-structured interviews were used for

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data collection and analysis, employing open, axial, and selective coding for theory generation. Emerging categories were identified, focusing on five dimensions (psychological, cognitive, contextual, sociocultural, and collaborative) and an additional dimension addressing strategies for narrowing the gender gap in higher education. These dimensions were crucial for structuring the interviews and guiding the exploration of the essential elements of the research topic. The dimensions are as follows:

1. Cognitive Dimension: Perceptions, knowledge, and cognitive skills that influence the gender gap in higher education.
2. Sociocultural Dimension: Social interactions and cultural influences shape the experiences and behaviors associated with the gender gap.
3. Contextual Dimension: Environmental and situational factors within the family and educational settings impact the gender gap.
4. Psychological Dimension: Emotions, attitudes, and mental states that play a role in the gender gap.
5. Collaborative Dimension: Teamwork dynamics and collaboration regarding the gender gap in higher education.
6. Strategies for Gender Equity: Institutions could implement policies and strategies to promote gender equity in the educational sphere.

These dimensions facilitated a thorough and multidimensional understanding of the topic, providing a robust framework for analyzing and interpreting the collected data. This study developed a comprehensive theory that offers a solid foundation for future research by integrating these aspects.

The sample for this study consisted of 30 participants selected through convenience or purposeful sampling. The inclusion criteria focused on researchers from universities and specialized research centers in the field of STEM and the gender gap, as well as experts in well-being, mental health, and collective intelligence at national and international levels. Researchers with gender and inclusion perspectives, as well as heads of gender departments in public and private universities, were also included. Exclusion criteria were established to ensure that participants had experience and knowledge of the study topics over the last five years. Table 1 provides a detailed profile of each participant.

This study followed the research protocols approved by the Ethics Committee of the University of Santiago de Chile, N°024, and all stages of the study were conducted following the Declaration of Helsinki. All participants signed an informed consent form before participating in the study. Participants were informed of the study's objectives, procedures, and right to withdraw without negative consequences. Confidence and privacy of the participant data were strictly maintained throughout the study.

The interviews took place between February 23, 2023, and April 31, 2023, using the paid Zoom One Pro platform in an audiovisual format, and every session lasted approximately 60 minutes (Zoom Video Communications, 2024). An interview guide was developed, focusing on the research objectives, and was adjusted after each interview to accommodate emerging themes and investigative focus. Subsequently, transcriptions were carried out, and analysis was conducted using the paid version 23.1.0 of the ATLAS.ti software(Atlas.ti GmbH., 2024). Peer reviews and data triangulation were employed to ensure the validity and reliability of the data. At the same time, data triangulation compared the results obtained from the interviews with the existing literature on theories related to stereotyped beliefs and factors influencing the gender gap, reaching a saturation point. This methodological design allows for exploring complex problems and collecting detailed data, offers flexibility, facilitates theory generation, and focuses on participants.

Results

This qualitative study identified three main analytical categories: internal and external factors affecting the gender gap and strategic actions in higher education. The first two categories encompass cognitive, psychological, contextual, collaborative, and sociocultural factors, reflecting the complexity and diversity that influence this disparity. This underscores the necessity for a comprehensive understanding of its root causes and interconnected effects. The third category focuses on potential solutions,

emphasizing the importance of targeted strategies to address the gender gap. This study advocates a multidimensional approach to achieve lasting change and provides a foundation for public policies and interventions to promote gender equity in STEM. A schematic representation of the findings is presented in Figure 3.

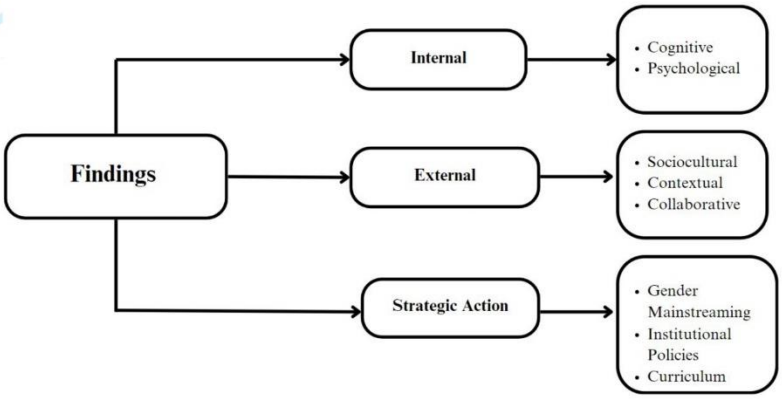


Figure 3. *Factors and Opportunities Influencing Gender Disparity in STEM.*

The gender gap in STEM is influenced by both internal and external factors. Societal perceptions and gender stereotypes affect career decisions and confidence in the scientific and technological fields. Traditional gender roles and the scarcity of female role models in STEM may deter women from pursuing and sustaining their careers. Externally, gender discrimination and bias, along with inadequate policies and programs that promote equal opportunities, further hinder women's advancement in STEM.

Internal Factors Influencing the Gender Gap

The gender gap remains a persistent issue in the academic field. While many factors contribute to this disparity, some of the most significant are internal factors, which relate to individuals' perceptions and attitudes toward their gender and roles in education and career. Two of the most important internal factors are cognitive and psychological factors. Figure 4 illustrates the results in a schematic format.

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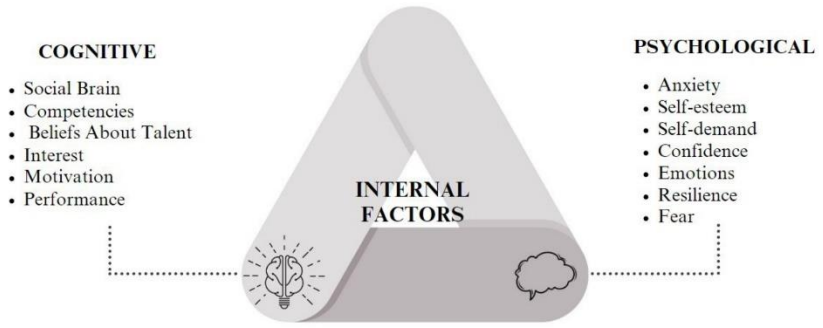


Figure 4. *Internal Factors.*

Cognitive factors refer to the perception of cognitive differences based on gender and how these perceptions can impact the choice of roles and gender stereotypes in the academic field. Some individuals may believe that certain areas of study are more suitable for a particular gender, which can limit their career choices and perpetuate gender stereotypes. Understanding and addressing these perceptions and attitudes is crucial for reducing the gender gap in academic performance and university career choices. In this regard, as pointed out by one of our interviewees,

> Some argue that there are brain differences between women and men that can influence our cognitive abilities. According to this perspective, these natural differences can impact the academic preferences of women and men, such as the choice of university programs and areas of study in higher education (Gracie, personal interview, February 28, 2023).

This statement reflects a societal perspective that suggests inherent cognitive differences between men and women, which, according to this view, may influence their academic preferences and choices in higher education.

Psychological factors include subjective aspects that affect the gender gap, such as emotional state, self-esteem, fear, interest, motivation, empowerment, and expectations. These elements influence individuals' engagement in activities and career choices, potentially limiting their group participation in certain fields. The participant narratives in this study highlighted the significant connection between students' self-esteem in STEM and their academic choices. The testimonies reveal how personal perceptions of worth and competence significantly influence the careers that students pursue and sustain. This relationship implies that self-esteem is pivotal in shaping students' educational goals and career trajectories. As one interviewee observed:

> So, as a woman, I may feel tempted to give up, reducing the dissonance between what I desire and what I perceive as possible. I can convince myself that I did not want to study physics because, deep down, I did not want to deal with mathematics. But this kind of self-convincing is a psychological mechanism that only disguises reality (María, personal interview, March 15, 2023).

This quote highlights the pressures and challenges that women may face when trying to balance their personal desires with social and gender expectations. The interviewee suggested that, as a woman,

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she may feel tempted to give in and settle for simplified explanations, such as avoiding mathematics, instead of addressing the challenge of gender discrimination in STEM disciplines. This underscores the importance of recognizing and challenging psychological mechanisms that can disguise reality and perpetuate gender stereotypes.

External Factors Influencing the Gender Gap

External factors play a fundamental role in pursuing gender equity, with three being particularly crucial: sociocultural, contextual, and collaborative. Sociocultural factors encompass societal roles and patterns that perpetuate gender discrimination and bias, often through media and cultural norms. Contextual factors pertain to external influences, such as the beliefs and attitudes of educators, community members, and families, which can reinforce gender stereotypes and limit gender-based opportunities (Kiernan et al., 2023). In this regard, one interviewee emphasized, "It has a significant impact if your father pursued a science-related career. Additionally, your mother's anxiety also greatly influences your ability to face male-dominated situations" (Zoe, personal interview, March 23, 2023).

Finally, the collaborative factor addresses group dynamics and interactions in social environments where opportunities for cooperation are limited. These limitations can lead to gender inequalities and hinder participation in and development of equal professional trajectories for men and women across various activities and roles. In this context, one interviewee emphasized the value of collaboration:

> I believe that when women form alliances, something special happens. I have experienced it now that I am in different groups; this support pushes us to keep going. It drives us forward and makes us realize we are not alone (Paulina, personal interview, March 24, 2023).

Addressing these factors is crucial for achieving a more gender-equitable society. Figure 5 illustrates these results in a diagrammatic form.

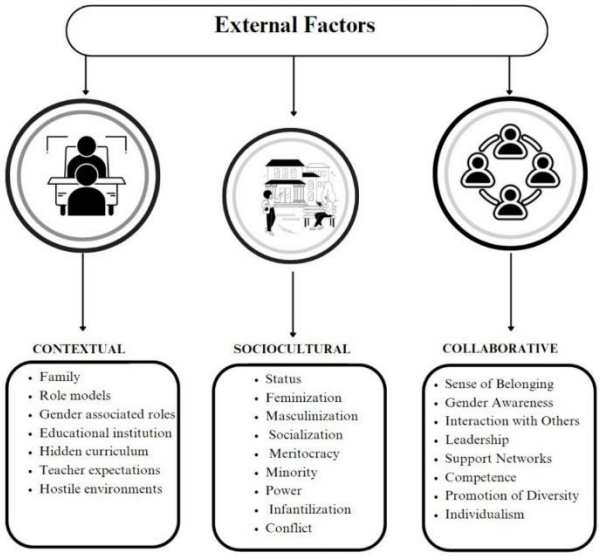


Figure 5. *External Factors.*

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Strategic Action in Higher Education

One aspect that emerged from the interviews relates to strategic action in higher education, which is a key element associated with potential solutions. The gender gap must be actively addressed through specific and concrete strategies in higher education institutions, emphasizing the incorporation of gender mainstreaming into organizational realities (Peterson & Jordansson, 2022), where integrative and transformative interpretative frameworks have been identified.

The integrative approach incorporates a gender equality perspective into existing policy models, often focusing on achieving equal opportunities for women and men. Despite this, the fundamental power dynamics between women and men in the organization remain mostly the same; what has changed is merely surface-level (Scala & Paterson, 2018). In contrast, the transformative approach sees the incorporation of the gender perspective as a fundamental re-articulation of the political agenda. The root of individual and group disadvantages lies in biased systems and structures that favor men (Lombardo & Mergaert, 2013). However, this is not an easy process and faces multiple challenges, as outlined below:

> This is a medium- to long-term process that requires time and reflection. To develop a strong gender awareness, it is essential to explore how individual experiences have impacted our lives, whether men or women and how we have internalized gender norms and stereotypes. This is the first step toward understanding the gender perspective (Tess, personal interview, March 1, 2023).

Additionally, this gender perspective should be embedded in the curriculum and guide educational policies. Developing solid gender awareness is a medium- to long-term process that requires time and reflection. The key to this development lies in exploring how subjective experiences have shaped individuals' lives, regardless of gender, and how gender norms and stereotypes have been internalized. This initial process is crucial for understanding gender perspectives and represents the first step in the journey of awareness.

Discussion

The results of the qualitative research revealed five fundamental factors that influence the gender gap in STEM careers: cognitive, psychological, contextual, collaborative, and sociocultural. These findings align with previous studies that separately address internal factors such as motivation (Eccles, 2024), anxiety and emotional states(Henderson, 2023), cognitive aspects (Chaffee et al., 2024; Cvencek et al., 2021; Master & Meltzoff, 2020), interest (Tey et al., 2024), and self-perception (Lundberg, 2020), as well as external factors such as the impact of family (Mari & Müller, 2023), school referents(Lv et al., 2022), and sociocultural aspects (Eagly & Wood, 2012; Steele & Aronson, 1995; Tajfel & Turner, 2004), except for the collaborative aspect, which can only be inferred from Bandura's (1999) concept of collective and cooperative agency. This reflects the rich complexity and diversity of the factors contributing to this disparity. Additionally, compelling ideas for targeted initiatives aimed at transforming this situation at the university level have emerged, underscoring the importance of comprehensively addressing the issue and understanding its causes and interconnected effects.

In competitive spaces, female students often doubt their abilities, academic characteristics, and potential for developing scientific skills due to societal beliefs that they are less intelligent than men(Rippon, 2019). These ingrained societal beliefs affect their competencies, talent beliefs, interest in specific fields, scientific method application, motivation, and performance in STEM, as well as their adherence to harmful gender standards (Coenen et al., 2021). Societal expectations of this perspective from women create a hegemonic model that they feel compelled to follow despite the negative consequences (Doerr, 2023). Women may believe they have less talent and fewer opportunities to develop it due to a lack of social and peer support in the face of inequality of opportunities, which can lead them to abandon their aspirations for socially barred careers (Jergins, 2023). People have varying responses to

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inequality (Domen et al., 2022). Consequently, women may experience dissonance between their desires and what is allowed based on gender, leading them to reduce their dissonance by abandoning their choices, as evidenced by the study results.

Regarding psychological factors, anxiety and fear emerge as crucial elements triggering 'negative' emotional states (Lunardon et al., 2022), factors such as emotional states, self-esteem, fear, interest, motivation, and empowerment(Lv et al., 2022); however, this impact can also trigger positive aspects such as resilience and self-demand (Blaique et al., 2022). These factors enable individuals to confront challenges in adverse environments, potentially influencing persistence or dropout rates. Female students, in particular, often rely on their self-confidence and seek to demonstrate competence in traditionally male-dominated areas(Chan, 2022). This interplay of emotions motivates these women to confront hostile situations, such as harassment (Reidy et al., 2023), and overcome them with a strong sense of determination. Understanding and analyzing cognitive and psychological aspects have emerged as essential components in studying the gender gap in the academic context.

Research in these areas can provide valuable insights into developing effective strategies to narrow the gender gap in higher education. Strategies designed based on these findings could include implementing mentorship programs that foster confidence and self-esteem among female students, thereby promoting more active and determined participation in fields traditionally dominated by men(Costello et al., 2023). Additionally, curriculum approaches could be developed to challenge gender stereotypes and foster an inclusive and diverse environment(Henrich et al., 2024), enabling female students to explore areas of study without feeling constrained by preconceived expectations. A deep understanding of cognitive and psychological factors affecting the gender gap in higher education can drive meaningful change toward a more equitable society with equal opportunities for all to reach their potential and contribute across academic and professional fields.

External factors, including collaborative, cultural, and contextual, considerably influence the gender gap in STEM careers. Institutions' and society's approaches to these aspects can significantly impact women's equitable participation in these masculinized fields (Katz-Gerro & Sullivan, 2023). As a minority, women face intricate challenges in male-dominated environments, necessitating the activation of their agency to avoid invisibility, identity loss, or adopting masculine traits in attire and behavior. As one interviewee noted, women often try to become invisible by adapting to masculinized behavior patterns and ways of interacting: “As an attempt to become invisible, in a way adapting to a kind of masculinization… adopting similar behavior patterns…ways of conversing, and interpersonal relationships” (Muriel, personal interview, March 12, 2023). University culture perpetuates societal stereotypes and power dynamics, exemplifying symbolic violence against women, even within the classroom.

Contextual factors are crucial in analyzing the gender gap, emphasizing the family's relevance and the university's educational framework (Turner et al., 2022). In the family sphere, parenting patterns have the potential to have a far-reaching impact, in some cases leading to the experience of learned helplessness. Parental figures exert considerable influence on women from an early age, shaping their decisions and perspectives. Established parenting patterns can shape how women perceive their abilities, aspirations, and possible societal roles (Anaya et al., 2022). When gender expectations are internalized in childhood, they can limit career perceptions and choices. Parental guidance significantly impacts the selection of study areas and career paths, as parents’ attitudes shape their daughters' perspectives. This study's findings align with previous research showing parents' crucial role in developing teenagers' professional interests and entry into STEM careers(Woo et al., 2023).

In university STEM fields, environments often lack support for women, leading to emotional burdens that can cause demotivation, exclusion, or self-doubt, ultimately impacting their participation and academic progress and resulting in the undervaluation of their skills in STEM careers(Woo et al., 2023). Additionally, a culture rooted in sexism and focused on competition often prevails, undermining collaboration in these settings(Boudreau & Kaushik, 2023). To thrive, it is crucial to promote a sense of belonging, facilitate group interactions, and encourage unity among female students, along with fostering gender awareness(Micari & Pazos, 2021). These efforts can counteract competitive dynamics and create

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an environment where women feel supported, motivated, and empowered to actively participate and excel in STEM careers.

Higher education institutions adopt integrative or transformative strategies to incorporate a gender perspective and address the gender gap. Nevertheless, a meritocratic culture emphasizing excellence, neutrality, and bureaucracy can obstruct these gender mainstreaming initiatives(Powell, 2018). Effective political measures include special admission quotas for women, mentoring programs, gender-focused curriculum changes, and teacher training to promote gender equality. Universities must also adopt inclusive education practices and clear policies to raise awareness of gender equality within the academic community (Rockinson-Szapkiw & Wendt, 2020). Closing the gender gap in higher education necessitates a multifaceted approach that fosters cultural change, confronts biases, and promotes inclusion. Initiatives should inspire and assist women in STEM, while policies must ensure equal opportunities and encourage gender diversity in these fields. Increasing women's representation in STEM demands collaborative efforts to secure an equitable and thriving future.

Conclusions

This qualitative study, employing a grounded theory design, explores the factors contributing to the gender gap in higher education, emphasizing cognitive, psychological, contextual, sociocultural, and collaborative elements. Cognitive analysis shows how societal perceptions of gender differences influence career choices and perpetuate stereotypes, thus limiting women's exploration of male-dominated academic fields. Psychologically, this study highlights how self-esteem, motivation, and emotional attitudes, including anxiety and fear, create barriers that impact women's performance and persistence in such disciplines.

Contextually, the influence of family, university, and educational structures on academic choices is evident; upbringing shapes early gender expectations, and university culture can be unwelcoming for women in STEM. This research identifies a male-dominated, competitive university culture that lacks collaboration, further challenging women in academic careers. Collaborative and empowerment strategies among female students are essential to address these challenges and actively support and enhance their academic trajectories. Strategies that foster a supportive environment and offer resources to women in traditionally male-dominated fields can ensure their persistence in studies and full academic achievement.

This research underscores the need for a comprehensive multidimensional approach to addressing the gender gap in higher education, filling a critical knowledge gap by thoroughly analyzing the complex factors contributing to this issue. By exploring cognitive, psychological, contextual, sociocultural, and collaborative influences in STEM fields, it provides insights that can inform effective university policies and shape academic trajectories. However, a limitation was the narrow sample size, primarily composed of women. Future research should include diverse profiles to better explore the factors behind the gender gap in STEM and other fields such as social sciences and humanities. Assessing customized educational interventions and institutional gender equity policies is crucial to comprehend their influence on female students' perceptions.

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References

Anaya, L., Stafford, F., & Zamarro, G. (2022). Gender gaps in math performance, perceived mathematical ability and college STEM education: The role of parental occupation. *Education Economics*, *30*(2), 113–128. https://doi.org/10.1080/09645292.2021.1974344

Ashlock, J., Stojnic, M., & Tufekci, Z. (2022). Gender Differences in Academic Efficacy across STEM Fields. *Sociological Perspectives*, *65*(3), 555–579. https://doi.org/10.1177/07311214211028617

Atlas.ti GmbH. (2024). *Atlas.ti* [Software]. https://atlasti.com/

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory* (pp. xiii, 617). Prentice-Hall, Inc.

Bandura, A. (1999). A Social Cognitive Theory of Personality. En *Handbook of Personality* (pp. 154–196). Guilford Publications.

Baron, A. S., Schmader, T., Cvencek, D., & Meltzoff, A. N. (2014). The gendered self-concept: How implicit gender stereotypes and attitudes shape self-definition. En *Gender and development* (pp. 109–132). Psychology Press.

Beroíza-Valenzuela, F., & Salas-Guzmán, N. (2024). STEM and gender gap: A systematic review in WoS, Scopus, and ERIC databases (2012–2022). *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1378640

Blaique, L., Pinnington, A. H., Al-Malkawi, H.-A., & Aldabbas, H. (2022). The influence of personal skills development and coping self-efficacy on the affective occupational commitment of women in STEM fields. *Equality, Diversity and Inclusion: An International Journal*, *42*(2), 173–192. https://doi.org/10.1108/EDI-10-2021-0264

Bogdan, R., & García-Carmona, A. (2021). «De STEM nos gusta todo menos STEM». Análisis crítico de una tendencia educativa de moda [«Of STEM we like everything but STEM». A critical analysis of a buzzing educational trend]. *Enseñanza de las Ciencias*, *39*, 65–80. https://doi.org/10.5565/rev/ensciencias.3093

Boudreau, K. J., & Kaushik, N. (2023). Gender Differences in Responses to Competitive Organization? A Field Experiment on Differences Between STEM and Non-STEM Fields from an Internet-of-Things Platform. *Organization Science*, *34*(6), 2119–2142. https://doi.org/10.1287/orsc.2022.1624

Breda, T., Jouini, E., Napp, C., & Thebault, G. (2020). Gender stereotypes can explain the gender-equality paradox. *Proceedings of the National Academy of Sciences*, *117*(49), 31063–31069. https://doi.org/10.1073/pnas.2008704117

Brockman, A. J., Naphan-Kingery, D. E., & Pitt, R. N. (2022). When talent goes unrecognized: Racial discrimination, community recognition, and STEM postdocs' science identities. *Studies in Graduate and Postdoctoral Education*, *13*(2), 221–241. https://doi.org/10.1108/SGPE-12-2020-0079

Chaffee, K. E., Plante, I., Good, C., Aronson, J. M., Kinch, S.-B., & Gauvin, I. (2024). When stereotypes disadvantage boys: Strength of stereotypes in mathematics and language arts and their relations with grades. *Journal of Applied Social Psychology*, *54*(2), 71–82. https://doi.org/10.1111/jasp.13013

Chan, R. C. H. (2022). A social cognitive perspective on gender disparities in self-efficacy, interest, and aspirations in science, technology, engineering, and mathematics (STEM): The influence of cultural and gender norms. *International Journal of STEM Education*, *9*(1), 37. https://doi.org/10.1186/s40594-022-00352-0

Coenen, J., Borghans, L., & Diris, R. (2021). Personality traits, preferences and educational choices: A focus on STEM. *Journal of Economic Psychology*, *84*, 102361. https://doi.org/10.1016/j.joep.2021.102361

Costello, R. A., Salehi, S., Ballen, C. J., & Burkholder, E. (2023). Pathways of opportunity in STEM: Comparative investigation of degree attainment across different demographic groups at a large research institution. *INTERNATIONAL JOURNAL OF STEM EDUCATION*, *10*(1), 46. https://doi.org/10.1186/s40594-023-00436-5

Cvencek, D., Brečić, R., Gaćeša, D., & Meltzoff, A. N. (2021). Development of Math Attitudes and Math Self-Concepts: Gender Differences, Implicit–Explicit Dissociations, and Relations to Math Achievement. *Child Development*, *92*(5). https://doi.org/10.1111/cdev.13523

Corbin, J. M., & Strauss, A. L. (2015). Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory (4th ed.). Thousand Oaks, CA: Sage publications.

Doerr, K. (2023). Chutes and Ladders: Gendered Systems of Privilege and Marginalization in University Science Teaching. *Journal of Women and Gender in Higher Education*, *16*(2), 115–136. https://doi.org/10.1080/26379112.2023.2213893

Domen, I., Scheepers, D., Derks, B., & van Veelen, R. (2022). It's a man's world; right? How women's opinions about gender inequality affect physiological responses in men. *Group Processes & Intergroup Relations*, *25*(3), 703–726. https://doi.org/10.1177/13684302211042669

Eagly, A. H., & Wood, W. (2012). Social Role Theory. En *Handbook of Theories of Social Psychology: Volume 2* (1–2, pp. 458–476). SAGE Publications Ltd. https://doi.org/10.4135/9781446249222

Eccles, J. S. (2024). International comparative study of motivation: A commentary. *European Journal of Psychology of Education*, *39*(2), 1661–1666. https://doi.org/10.1007/s10212-024-00820-x

Eccles, J., & Wigfield, A. (2002). Motivational Beliefs, Values and Goals. *Annual Review of Psychology*, *53*, 109–132. https://doi.org/10.1146/annurev.psych.53.100901.135153

ECLAC, N. (2019). *The 2030 Agenda and the Sustainable Development Goals: An opportunity for Latin America and the Caribbean. Goals, Targets and Global Indicators*. https://repositorio.cepal.org/handle/11362/40156

Etheridge, B., & Spantig, L. (2022). The gender gap in mental well-being at the onset of the Covid-19 pandemic: Evidence from the UK. *European Economic Review*, *145*, 104114. https://doi.org/10.1016/j.euroecorev.2022.104114

Fine, C. (2018). *Testosterone Rex: Unmaking the Myths of Our Gendered Minds*. Icon Books.

Gagnier, K. M., Holochwost, S. J., Ceren, M., & Fisher, K. R. (2024). Filling a gap: Initial evidence for reliable and valid measures of students' self-concept, self-efficacy, and interest in science with elementary students traditionally underrepresented in STEM. *Frontiers in Education*, *8*. https://doi.org/10.3389/feduc.2023.1242876

Gagnier, K. M., Holochwost, S. J., & Fisher, K. R. (2022). Spatial thinking in science, technology, engineering, and mathematics: Elementary teachers' beliefs, perceptions, and self-efficacy. *Journal of Research in Science Teaching*, *59*(1), 95–126. https://doi.org/10.1002/tea.21722

Garriott, P. O., Navarro, R. L., Flores, L. Y., Lee, H.-S., Carrero Pinedo, A., Slivensky, D., Muñoz, M., Atilano, R., Lin, C.-L., Gonzalez, R., Luna, L., & Lee, B. H. (2019). Surviving and thriving: Voices of Latina/o engineering students at a Hispanic serving institution. *Journal of Counseling Psychology*, *66*(4), 437–448. https://doi.org/10.1037/cou0000351

Gjøvik, Ø., Kaspersen, E., & Farsani, D. (2022). Stereotypical images of male and female mathematics teachers. *Research in Mathematics Education*, *0*(0), 1–16. https://doi.org/10.1080/14794802.2022.2041471

Greenwald, A. G., & Banaji, M. R. (2017). The implicit revolution: Reconceiving the relation between conscious and unconscious. *American Psychologist*, *72*(9), 861–871. https://doi.org/10.1037/amp0000238

Henderson, E. (2023). Opportunities for libraries to address research anxiety in undergraduate students in STEM fields. *Insights*, *36*(1). https://doi.org/10.1629/uksg.626

Henrich, J. B., Richman, I., Rabin, T. L., Giclissen, K. A., Dhond, M., Canaric, J. X., Hirschman, A. F., Windham, M. R., Maya, S., McNamara, C., Pathy, S., Bernstein, P., Smith, R., & Vasquez, L. (2024). It Takes a Village: An Interdisciplinary Approach to Preparing Internal Medicine Residents to Care for Patients at the Intersection of Women's Health, Gender-Affirming Care, and Health Disparities. *Journal of Women's Health*, *33*(2), 152–162. https://doi.org/10.1089/jwh.2023.0217

Idrizi, E., Filiposka, S., & Trajkovikj, V. (2023). Gender impact on STEM online learning- a correlational study of gender, personality traits and learning styles in relation to different online teaching

UMCE
VICERRECTORIA ACADÉMICA.
DIRECCIÓN DE POSTGRADO
PROGRAMA DOCTORADO EN EDUCACIÓN

modalities. *Multimedia Tools and Applications*, *82*(19), 30201–30219. https://doi.org/10.1007/s11042-023-14908-x

Jergins, W. (2023). Gender equity and the gender gap in STEM: Is there really a paradox? *Journal of Population Economics*, *36*(4), 3029–3056. https://doi.org/10.1007/s00148-023-00959-9

Katz-Gerro, T., & Sullivan, O. (2023). Cultural stratification in the UK: Persistent gender and class differences in cultural voraciousness. *JOURNAL OF CONSUMER CULTURE*, *23*(2), 391–408. https://doi.org/10.1177/14695405221100388

Kiernan, L., Walsh, M., & White, E. (2023). Gender in Technology, Engineering and Design: Factors which influence low STEM subject uptake among females at third level. *International Journal of Technology and Design Education*, *33*(2), 497–520. https://doi.org/10.1007/s10798-022-09738-1

Kwon, H., Capraro, R. M., & Capraro, M. M. (2021). When I Believe, I Can: Success STEMs from My Perceptions. *Canadian Journal of Science, Mathematics and Technology Education*, *21*(1), 67–85. https://doi.org/10.1007/s42330-020-00132-4

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior*, *45*(1), 79–122. https://doi.org/10.1006/jvbe.1994.1027

Lombardo, E., & Mergaert, L. (2013). Gender Mainstreaming and Resistance to Gender Training: A Framework for Studying Implementation. *NORA - Nordic Journal of Feminist and Gender Research*, *21*(4), 296–311. https://doi.org/10.1080/08038740.2013.851115

Lunardon, M., Cerni, T., & Rumiati, R. I. (2022). Numeracy Gender Gap in STEM Higher Education: The Role of Neuroticism and Math Anxiety. *Frontiers in Psychology*, *13*. https://www.frontiersin.org/articles/10.3389/fpsyg.2022.856405

Lundberg, S. (2020). Educational Gender Gaps. *Southern economic journal*, *87*(2), 416–439. https://doi.org/10.1002/soej.12460

Lv, B., Wang, J., Zheng, Y., Peng, X., & Ping, X. (2022). Gender differences in high school students' STEM career expectations: An analysis based on multi-group structural equation model. *JOURNAL OF RESEARCH IN SCIENCE TEACHING*, *59*(10), 1739–1764. https://doi.org/10.1002/tea.21772

Mari, M. A., & Müller, M.-L. (2023). Social cognition and Relevance: How stereotypes impact the processing of definite and indefinite descriptions. *Frontiers in Communication*, *8*. https://www.frontiersin.org/articles/10.3389/fcomm.2023.1088861

Master, A., & Meltzoff, A. (2020). Cultural Stereotypes and Sense of Belonging Contribute to Gender Gaps in STEM. *Science and Technology*, *12*, 47.

Meltzoff, A., & Cvencek, D. (2019). *How Stereotypes Shape Children's STEM Identity and Learning*. (pp. 37–47).

Micari, M., & Pazos, P. (2021). Beyond grades: Improving college students' social-cognitive outcomes in STEM through a collaborative learning environment. *Learning Environments Research*, *24*(1), 123–136. https://doi.org/10.1007/s10984-020-09325-y

Moè, A., Hausmann, M., & Hirnstein, M. (2021). Gender stereotypes and incremental beliefs in STEM and non-STEM students in three countries: Relationships with performance in cognitive tasks. *Psychological Research*, *85*(2), 554–567. https://doi.org/10.1007/s00426-019-01285-0

Moskos, M. (2020). Why is the gender revolution uneven and stalled? Gender essentialism and men's movement into 'women's work'. *Gender, Work & Organization*, *27*(4), 527–544. https://doi.org/10.1111/gwao.12406

Nix, S., Perez-Felkner, L., & Thomas, K. (2015). Perceived mathematical ability under challenge: A longitudinal perspective on sex segregation among STEM degree fields. *Frontiers in Psychology*, *6*, 530. https://doi.org/10.3389/fpsyg.2015.00530

OECD. (2021). *Education at a Glance 2021: OECD Indicators*. OECD. https://doi.org/10.1787/b35a14e5-en

OECD. (2022). *Report on the implementation of the OECD gender recommendations*. https://www.oecd.org/mcm/mcm-2022/Implementation-OECD-Gender-Recommendations.pdf

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UMCE
VICERRECTORIA ACADÉMICA.
DIRECCIÓN DE POSTGRADO
PROGRAMA DOCTORADO EN EDUCACIÓN

Perez-Felkner, L., Nix, S., & Thomas, K. (2017). Gendered Pathways: How Mathematics Ability Beliefs Shape Secondary and Postsecondary Course and Degree Field Choices. *Frontiers in Psychology*, *8*. https://www.frontiersin.org/article/10.3389/fpsyg.2017.00386

Peterson, H., & Jordansson, B. (2022). Gender mainstreaming in Swedish academia: Translating policy into practice. *Journal of Gender Studies*, *31*(1), 87–100. https://doi.org/10.1080/09589236.2021.2004539

Powell, S. (2018). Gender Equality in Academia: Intentions and Consequences. *The International Journal of Diversity in Organizations, Communities, and Nations: Annual Review*, *18*(1), 19–35. https://doi.org/10.18848/1447-9532/CGP/v18i01/19-35

Reidy, D. E., Baumler, E. R., & Temple, J. R. (2023). Sexual violence against sexual minority women in STEM: Compound backlash. *Social Science & Medicine*, *338*, 116366. https://doi.org/10.1016/j.socscimed.2023.116366

Rippon, G. (2019). *The Gendered Brain: The new neuroscience that shatters the myth of the female brain*. Bodley Head.

Rockinson-Szapkiw, A., & Wendt, J. L. (2020). The benefits and challenges of a blended peer mentoring program for women peer mentors in science, technology, engineering and mathematics (STEM). *International Journal of Mentoring and Coaching in Education*, *10*(1), 1–16. https://doi.org/10.1108/IJMCE-03-2020-0011

Scala, F., & Paterson, S. (2018). Stories from the Front Lines: Making Sense of Gender Mainstreaming in Canada. *Politics & Gender*, *14*(2), 208–234. https://doi.org/10.1017/S1743923X17000526

Schmader, T. (2023). Gender Inclusion and Fit in STEM. *Annual Review of Psychology*, *74*(Volume 74, 2023), 219–243. https://doi.org/10.1146/annurev-psych-032720-043052

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, 101832. https://doi.org/10.1016/j.cedpsych.2019.101832

Sczesny, S., Nater, C., & Eagly, A. (2019). *Agency and communion: Their implications for gender stereotypes and gender identities* (pp. 103–116). https://doi.org/10.4324/9780203703663-9

Spence, J. T. (1993). Gender-related traits and gender ideology: Evidence for a multifactorial theory. *Journal of Personality and Social Psychology*, *64*(4), 624–635. https://doi.org/10.1037//0022-3514.64.4.624

Stearns, E., Bottia, M. C., Giersch, J., Mickelson, R. A., Moller, S., Jha, N., & Dancy, M. (2020). Do Relative Advantages in STEM Grades Explain the Gender Gap in Selection of a STEM Major in College? A Multimethod Answer. *American Educational Research Journal*, *57*(1), 218–257. https://doi.org/10.3102/0002831219853533

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, *69*(5), 797–811. https://doi.org/10.1037/0022-3514.69.5.797

Tajfel, H., & Turner, J. C. (1979). An Integrative Theory of Intergroup Conflict | ALNAP. En *The social psychology of intergroup relations* (pp. 33–37). Brooks/Cole. https://www.alnap.org/help-library/an-integrative-theory-of-intergroup-conflict

Tajfel, H., & Turner, J. C. (2004). *The Social Identity Theory of Intergroup Behavior* (p. 293). Psychology Press. https://doi.org/10.4324/9780203505984-16

Tandrayen-Ragoobur, V., & Gokulsing, D. (2021). Gender gap in STEM education and career choices: What matters? *Journal of Applied Research in Higher Education*, *14*(3), 1021–1040. https://doi.org/10.1108/JARHE-09-2019-0235

Tarkovska, V., Gabaldon, P., & Ratiu, R. V. (2023). The importance of a critical mass of women on boards to reduce the gender pay disparity among non-executive directors. *Gender in Management: An International Journal*, *38*(6), 821–840. https://doi.org/10.1108/GM-12-2021-0386

Tatar, C. F., Tatar, M. I., Penzes, J., & White, G. W. (2023). How Gender, Culture, and Economy Influence Field of Study Preferences in Higher Education: Exploring Gender Gaps in STEM, AHSS, and Medicine among International Students. *SUSTAINABILITY*, *15*(22), 15820. https://doi.org/10.3390/su152215820

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VICERRECTORIA ACADÉMICA.
DIRECCIÓN DE POSTGRADO
PROGRAMA DOCTORADO EN EDUCACIÓN

Tey, T. C. Y., Moses, P., & Cheah, P. K. (2024). The influence of gender on STEM career choice: A partial least squares analysis. *Research and Practice in Technology Enhanced Learning*, *19*, 025–025. https://doi.org/10.58459/rptel.2024.19025

Turner, S. L., McWhirter, E. H., Lee, H., Mason-Chagil, G., Smith, S., Jacobs, S. C., & Jackson, A. P. (2022). Barriers to STEM Efficacy and Outcome Expectations Among Native American College Students. *The Counseling Psychologist*, *50*(7), 981–1008. https://doi.org/10.1177/00110000221108454

UNESCO. (2024). *Global education monitoring report 2024, gender report: Technology on her terms*. https://doi.org/10.54676/WVCF2762

Woo, H., Heo, N., Jang, H., & Jang, Y. (2023). Parental and school factors on American high school students' academic and career intentions in STEM fields. *International Journal for Educational and Vocational Guidance*, *23*(1), 19–42. https://doi.org/10.1007/s10775-021-09498-9

World Economic Forum. (2024). *Global Gender Gap 2024. Insight Report.* https://www.weforum.org/publications/global-gender-gap-report-2024/digest/

Zoom Video Communications. (2024). *Zoom (Version 5.13.0)* [Software]. https://zoom.us/

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Supplementary Material

Table 1

Profiles of Study Participants.

Pseudonym	Occupation	Years of Experience	Education
Beatriz	University Director of Gender and Diversity	5+ years	Master of Communication Sciences
Karla	University Director of Gender and Diversity	5+ years	Master of Sociology
Mariana	University Director of Gender and Diversity	5+ years	Ph.D. in Psychology
Lily	University Director of Gender and Diversity	5+ years	Ph.D. in Psychology
Paula	University Director of Gender and Diversity	5+ years	Ph.D. in Psychology
Ana	University Director of Gender and Diversity	5+ years	Ph.D. in Psychology
Danielle	STEM Project Director	5+ years	Ph.D. in Neuroscience
Amanda	Gender and Collective Intelligence Researcher	5+ years	Ph.D. in Psychology
Marcela	Mental Health Researcher	5+ years	Ph.D. in Engineering
Victoria	Mental Health Researcher	5+ years	Master of Education
Carolina	Mental Health Researcher	5+ years	Master of Neuroscience
Rocío	Mental Health Researcher	5+ years	Ph.D. in Neuroscience
Constanza	Researcher in Gender and Social Sciences	5+ years	Ph.D. in Psychology
Antonia	Researcher in Gender and Social Sciences	5+ years	Ph.D. in Psychology
Carmen	Researcher in Gender and Social Sciences	5+ years	Ph.D. in Psychology
Cristina	STEM and Collective Intelligence Researcher	5+ years	Ph.D. in Psychology
Tess	STEM Researcher	5+ years	Ph.D. in Mathematics
María	STEM Researcher	5+ years	Ph.D. in Mathematics
Sonia	STEM Researcher	5+ years	Ph.D. in Physics
Carla	STEM Researcher	5+ years	Ph.D. in Education
Alicia	STEM Researcher	5+ years	Ph.D. in Education
Paulina	STEM Researcher	5+ years	Ph.D. in Biochemistry
Muriel	STEM Researcher	5+ years	Ph.D. in Physics
Marianela	STEM Researcher	5+ years	Ph.D. in Psychology
Ana	STEM Researcher	5+ years	Ph.D. in Psychology
Gracie	STEM Researcher	5+ years	Ph.D. in Psychology
Zoe	STEM Researcher	5+ years	Master of Sociology
Marta	STEM Researcher	5+ years	Master of Sociology
Lucía	STEM Researcher	5+ years	Master of Psychologist
Karin	STEM Researcher	5+ years	Master of Psychologist

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Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education.

***Peer Review

Beroíza-Valenzuela; Salas-Guzmán and Huepe-Artigas.

Abstract

Introduction: Gender stereotypes considerably influence human behavior, creating gaps between men and women in higher education. Society faces the challenge of preventing the loss of human talent in Science, Technology, Engineering, and Mathematics (STEM) disciplines and Social Sciences and Humanities (SSH). However, it remains unclear which factors influence the gender gap that may hinder attracting and retaining female talent in these fields. This research aimed to develop and validate an instrument, the 'Assessing Gender Gap Factors in Higher Education' (FACT-GÉN), to identify and measure the factors influencing the gender gap.

Method: This study employed an instrumental design to develop and validate the 'Assessing Gender Gap Factors in Higher Education' (FACT-GÉN) instrument. Using a cross-sectional quantitative approach, data were collected from 851 students across STEM and SSH disciplines to ensure the instrument's reliability and validity through confirmatory factor analysis (CFA).

Results: The model demonstrated a good fit to the data, with indices such as CFI (0.911), TLI (0.894), and RMSEA (0.049), supporting its validity. The scaled chi-square difference test confirmed the adjusted model's superiority over the null model (χ^2_diff(4) = 30.805, $p < 0.001$). Internal consistency was acceptable, with Cronbach's alpha ranging from 0.62 to 0.78, and McDonald's omega from 0.69 to 0.80. The strong factor loadings and significant correlations between the latent factors validated the model's structure, making it a reliable tool for addressing the gender gap in academic fields.

Discussion: The validated instrument offers valuable data for research and policy, aiding efforts to mitigate the gender gap and promote equity in academia. This study highlights the instrument's effectiveness in identifying barriers and formulating solutions for gender equality, filling a critical gap with a reliable tool for addressing the gender gap in higher education.

Keywords: gender gap, psychometric instrument, higher education, critical factors, educational interventions, gender policies.

The challenges of mental health in Chilean university students.

***Publicado

Beroíza-Valenzuela.

Abstract

Introduction: Mental health has emerged as a critical issue in Chile, particularly in the aftermath of the sociopolitical crisis of 2019 and the subsequent COVID-19 pandemic. These events have intensified the prevalence of mental health disorders, with over 20% of Chilean adolescents suffering from conditions such as anxiety, depression, and stress. University students are especially vulnerable due to the heightened academic pressures and the adoption of behaviors that can detrimentally impact both physical and mental health. Gender differences in the experience and manifestation of these mental health challenges are significant, underscoring the need for targeted interventions.

Method: This study adopts a reflective essayistic approach, drawing on an extensive analysis of existing literature and current mental health policies. The aim is to critically explore the mental health challenges faced by university students in Chile, focusing on how recent social and public health crises have shaped these issues.

Results: The analysis reveals that the mental health of university students in Chile is significantly impacted by the pressures associated with academic life, which the COVID-19 pandemic has further aggravated. Notably, there are evident gender disparities in how these pressures are experienced and their subsequent effects on mental health. The findings highlight a critical need for developing targeted policies and programs that address these specific mental health challenges and provide adequate support for university students.

Discussion: The discussion underscores the urgency of formulating and implementing policies specifically tailored to university students' mental health needs. Given the significant gender differences observed and the impact of recent crises, these policies must be responsive and inclusive. The findings call for a proactive approach to mental health in higher education that addresses the immediate needs of students and fosters a sustainable and supportive academic environment.

Keywords: Mental health, higher education, gender differences, academic environment, psychological well-being.

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The challenges of mental health in Chilean university students

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Mental health is a crucial issue in Chile and worldwide, gaining even more relevance following social events in Chile in 2019, including the sociopolitical crisis and the COVID-19 pandemic. In Chile, over 20% of adolescents experience mental health problems such as anxiety, depression, and stress, with many going untreated due to limited access or the stigma associated with these issues. The COVID-19 pandemic has exacerbated this situation, with a 25% increase in the prevalence of anxiety and depression. The university population is particularly vulnerable to mental health challenges due to the unique pressures of the academic environment, including increased academic demands and the acquisition of university-related behaviors that can negatively impact physical and mental health, with notable gender differences. Effectively addressing these issues is essential for ensuring the emotional and psychological well-being of university students. Specific policies and programs are needed to address the mental health needs of university adolescents and ensure that they have access to mental health services required to navigate the challenges of daily life. A methodology reflective of the essayistic approach guides this exploration, which is characterized by critical reflection and structured argumentation.

KEYWORDS

mental health, adolescence, social determinants, gender differences, COVID-19

Introduction

The mental health is a crucial aspect of overall well-being, as acknowledged by researchers such as Chong et al. (1) and Ramsey et al. (2). In recent years, Chile has placed increasing emphasis on this issue, particularly in light of the sociopolitical crisis of 2019 (3) and the COVID-19 pandemic (4). The pandemic has underscored the significance of mental health and highlighted the need for specialized services worldwide (5). In Chile, mental health poses a significant challenge that impacts numerous individuals and communities nationwide, necessitating attention to ensure the emotional and psychological well-being (6). To address this issue comprehensively, it is crucial to understand the prevailing mental health challenges in Chile and to actively seek solutions to mitigate them. This entails recognizing the multifaceted nature of mental health issues, as well as acknowledging the unique sociocultural factors that contribute to their complexity in the Chilean context. By investigating the root causes and examining the specific challenges faced by diverse demographic groups, customized interventions and support systems can be developed.

The number of mental health-related claims has clearly increased in Chile (7, 8), this is compounded by the fact that the Agenda 2030, in its Sustainable Development Goal (SDG) number 3, stipulates that states must promote actions focused on the mental health and well-being of the population. (9). In this context, according to the "The Sustainable Development Goals Report 2022" regarding the progress of SDG 3, it highlights an increase in the prevalence

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of conditions such as anxiety and depression, with an up to 25% rise following the COVID-19 pandemic. In this regard, member countries are urged to take actions and allocate resources to mitigate this issue (10), as it affects the mobility of human capital for the progress and sustainable development of nations.

The university stage is a critical period in students' developmental journey (11). During this time, university students are considered a psychologically vulnerable population as they assume new responsibilities and adapt to new environments and teaching styles (12–16). The increased academic demands, adherence to schedules, and engagement in risky behaviors such as the use of caffeine, tobacco, and alcohol (17, 18), contribute to the deterioration of both physical and mental health (19).

The academic environment is widely recognized as a significant stressor for university students (20). This acknowledgement is based on a complex array of obstacles that students encounter as they progress through their academic journey. The intense competition, demanding coursework, and relentless pressure to achieve academic excellence contribute to an environment where stress is omnipresent (21, 22). Academic stressors are multifaceted and encompass factors such as challenging assignments, tight deadlines, and expectations of maintaining high grades. These stressors can result in the development of mental health problems including depression, anxiety, and stress symptoms (23). The competitive nature of academic settings often leaves students struggling to meet high expectations, both self-imposed and external. Consequently, the pursuit of academic excellence can inadvertently foster a culture of perfectionism, where fear of failure and the constant need for validation create an environment that exacerbates mental health challenges.

There is a trend among college students to avoid seeking psychological assistance, a phenomenon that might be influenced by cultural beliefs surrounding psychotherapy and psychological factors such as expectations (24, 25). Students' reluctance to seek mental health support can be linked to cultural norms that stigmatize discussions on mental health or therapy. In certain cultural contexts, some individuals may believe that seeking help for mental health concerns signifies a lack of strength or failure to cope (26). The societal stigma surrounding mental health problems may discourage students from openly acknowledging their struggles or seeking professional support (27). Additionally, students' personal expectations and perceptions of their mental well-being can significantly influence their willingness to seek assistance. Some students may have overly optimistic views of themselves, believing that they should be able to handle all aspects of their lives without outside help (28). This self-imposed pressure not to seek help can be exacerbated by fear of judgment or concerns about how seeking psychological support might be perceived by others (29). These factors could lead to worsening psychological situations by not receiving timely support in the early stages, where it is possible to prevent, intervene, and address mental health concerns (30). Furthermore, most students and the educational community are unfamiliar with healthy living standards, which can negatively affect the psychological and physical health of members.

In the academic environment, significant dissimilarities exist in mental health symptomatology between men and women (31). Moreover, there are disparities in the inclination of men and women to seek professional assistance for mental health issues (32). This may be due to adherence to specific traits such as emotional control, self-sufficiency, dominance, masculine rigidity, and resistance to attributes considered feminine (33, 34). Recognizing and understanding these gender-specific dynamics is crucial for devising targeted interventions that acknowledge the unique needs and challenges faced by male and female students. Failure to consider these nuances may result in the development of interventions that do not effectively address the diverse mental health experiences within the university population. For instance, international studies indicate a gender gap in mental health, with a higher prevalence of mental health issues among women (35, 36). Similarly, this trend was observed in Chile, where studies have shown an increase in psychological distress in women during the pandemic, including anxiety, depression, and stress (37), Research has also found a higher prevalence of depressive symptoms in women (23.2%) than in men (13.4%). This, combined with low social support and stressful life events, constitutes the combined effect of socioeconomic and gender inequalities (38). Regrettably, little is known about the extent to which the gender gap affects these figures, even though it shapes individual and social behaviors. Therefore, it is essential to study these issues to understand the phenomenon and encourage the government to formulate public policies that contribute to the well-being of individuals, enabling them to develop their competencies and skills optimally.

Among the numerous challenges university students encounter, mental health issues are among the most prevalent, with studies indicating a rate of 20–30% of students experience such difficulties, particularly depression and anxiety disorders (39, 40). Furthermore, these rates are even higher among individuals from lower socioeconomic backgrounds (41). It is important to note that these statistics were obtained prior to the COVID-19 pandemic, which has likely exacerbated the situation and further strained the resources of student affairs offices. To develop effective prevention and treatment policies, it is crucial to consider the unique needs of the community.

Among the many challenges faced by university students, it is noteworthy that approximately one in five students experience suicidal ideation and one in 15 have attempted suicide (42). Moreover, these figures are expected to have increased since then. Furthermore, substance abuse exacerbates these conditions, adding another layer of complexity to the situation. Substance abuse is often viewed as part of university culture (43), with over half of the students reporting the use of alcohol and drugs (44). Given that these factors contribute to increased mental health symptoms (45, 46), it is crucial to develop tailored management and prevention programs. Additionally, academic stress is a significant factor in the university context that affects students' mental health. The primary sources of stress include academic workload and the amount of time dedicated to studying (47). Importantly, this factor exacerbates eating disorders and substance abuse (48). These four elements are critical for understanding the areas in which intervention is necessary for higher education institutions to address the mental health challenges faced by students.

The purpose of this essay was to examine the mental well-being of university students in Chile and explore the influence of the COVID-19 pandemic, gender disparities, and the resumption of in-person education on their mental health. This analysis highlights the significance of addressing this issue for the country's socioeconomic

progress, as higher education is vital for social mobility and the development of sophisticated human resources. This work presents a perspective in this field, considering the sociopolitical implications and the post-pandemic context. Moreover, specific recommendations are suggested for establishing a healthy environment for university students. The methodology used in this study adheres to the characteristics of an essay that entails critical reflection and structured argumentation. To substantiate these arguments, a comprehensive review of pertinent literature was conducted. The essay also encourages dialog and exploration of diverse viewpoints, reflecting the discursive nature of this literary form.

Sociopolitical considerations of mental health in university adolescence

The legislation in Chile regarding the mental health of university adolescents is guided by the Mental Health Plan, which aims to ensure the right to mental health protection and promote psychological and social well-being across the lifespan through the prevention, promotion, treatment, and rehabilitation of individuals with mental disorders (Ministerio (49)). Additionally, this legislation is supported by the Higher Education Law, which includes regulations for promoting a safe and healthy environment for students as well as supporting mental health promotion programs in university institutions (50).

The lack of a dedicated institution to address adolescent mental health concerns can have detrimental consequences for the overall welfare of young individuals. Given the psychological ramifications of the pandemic on the population, it is vital to underscore the absence of a clear political plan to address this urgent social need, given the psychological ramifications of the COVID-19 pandemic on the population (51). It is imperative for the state and society as a whole to assume responsibility for comprehensively addressing this issue and catering to the specific requirements of adolescents.

Coordinated political action is essential to ensure access to mental healthcare services for adolescents across the nation. Various social determinants can impact mental health, including demographic factors, such as gender, ethnicity, and age gaps, as well as economic aspects, such as poverty, insecurity, and job precariousness. Additionally, support networks in the neighborhood environment, such as social cohesion, violence, and the quality of infrastructure, can also play a significant role, as can elements linked to climatic events and social and cultural aspects such as education, social cohesion, social capital, culture, and social class (52, 53). Mental health issues can be explained by variability in living conditions, many of which result from social inequities (54). Therefore, intersectoral coordination is necessary to ensure universal protection as a regulatory right framework.

Post-COVID-19 pandemic: diagnosis of mental health in Chilean university students

The global mental Health Post-Coronavirus Pandemic is an issue that affects various population groups. According to an international study conducted by researchers from the Queensland Mental Health Research Center in the United States and published in the esteemed journal The Lancet, depressive disorders experienced an increase of 27.6%. The prevalence of depressive disorders among women was higher (29.8%) than that among men (24.0%). Similarly, women have experienced a higher increase in the prevalence of anxiety disorders (27.9%) than men (21.7%) (55). The study conducted by researchers at Boston University and published in the Journal of Affective Disorders between 2013 and 2020 revealed sex differences in relation to clinical cases of mental health. The researchers found that depression increased by almost 135% over 8 years, while anxiety increased by 110%. Furthermore, during the peak years of the pandemic–2020-2021, the prevalence of mental health problems increased by 60% (56).

Various international studies have reported an increase in mental health disorders among university students who, due to the pandemic, experience high levels of anxiety and depression (57, 58), suicidal ideation (59, 60), stress, fear (61), emotional, learning, financial, social, and technological impacts (62), changes in eating habits, sleep, lifestyle, and behavior (63), and nightmares (64). These factors impair academic performance (65). Studies indicate that women have reported worse mental health than men (66), highlighting gender differences in mental health, which is a matter of great concern, as it does not contribute to the overall well-being of women and hinders their emotional and social progress and development (67).

Data for the year 2022 in Chile revealed a significant deterioration in mental well-being. The prevalence of mental health issues increased by 21.1% compared to the previous year, with generalized anxiety disorders increasing by 27.5% in both men and women but at a higher rate among women (36.6%). Depression, however, saw an increase of 16.4%, and women once again experienced a higher prevalence of 22.4% (68). Studies conducted before the COVID-19 pandemic suggested that mental health disorders in university students could be more complex than those in the general population (12, 69). These issues in the university population contribute significantly to the global burden of disease and can impede young individuals' ability to complete age-relevant tasks during critical periods of their development (70), This period is considered complex in terms of identity exploration (71, 72).

A 2018 study conducted at three universities belonging to the Council of Rectors revealed a distressing situation, with over 45% of clinical cases involving depression, anxiety, and stress frequently presenting in a comorbid state. Women in this study had higher levels of anxiety and stress. Approximately 5% of university students reported suicidal ideation and 14% exhibited risky eating behaviors, with a higher prevalence among women. Additionally, 50% of the participants reported symptoms of insomnia, while 42% experienced daytime hypersomnia (17).

In light of the pandemic, a study carried out in September 2020 among students at the University of Los Andes revealed a substantial prevalence of mental health clinical conditions, with alarming rates of stress (54.6%), anxiety (37.9%), depression (37.1%), and suicide risk (20.4%) (73). These findings underscore the need for a comprehensive examination of clinical symptoms associated with mental health disorders in university students.

However, merely identifying the frequency and severity of these symptoms is insufficient for developing tailored intervention strategies. In addition to eating disorders, self-destructive behaviors, problematic substance use, and academic stress (74), there are affective and social spaces that serve as protective factors or early indicators that must be considered. For instance, assessing the positive and negative affect of students can provide valuable information about whether they engage in rewarding and energetic experiences or struggle with an unpleasant and distressing sense of participation (75). While this in and of itself is not a problem, a high presence of negative affect is evidence of a contextual issue within the university community that needs to be addressed before these affects evolve or contribute to the emergence of severe symptomatology.

Discussion

The mental health of college students is a significant issue in the contemporary society. During the transitional period between childhood and adulthood, young people undergo both physical and emotional changes, which can lead to the development of mental disorders that can affect their well-being and future prospects (76). To undertake this issue, it is crucial to establish strategies for the prevention, detection, and early treatment of these disorders. Failure to do so may result in negative consequences for the lives of adolescents nationwide. Maintaining good mental health involves developing mental health literacy; adopting a positive attitude toward mental disorders; cultivating self-perception and values that promote a meaningful life; developing cognitive skills for decision-making and problem-solving; demonstrating adaptability; focusing on emotional states, behaviors, and self-management strategies; developing social skills; maintaining physical and sexual health; nurturing family and meaningful relationships; possessing a sense of purpose in life; and achieving a good quality of life (77). These domains can serve as a foundation for standardizing future public policy actions to promote good mental health.

One of the main obstacles hindering the resolution of adolescent mental health issues is the social stigma associated with mental disorders, as evidenced by Gerlinger et al. (78) and Haugen et al. (79). Often, these young individuals shy away from seeking help because of fear of rejection or stigmatization. Therefore, fostering a culture of respect and acceptance for those affected by mental illness is of utmost importance. It is essential that adolescents realize that they are not alone, and that resources and professionals are available to assist them.

Education is a vital factor for adolescents' emotional well-being. It is crucial to teach young individuals essential emotional skills from a tender age to enable them to manage their emotions in a healthy manner. Moreover, incorporating mental disorder prevention programs in universities and equipping teachers with the ability to detect possible mental health issues are essential. Accessible and affordable mental healthcare services for all adolescents are also necessary. For this, community engagement is necessary to ensure access to mental healthcare services and to implement measures focused on this area (80, 81). Such initiatives promote a culture of respect and acceptance, while providing accessible education and resources for all young people, allowing them to lead a fulfilling and satisfying life. To address these challenges, a comprehensive and collaborative response that involves multiple stakeholders is necessary. Convincing evidence indicates that policymaking at all levels of government and across all sectors can significantly impact mental health outcomes, emphasizing the importance of inter-sectoral work.

The present investigation comprehensively explored the mental health of university students in Chile. This is a critical component of overall well-being. Despite the limitations imposed by the essay format on the research methodology, it is essential to explore the importance of addressing students' mental health and engaging in extensive discourse on the subject. This would facilitate a deeper understanding of the issue, although the study relied on subjective interpretations and critical evaluations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

FB-V: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

1. Chong YY, Frey E, Chien WT, Cheng HY, Gloster AT. The role of psychological flexibility in the relationships between burnout, job satisfaction, and mental health among nurses in combatting COVID-19: a two-region survey. *J Nurs Scholarsh*. (2023) 55:1068–81. doi: 10.1111/jnu.12874

2. Ramsey N, Obeidallah M, Abraham A. Impact of COVID-19 on adolescent health and use of social media. *Curr Opin Pediatr*. (2023) 35:362–7. doi: 10.1097/MOP.0000000000001248

3. Montenegro MC, Ramírez AC, Hernandez Rodriguez J, Villalobos BT, Garrido G, Amigo C, et al. Where I am from matters: factors influencing behavioral and emotional changes in autistic individuals during COVID-19 in Latin America. *Front Psych*. (2023) 14. doi: 10.3389/fpsyt.2023.1283326

4. Borrescio-Higa F, Droller F, Valenzuela P. Financial distress and psychological well-being during the COVID-19 pandemic. *Int J Public Health*. (2022) 67:1604591. doi: 10.3389/ijph.2022.1604591

5. Witteveen D, Velthorst E. Economic hardship and mental health complaints during COVID-19. *Proc Natl Acad Sci USA*. (2020) 117:27277–84. doi: 10.1073/pnas.2009609117

6. Varela JJ, Sánchez PA, Aguayo F, González C, Alfaro J, De Tezanos-Pinto P. Gender attitudes, school violence and well-being among Chilean adolescents. *Curr Psychol*. (2022) 42:14107–21. doi: 10.1007/s12144-021-02637-z

7. Superintendencia de Seguridad Social. (2015). *Estadísticas de Seguridad Social*. Available at: https://www.suseso.cl/607/w3-article-19040.html

8. Superintendencia de Seguridad Social. (2018). *Estadísticas de la Seguridad Social 2018*. Available at: https://www.suseso.cl/607/w3-article-578398.html

9. United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. Available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/89/PDF/N1529189.pdf?OpenElement

10. United Nations. (2022). *The Sustainable Development Goals Report 2022*. Available at: https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf

11. Hinrichs C. P., Ortiz L. E., and Pérez C. E.. Relación entre el Bienestar Académico de Estudiantes de Kinesiología de una Universidad Tradicional de Chile y su Percepción del Ambiente Educacional. *Formación universitaria*. (2016) 9, 109–116. doi: 10.4067/S0718-50062016000100012

12. Antúnez Z, Vinet EV. Problemas de salud mental en estudiantes de una universidad regional chilena. *Rev Med Chile*. (2013) 141:209–16. doi: 10.4067/S0034-98872013000200010

13. Arnett JJ, Žukauskienė R, Sugimura K. The new life stage of emerging adulthood at ages 18-29 years: implications for mental health. *Lancet Psychiatry*. (2014) 1:569–76. doi: 10.1016/S2215-0366(14)00080-7

14. Barrera-Herrera A, Vinet EV. Adultez Emergente y características culturales de la etapa en universitarios chilenos. *Terapia psicológica*. (2017) 35:47–56. doi: 10.4067/S0718-48082017000100005

15. Carrillo-Mora P, Ramírez-Peris J, Magaña-Vázquez K. Sleep neurobiology and its importance: anthology for the university student. *Revista de la Facultad de Medicina UNAM*. (2013) 56:5–15.

16. Jensen Arnett J. Socialization in emerging adulthood: from the family to the wider world, from socialization to self-socialization. In: *handbook of socialization: theory and research*. Eds. J. E. Grusec and P. D. Hastings. *2nd* ed: The Guilford Press (2015). 85–108.

17. Barrera-Herrera A, San Martín Y, Barrera-Herrera A, San Martín Y. Prevalencia de Sintomatología de Salud Mental y Hábitos de Salud en una Muestra de Universitarios Chilenos. *Psykhe*. (2021) 30:1–16. doi: 10.7764/psykhe.2019.21813

18. Bastías Arriagada EM, Stiepovich Bertoni J. UNA REVISIÓN DE LOS ESTILOS DE VIDA DE ESTUDIANTES UNIVERSITARIOS IBEROAMERICANOS. *Ciencia y enfermería*. (2014) 20:93–101. doi: 10.4067/S0717-95532014000200010

19. Portilla-Maya S, Dussán-Lubert C, Montoya Londoño D, Taborda-Chaurra J, Nieto-Osorio L. Calidad de sueño y somnolencia diurna excesiva en estudiantes universitarios de diferentes dominios. *Hacia la Promoción de la Salud*. (2019) 24:84–96. doi: 10.17151/hpsal.2019.24.1.8

20. Yu Y. Academic success: Don't forget our mental health. *Lancet Child Adolescent Health*. (2024) 8:14–6. doi: 10.1016/S2352-4642(23)00325-5

21. Mofatteh M. Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*. (2021) 8:36–65. doi: 10.3934/publichealth.2021004

22. Sun N, Liu W, Zheng Z. Campus outdoor environment, learning engagement, and the mental health of college students during the COVID-19 pandemic: from the perspective of students in different grades. *Front Public Health*. (2023) 11:1143635. doi: 10.3389/fpubh.2023.1143635

23. Clough BA, Nazareth SM, Day JJ, Casey LM. A comparison of mental health literacy, attitudes, and help-seeking intentions among domestic and international tertiary students. *British J. Guidance Counsel*. (2019) 47:123–35. doi: 10.1080/03069885.2018.1459473

24. Chan KKS, Tsui JKC. Longitudinal impact of experienced discrimination on mental health among people with mental disorders. *Psychiatry Res*. (2023) 322:115099. doi: 10.1016/j.psychres.2023.115099

25. Rayan A, Fawaz M. Cultural misconceptions and public stigma against mental illness among Lebanese university students. *Perspect Psychiatr Care*. (2018) 54:258–65. doi: 10.1111/ppc.12232

26. Kantar A, Yalçın İ. Masculine gender role stress and attitudes towards seeking psychological help: serial mediation by self-stigma and self-compassion. *Curr Psychol*. (2023). doi: 10.1007/s12144-023-04702-1

27. Song N, Hugh-Jones S, West RM, Pickavance J, Mir G. The effectiveness of anti-stigma interventions for reducing mental health stigma in young people: a systematic review and meta-analysis. *Cambridge Prisms*. (2023) 10:e39. doi: 10.1017/gmh.2023.34

28. El-Hachem SS, Lakkis NA, Osman MH, Issa HG, Beshara RY. University students' intentions to seek psychological counseling, attitudes toward seeking psychological help, and stigma. *Soc Psychiatry Psychiatr Epidemiol*. (2023) 58:1661–74. doi: 10.1007/s00127-023-02470-8

29. Dagani J, Buizza C, Ferrari C, Ghilardi A. The role of psychological distress, stigma and coping strategies on help-seeking intentions in a sample of Italian college students. *BMC Psychol*. (2023) 11:177. doi: 10.1186/s40359-023-01171-w

30. Cogan NA, Liu X, Chin-Van Chau Y, Kelly SW, Anderson T, Flynn C, et al. The taboo of mental health problems, stigma and fear of disclosure among Asian international students: implications for help-seeking, guidance and support. *British J. Guidance Counsel*. (2023):1–19. doi: 10.1080/03069885.2023.2214307

31. Sagar-Ouriaghli I, Godfrey E, Tailor V, Brown JSL. Improving mental health help-seeking among male university students: a series of gender-sensitive mental health feasibility interventions. *Am J Mens Health*. (2023) 17:15579883231163728. doi: 10.1177/15579883231163728

32. Haavik L, Joa I, Hatloy K, Stain HJ, Langeveld J. Help seeking for mental health problems in an adolescent population: the effect of gender. *J Ment Health*. (2019) 28:467–74. doi: 10.1080/09638237.2017.1340630

33. Sileo KM, Kershaw TS. Dimensions of masculine norms, depression, and mental health service utilization: results from a prospective cohort study among emerging adult men in the United States. *Am J Mens Health*. (2020) 14:1557988320906980. doi: 10.1177/1557988320906980

34. Wang C, Havewala M, Fan Q, Wang Q, Bali D. The relations between COVID-19 stress, social connectedness, and mental health: a longitudinal investigation comparing Chinese and American college students. *Curr Psychol*. (2023):1–14. doi: 10.1007/s12144-023-04290-0

35. Churchill SA, Munyanyi ME, Prakash K, Smyth R. Locus of control and the gender gap in mental health. *J Econ Behav Organ*. (2020) 178:740–58. doi: 10.1016/j.jebo.2020.08.013

36. Dengate J, Peter T, Farenhorst A. Gender and the faculty care gap: "the obvious go-to person" for Canadian university students' personal problems. *Can J High Educ*. (2019) 49:104–14. doi: 10.47678/cjhe.v49i3.188311

37. Duarte F, Jiménez-Molina Á. A longitudinal Nationwide study of psychological distress during the COVID-19 pandemic in Chile. *Front Psych*. (2022) 13:744204. doi: 10.3389/fpsyt.2022.744204

38. Jimenez-Molina A, Reyes P, Rojas G. Socioeconomic determinants and gender gaps in depressive symptoms in Chile. *Revista Medica De Chile*. (2021) 149:533–42. doi: 10.4067/s0034-98872021000400533

39. Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, et al. Mental disorders among college students in the World Health Organization world mental health surveys. *Psychol Med*. (2016) 46:2955–70. doi: 10.1017/S0033291716001665

40. Auerbach RP, Mortier P, Bruffaerts R, Alonso J, Benjet C, Cuijpers P, et al. WHO world mental health surveys international college student project: prevalence and distribution of mental disorders. *J Abnorm Psychol*. (2018) 127:623–38. doi: 10.1037/abn0000362

41. Knifton L, Inglis G. Poverty and mental health: policy, practice and research implications. *BJPsych Bulletin*. (2020) 44:193–6. doi: 10.1192/bjb.2020.78

42. Cova Solar F, Alvial S W, Aro D M, Bonifetti D A, Hernández M M, Rodríguez C C. Problemas de Salud Mental en Estudiantes de la Universidad de Concepción. *Terapia psicológica*. (2007) 25:105–12. doi: 10.4067/S0718-48082007000200001

43. Sepúlveda MJ, Roa J, Muñoz M. Estudio cuantitativo del consumo de drogas y factores sociodemográficos asociados en estudiantes de una universidad tradicional chilena. *Rev Med Chile*. (2011) 139:856–63. doi: 10.4067/S0034-98872011000700005

44. SENDA. (2019). *Primer estudio de drogas en educación superior*. Ministerio del Interior y Seguridad Pública del Gobierno de Chile. Available at: https://www.senda.gob.cl/wpcontent/uploads/2019/05/2019_05_23_PPT_Ed_SuperiorEstudiosOK.pdf

45. Fooladi N, Jirdehi R, Mohtasham-Amiri Z. Comparison of depression, anxiety, stress and quality of life in drug abusers with Normal subjects. *Procedia Soc Behav Sci*. (2014) 159:712–7. doi: 10.1016/j.sbspro.2014.12.459

46. Krill PR, Johnson R, Albert L. The prevalence of substance use and other mental health concerns among American attorneys. *J Addict Med*. (2016) 10:46–52. doi: 10.1097/ADM.0000000000000182

47. Micin S, Bagladi V. Salud Mental en Estudiantes Universitarios: Incidencia de Psicopatología y Antecedentes de Conducta Suicida en Población que Acude a un Servicio de Salud Estudiantil. *Terapia psicológica*. (2011) 29:53–64. doi: 10.4067/S0718-48082011000100006

48. Barker ET, Howard AL, Villemaire-Krajden R, Galambos NL. The rise and fall of depressive symptoms and academic stress in two samples of university students. *J Youth Adolesc.* (2018) 47:1252–66. doi: 10.1007/s10964-018-0822-9

49. Ministerio de Salud. (2017). *Plan Nacional de Salud Mental (2017–2025).* Available at: https://www.minsal.cl/wp-content/uploads/2017/12/PDF-PLAN-NACIONAL-SALUD-MENTAL-2017-A-2025.-7-dic-2017.pdf

50. Ministerio de Educación. (2018). *Ley 21091.* Available at: https://www.bcn.cl/leychile/navegar?idNorma=1118991

51. Quijada Y, Villagrán L, Vaccari Jiménez P, Reyes C, Gallardo LD. Social inequality and mental health in Chile, Ecuador, and Colombia. *Lat Am Perspect.* (2019) 46:92–108. doi: 10.1177/0094582X18803682

52. Lund C, Brooke-Sumner C, Baingana F, Baron EC, Breuer E, Chandra P, et al. Social determinants of mental disorders and the sustainable development goals: a systematic review of reviews. *Lancet Psychiatry.* (2018) 5:357–69. doi: 10.1016/S2215-0366(18)30060-9

53. Lund C., Stansfeld S., Silva M. D. (2013). Social Determinants of Mental Health, Global Mental Health: Principles and Practice, Eds. V. Patel, H. Minas, A. Cohen, and M. Prince. Oxford University Press. 116–136.

54. Alegría M, NeMoyer A, Falgas I, Wang Y, Alvarez K. Social determinants of mental health: where we are and where we need to go. *Curr Psychiatry Rep.* (2018) 20:95. doi: 10.1007/s11920-018-0969-9

55. Santomauro DF, Herrera AMM, Shadid J, Zheng P, Ashbaugh C, Pigott DM, et al. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet.* (2021) 398:1700–12. doi: 10.1016/S0140-6736(21)02143-7

56. Lipson SK, Zhou S, Abelson S, Heinze J, Jirsa M, Morigney J, et al. Trends in college student mental health and help-seeking by race/ethnicity: findings from the national healthy minds study, 2013–2021. *J Affect Disord.* (2022) 306:138–47. doi: 10.1016/j.jad.2022.03.038

57. Ghanim M, Rabayaa M, Atout S, Al-Othman N, Alqub M. Prevalence of anxiety and depression among Palestinian university students: a cross-sectional study during COVID-19 pandemic. *Middle East Current Psychiatry.* (2022) 29:71. doi: 10.1186/s43045-022-00238-5

58. Hauck A, Michael T, Ferreira de Sá DS. Fear learning and generalization during pandemic fear: how COVID-19-related anxiety affects classical fear conditioning with traumatic film clips. *J Psychiatr Res.* (2022) 155:90–9. doi: 10.1016/j.jpsychires.2022.07.068

59. Frajerman A, Chaumette B, Krebs M-O, Morvan Y. Mental health in medical, dental and pharmacy students: a cross-sectional study. *J Affective Disorders Rep.* (2022) 10:100404. doi: 10.1016/j.jadr.2022.100404

60. Liang S-W, Liu L-L, Peng X-D, Chen J-B, Huang A-D, Wang X-Y, et al. Prevalence and associated factors of suicidal ideation among college students during the COVID-19 pandemic in China: a 3-wave repeated survey. *BMC Psychiatry.* (2022) 22:336. doi: 10.1186/s12888-022-03968-2

61. Azmi FM, Khan HN, Azmi AM. The impact of virtual learning on students' educational behavior and pervasiveness of depression among university students due to the COVID-19 pandemic. *Glob Health.* (2022) 18:70. doi: 10.1186/s12992-022-00863-z

62. Pelucio L, Simões P, Dourado MCN, Quagliato LA, Nardi AE. Depression and anxiety among online learning students during the COVID-19 pandemic: a cross-sectional survey in Rio de Janeiro, Brazil. *BMC Psychol.* (2022) 10:192. doi: 10.1186/s40359-022-00897-3

63. Gadi N, Saleh S, Johnson J-A, Trinidade A. The impact of the COVID-19 pandemic on the lifestyle and behaviours, mental health and education of students studying healthcare-related courses at a British university. *BMC Med Educ.* (2022) 22:115. doi: 10.1186/s12909-022-03179-z

64. Velarde-García JF, González-Hervías R, Álvarez-Embarba B, Cachón-Pérez JM, Rodríguez-García M, Oliva-Fernández O, et al. Under-graduate nursing students working during the first outbreak of the COVID-19 pandemic: a qualitative study of psychosocial effects and coping strategies. *Int J Nurs Pract.* (2022) 28:e13065. doi: 10.1111/ijn.13065

65. El-Gabry DA, Okasha T, Shaker N, Elserafy D, Yehia M, Aziz KA, et al. Mental health and wellbeing among Egyptian medical students: a cross-sectional study. *Middle East Current Psychiatry.* (2022) 29. doi: 10.1186/s43045-022-00193-1

66. Spagert L, Janssen C, Geigl C. Mental health indicators and their lifestyle associations in German students: a gender-specific multivariable analysis. *BMC Public Health.* (2022) 22:1413. doi: 10.1186/s12889-022-13777-7

67. Jahan T. An impact of COVID-19 a well-being perspective for a New World. *Lecture Notes Networks Systems.* (2023) 478:245–51. doi: 10.1007/978-981-19-2940-3_17

68. Bravo D., Errázuriz A., Campos D. (2022). *Termómetro de Salud Mental en Chile ACHS-UC: Quinta Ronda.* Available at: https://www.achs.cl/docs/librariesprovider2/noticias-2022/achs-127833/tms-ronda-5-conferencia.pdf

69. Baader M T, Rojas C C, Molina F JL, Gotelli V M, Alamo P C, Fierro F C, et al. Diagnóstico de la prevalencia de trastornos de la salud mental en estudiantes universitarios y los factores de riesgo emocionales asociados. *Rev Chil Neuropsiquiatr.* (2014) 52:167–76. doi: 10.4067/S0717-92272014000300004

70. Gustavson K, Knudsen AK, Nesvåg R, Knudsen GP, Vollset SE, Reichborn-Kjennerud T. Prevalence and stability of mental disorders among young adults: findings from a longitudinal study. *BMC Psychiatry.* (2018) 18:65. doi: 10.1186/s12888-018-1647-5

71. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. *Am Psychol.* (2000) 55:469–80. doi: 10.1037/0003-066X.55.5.469

72. Padilla-Walker LM, Barry CM, Carroll JS, Madsen SD, Nelson LJ. Looking on the bright side: the role of identity status and gender on positive orientations during emerging adulthood. *J Adolesc.* (2008) 31:451–67. doi: 10.1016/j.adolescence.2007.09.001

73. Valdés JM, Díaz FJ, Christiansen PM, Lorca GA, Solorza FJ, Alvear M, et al. Mental health and related factors among undergraduate students during SARS-CoV-2 pandemic: a cross-sectional study. *Front Psych.* (2022) 13:833263. doi: 10.3389/fpsyt.2022.833263

74. Vinet EV, Trizano-Hermosilla Í, Saiz JL, Cova F. Desarrollo del Inventario de Desajustes Psicológicos para Estudiantes Universitarios Chilenos. *Revista Iberoamericana de Diagnóstico y Evaluación – e Avaliação Psicológica.* (2022) 64, 93–108. doi: 10.21865/RIDEP64.3.08

75. Sandín B, Chorot P, Lostao L, Joiner T, Santed M, Valiente R. Escalas PANAS de afecto positivo y negativo: Validación factorial y convergencia transcultural | Psicothema. *Psicothema.* (1999) 11:15.

76. Bailey S, Grummitt L, Birrell L, Kelly E, Gardner LA, Champion KE, et al. Young people's evaluation of an online mental health prevention program for secondary school students: a mixed-methods formative study. *Mental Health Prevention.* (2023) 30:200263. doi: 10.1016/j.mhp.2023.200263

77. Fusar-Poli P, Salazar de Pablo G, De Micheli A, Nieman DH, Correll CU, Kessing LV, et al. What is good mental health? A scoping review. *Eur Neuropsychopharmacol.* (2020) 31:33–46. doi: 10.1016/j.euroneuro.2019.12.105

78. Gerlinger G, Hauser M, De Hert M, Lacluyse K, Wampers M, Correll CU. Personal stigma in schizophrenia spectrum disorders: a systematic review of prevalence rates, correlates, impact and interventions. *World Psychiatry.* (2013) 12:155–64. doi: 10.1002/wps.20040

79. Haugen PT, McCrillis AM, Smid GE, Nijdam MJ. Mental health stigma and barriers to mental health care for first responders: a systematic review and meta-analysis. *J Psychiatr Res.* (2017) 94:218–29. doi: 10.1016/j.jpsychires.2017.08.001

80. McGrail K, Morgan J, Siddiqi A. Looking back and moving forward: addressing health inequities after COVID-19. *Lancet Regional Health.* (2022) 9:100232. doi: 10.1016/j.lana.2022.100232

81. O'Mara-Eves A, Brunton G, Oliver S, Kavanagh J, Jamal F, Thomas J. The effectiveness of community engagement in public health interventions for disadvantaged groups: a meta-analysis. *BMC Public Health.* (2015) 15:129. doi: 10.1186/s12889-015-1352-y

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What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors.

***Peer Review

Beroíza-Valenzuela; Salas-Guzmán and Huepe-Artigas.

Abstract

Introduction: This study investigated the associations between wisdom, psychological well-being, social well-being, and self-efficacy in higher education. Integrating these constructs is critical because higher education institutions aim to foster environments that support both academic success and personal development. While previous research has explored these variables in isolation or pairs, few studies have comprehensively examined their interconnectedness.

Method: Using a cross-sectional correlational design, this study sampled 105 students from STEM higher education programs. Data were collected using validated scales for wisdom, psychological well-being, social well-being, and self-efficacy. Path analysis was employed to examine the direct and indirect relationships between variables.

Results: The analysis revealed that both psychological well-being ($\hat{\beta}$ = -0.131, $p < 0.001$) and social well-being ($\hat{\beta}$ = 0.148, $p < 0.001$) had significant effects on wisdom, while self-efficacy ($\hat{\beta}$ = -0.054, $p = 0.580$) did not show a significant effect. Indirectly, psychological well-being significantly influenced self-efficacy ($\hat{\beta}$ = 0.127, $p < 0.001$), and social well-being significantly affected psychological well-being ($\hat{\beta}$ = 1.047, $p < 0.001$). The relationships between sex and both self-efficacy ($\hat{\beta}$ = 0.213, $p = 0.798$) and psychological well-being ($\hat{\beta}$ = −4.856, $p = 0.131$) were not significant. The model fit was good, with indices of Chi-square ($\chi^2 = 1.149$, $df = 2$, $p = 0.563$), CFI (1.000), TLI (1.033), RMSEA (0.000 [90% CI: 0.000, 0.164], $p = 0.640$), and SRMR (0.023).

Discussion: These findings emphasize promoting student well-being to enhance self-efficacy and wisdom. Practically, this calls for targeted interventions that foster a supportive learning environment. Theoretically, the study deepens our understanding of the interplay between these constructs, advocating for an integrated approach in educational research. However, the cross-sectional design limits causal conclusions, and self-reported data may introduce bias. Future research should consider longitudinal studies and additional measures for validation.

Keywords: Psychological well-being, social well-being, wisdom, self-efficacy, higher education, STEM.

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Academic Resilience and Its Relationship with Anxiety and Depression in STEM Students: A Structural Equation Modeling Approach.

***Peer Review

Beroíza-Valenzuela.

Abstract

Introduction: The primary objective of this study was to explore how resilience, conceptualized through psychological well-being, social well-being, and self-efficacy, relates to anxiety and depression among STEM students in higher education.

Method: A cross-sectional design was used to collect data from a sample of *N*=350. The data were analyzed using Structural Equation Modeling (SEM).

Results: The model fit indices indicated a good fit: $\chi^2(110) = 341.211$, $p < 0.001$; CFI = 0.899; TLI = 0.876; RMSEA = 0.077; SRMR = 0.070. Psychological well-being was measured using significant indicators including self-acceptance, positive relationships, autonomy, personal growth, and purpose in life. Social well-being was assessed through social integration and social contributions, both of which were significant. Self-efficacy, anxiety, and depression also had significant factor loading. Resilience showed significant positive relationships with psychological well-being ($\beta = 0.993$), social well-being ($\beta = 0.903$), and self-efficacy ($\beta = 0.657$) and negative relationships with anxiety ($\beta = -0.563$) and depression ($\beta = -0.681$). Measurement invariance analyses indicated no significant differences in latent means across sex ($\Delta\chi^2 = 0$, $p = 1$), suggesting similar levels of the evaluated constructs between men and women.

Discussion: This study highlights the importance of fostering psychological and social well-being and self-efficacy to enhance resilience among STEM students. It contributes to understanding resilience by integrating multiple dimensions and suggests practical interventions for improving student resilience and mental health. Future studies should use longitudinal and direct measures to validate these findings.

Keywords: Academic Resilience, STEM Education, Higher Education, Structural Equation Modeling, depression, anxiety.

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Structural Equation Model to Explore the Association between Gender Gap, Mental Health, Self-Efficacy in STEM Higher Education.

***Peer Review

Beroíza-Valenzuela; Franco-Obyrne; Salas-Guzmán and Huepe-Artigas.

Abstract

Introduction: This study investigates the complex relationships between perceived gender gap factors, self-efficacy, and emotional well-being among higher education in science, technology, engineering, and mathematics fields (STEM).

Method: Using a cross-sectional correlational design, data from 528 participants were analyzed through Structural Equation Modeling (SEM) with parceling techniques to enhance model reliability and reduce complexity in latent constructs.

Results: The model, estimated using the Maximum Likelihood (ML) method and optimized via NLMINB, converged after 53 iterations. The findings reveal that perceptions of gender gaps significantly affect students' self-efficacy and mental health outcomes. The chi-square test (χ^2 = 294.656, df = 80, $p < 0.001$) and fit indices such as CFI (0.953) and TLI (0.938) indicate a good model fit. The RMSEA value of 0.071, with a 90% confidence interval of 0.063 to 0.080, further supports the model's adequacy. Critically, the study identifies a negative impact of gender gap perceptions on self-efficacy (β =-0.289, $p < 0.001$) and positive associations with depression, anxiety, and negative affect (β = 0.254, 0.263, 0.284, respectively; all $p < 0.001$).

Discussion: These results underscore the interconnectedness of mental health variables and highlight the pervasive influence of gender disparities on student outcomes. The contribution of this study lies in its demonstration that addressing gender disparities in educational settings can significantly enhance students' self-efficacy and emotional well-being. The findings suggest that targeted interventions to promote gender equality in STEM fields are crucial for improving students' academic performance and psychological health.

Keywords: Gender gap, mental health, self-efficacy, depression, anxiety, emotional states, higher education, STEM.

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A Decade of Insights: The Cognitive Impact of Stereotype-Driven Biases on Language Processing.

***Peer Review.

Beroíza-Valenzuela and Salas-Guzmán.

Abstract

Introduction: Gender stereotypes have long influenced various aspects of human cognition, including language processing. This systematic review aims to explore the impact of these stereotypes on language interpretation and understanding, focusing on how stereotypical beliefs shape the comprehension of words, phrases, discourse, and perceptions of professional roles and gender identity. Understanding the effects of gender stereotypes on language processing is crucial for addressing biases that reinforce societal norms and hinder progress toward gender equity.

Method: This review followed the PRISMA (2020) guidelines to ensure a comprehensive and transparent analysis. The review covers empirical studies published between 2012 and 2023 that investigate the influence of gender stereotypes on language processing. A systematic search of relevant databases was performed, followed by a critical evaluation and synthesis of the selected studies to examine how gender stereotypes affect cognitive processes related to language comprehension and production.

Results: The synthesis of the studies consistently reveals that gender stereotypes significantly impact cognitive processes in both language comprehension and production. These stereotypes lead to biased interpretations, recall, and understanding, reinforcing and perpetuating existing gender norms across various contexts. The findings indicate that these biases are pervasive and influence individual language processing and broader societal communications and perceptions.

Discussion: The discussion highlights the pressing need to address and mitigate the effects of gender stereotypes in language to promote equity and challenge entrenched societal norms. By deepening our understanding of the relationship between language and gender, this review provides valuable insights for developing targeted interventions to reduce stereotype-driven communication biases. These interventions are essential for fostering more inclusive and equitable language practices that challenge and change the status quo.

Keywords: Gender stereotypes, language processing, cognitive biases, sociocultural roles, gender equity.

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STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes

***Peer Review

Beroíza-Valenzuela; Salas-Guzmán and Huepe-Artigas.

Abstract

Introduction: This study examines how gender stereotypes affect collective intelligence in STEM fields, focusing on how collaborative environments can mitigate these effects. Effective collaboration, free from stereotypes, improves performance and creates a more inclusive and productive environment.

Method: A convergent parallel mixed-methods design was employed, with a sample *of N = 102,* to assess the impact of collective intelligence on overcoming gender differences. Integrating quantitative and qualitative analyses reveals that environments fostering collective intelligence can enhance individual capabilities, overcoming gender differences.

Results: The analysis revealed that collective performance, when free from gender stereotypes, significantly outperformed individual efforts, enhancing both inclusivity and productivity. The study showed that collective performance, free from gender stereotypes, significantly outperformed individual efforts, enhancing inclusivity and productivity. Quantitative outcomes revealed significant differences in Test A scores by gender ($p = 0.01209$) and field of study ($p = 0.009115$), with age differences across OECD fields ($p = 0.0427$). Post-hoc analysis confirmed differences between "Male" and "Female" in Test A and between Medical and Natural Sciences fields. Qualitative findings highlighted that male-dominated groups faced more challenges, while female-majority groups demonstrated greater collaboration.

Discussion: The study highlights the importance of developing collaborative skills to promote equitable collaboration in STEM fields. It suggests future research to broaden sample diversity and further explore group dynamics. These insights are essential for creating educational programs and workplace policies that foster inclusivity and address gender disparities. The findings also advance the understanding of collective intelligence in diverse groups and the impact of gender dynamics on collaborative efficiency. This knowledge is critical for designing interventions that maximize resource use and create equitable environments in traditionally male-dominated fields.

Keywords: Mixed Methods Research, Collective intelligence, Collaborative work, team performance, gender stereotypes, STEM.

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Gender Stereotypes and Career Choices in STEM: The Role of Implicit Associations among University Students.

***Peer Review

Beroíza-Valenzuela; Salas-Guzmán and Huepe-Artigas.

Abstract

Introduction: Addressing the issue of gender disparity in science, technology, engineering, and mathematics (STEM) fields is critical for achieving social parity and advancing nations, as highlighted in the Agenda 2030 for Sustainable Development. Unfortunately, stereotypical beliefs continue to restrict women's aspirations and hinder their access to male-dominated STEM fields, influencing their social cognition in the process. This study investigates how implicit gender and career associations affect university students in STEM fields, hypothesizing a more detrimental impact on women. **Method:** A cross-sectional quantitative design was employed to administer the Implicit Association Test (IAT) and assess implicit associations between gender and career among 136 university students enrolled in STEM programs.

Results: Paired t-tests revealed significant differences for women who took longer to respond in stereotype-inconsistent blocks than inconsistent ones (p = 0.0004). In men, this difference was not statistically significant (p = 0.207). ANOVA showed significant differences in response latencies between blocks for both women ($p = 5.97\times10^{-20}$) and men ($p = 4.77\times10^{-21}$) but not for non-binary and other genders. When calculating Cohen's d for women, a difference in reaction times was observed (d = 0.2255; d =-0.0639). For men, the values were (d = 0.1545; d =-0.0995). For the female gender, Cohen's d was (d = 0.2237; d =-0.0669). For the male gender, the values were (d = 0.151; d =-0.1149). For the non-binary gender, Cohen's d was (d = 0.4408; d =-0.0446). For participants of other genders, the values were (d = 0.1984; d = 0.2801).

Discussion: These findings highlight the critical role of implicit gender-career associations in shaping perceptions and attitudes towards STEM careers, disproportionately affecting women. This study highlights the need for targeted interventions and educational policies to mitigate these biases and to promote more significant gender equity in STEM in Higher Education. By addressing these implicit beliefs, institutions can better support the retention and success of women in STEM disciplines.

Keywords: Implicit Bias, Gender Bias, STEM, Career Choices, Implicit Association Test (IAT), Gender Disparity.

Conclusiones

Los hallazgos de esta tesis obtenidos a través de los diez artículos que la componen ofrecen una comprensión integral y matizada de la influencia de los estereotipos de género, los factores que perpetúan la brecha de género, y los sesgos presentes en el ámbito de las carreras STEM en la educación superior. Cada hallazgo se fundamenta sólidamente en la evidencia empírica y teórica presentada en los artículos, lo que permite articular una respuesta coherente y sustantiva a la pregunta de investigación y a los objetivos planteados.

En primer lugar, los estudios han demostrado de manera consistente que la brecha de género y los sesgos asociados afectan significativamente las dinámicas de trabajo colaborativo entre estudiantes de STEM, impactando negativamente su rendimiento y participación(Borgonovi et al., 2023). Este hallazgo confirma la hipótesis de que los determinantes de la brecha de género repercuten directamente en las interacciones grupales, evidenciando la necesidad de abordar estas barreras para fomentar un entorno académico más equitativo(Crimmins et al., 2024).

Asimismo, la investigación subraya la relevancia de la inteligencia colectiva como un medio eficaz para superar las barreras individuales impuestas por los estereotipos de género(Bates & Gupta, 2017; Grossmann et al., 2017). Los análisis comparativos entre la inteligencia colectiva e individual, diferenciados por sexo y género, revelan que las dinámicas grupales inclusivas pueden mitigar los efectos negativos de los sesgos(Woolley et al., 2023), destacando la importancia de promover la colaboración en contextos académicos(Petzel et al., 2024). Estos resultados no solo amplían el conocimiento teórico sobre la inteligencia colectiva en STEM, sino que también proporcionan una base empírica sólida para la implementación de estrategias pedagógicas más inclusivas(Verge, 2021).

Uno de los aportes más significativos de esta tesis es el desarrollo y validación de un instrumento psicométrico destinado a medir los factores que contribuyen a la brecha de género en la educación superior. Este instrumento, una herramienta robusta y fiable, representa un avance metodológico crucial que permite diagnosticar de manera precisa las variables críticas en la equidad de género, facilitando futuras investigaciones y el diseño de políticas orientadas a reducir estas desigualdades(Hoskins & Carrasco, 2024).

Por otro lado, los modelos que exploran la relación entre la resiliencia académica, la salud mental y la autoeficacia en estudiantes de STEM también han sido objeto de análisis detallado. Los

resultados indican que la resiliencia actúa como un factor protector frente a los efectos adversos de la ansiedad y la depresión. Mientras que la autoeficacia se ve seriamente afectada por la brecha de género, especialmente en contextos académicos exigentes(Al-Enazi & Jadea, 2022; Reidy & Wood, 2023). Además, el bienestar psicológico y social, junto con la sabiduría entendida como un factor psicosocial, son elementos críticos que influyen en la percepción que los estudiantes tienen de su propio desarrollo y capacidad de adaptación en el entorno académico(Glück & Weststrate, 2022). No obstante, la presencia de sesgos de género exacerba estos desafíos, subrayando la necesidad de intervenciones específicas que fortalezcan la resiliencia y promuevan el bienestar de los estudiantes de STEM(Anderson et al., 2020).

Asimismo, el uso del Test de Asociación Implícita (IAT) en este estudio reveló de manera efectiva los sesgos de género relacionados con las carreras que contribuyen a las disparidades en los campos STEM(Ratliff & Smith, 2024). Las diferencias significativas en los tiempos de respuesta, especialmente entre las mujeres, ilustran cómo los estereotipos profundamente arraigados pueden influir en la cognición social y en la toma de decisiones(Cvencek et al., 2023). Estos hallazgos validan el IAT como una herramienta crucial para detectar sesgos implícitos que podrían no ser capturados a través de métodos explícitos. Esto subraya la necesidad de integrar herramientas como esta en investigaciones futuras y en el desarrollo de estrategias de intervención para abordar estos sesgos subconscientes, promoviendo así un entorno más equitativo y de apoyo para las mujeres en STEM.

Finalmente, las implicaciones teóricas y prácticas de esta investigación son de gran relevancia. Teóricamente, el trabajo amplía la comprensión de cómo los estereotipos de género y los sesgos implícitos afectan el desarrollo académico y profesional en STEM, proporcionando nuevas perspectivas sobre la inteligencia colectiva y los factores psicosociales(Aggarwal et al., 2023; An et al., 2024). En el plano práctico, los hallazgos sirven como base para el diseño de políticas educativas que promuevan la equidad de género y el bienestar de los estudiantes, contribuyendo a la creación de un entorno académico más inclusivo y sostenible(Mahajan et al., 2022). Estas políticas deben enfocarse en reducir los sesgos de género, fortalecer la autoeficacia y la resiliencia de los estudiantes, y fomentar un aprendizaje colaborativo que maximice el potencial de todos los individuos, independientemente de su género.

Este estudio presenta algunas limitaciones que futuras investigaciones pueden abordar para profundizar el conocimiento adquirido. En primer lugar, sería útil explorar cómo los determinantes de la brecha de género varían en contextos culturales y educativos diferentes, permitiendo comparaciones más amplias e identificando factores contextuales que influyen en la equidad de género en STEM. Además, se recomienda realizar estudios longitudinales para observar cambios en la autoeficacia, resiliencia y salud mental a lo largo del tiempo, especialmente tras intervenciones diseñadas para reducir la brecha de género. Finalmente, sería valioso desarrollar y validar nuevos instrumentos que no solo midan los factores clave de la brecha de género, sino también la efectividad de políticas y programas educativos orientados a promover la equidad en STEM.

Referencias

Aggarwal, I., Schilpzand, M. C., Martins, L. L., Woolley, A. W., & Molinaro, M. (2023). The benefits of cognitive style versatility for collaborative work. *The Journal of Applied Psychology*, *108*(4), 647-659. https://doi.org/10.1037/apl0001035

Alam, M. S., Sajid, S., Kok, J. K., Rahman, M., & Amin, A. (2021). Factors that influence high school female Students' intentions to pursue science, technology, engineering, and mathematics (STEM) education in Malaysia. *Pertanika Journal of Social Sciences and Humanities*, *29*(2), 839-867. https://doi.org/10.47836/pjssh.29.2.06

Al-Enazi, A. A., & Jadea, W. M. A. (2022). The competitive behavior of university students and its relation to some variables. *JOURNAL FOR EDUCATORS TEACHERS AND TRAINERS*, *13*(4), 260-269. https://doi.org/10.47750/jett.2022.13.04.035

An, J., Zhu, X., Shi, Z., & An, J. (2024). A serial mediating effect of perceived family support on psychological well-being. *BMC Public Health*, *24*(1), 940. https://doi.org/10.1186/s12889-024-18476-z

Anderson, R., Beach, P., & Jacovidis, J. (2020). *Academic Buoyancy and Resilience for Diverse Students Around the World*. https://www.ibo.org/globalassets/new-structure/research/pdfs/academic-resilience-policy-paper-en.pdf

Asghar, M., Minichiello, A., & Ahmed, S. (2024). Mental health and wellbeing of undergraduate students in engineering: A systematic literature review. *Journal of Engineering Education*, *n/a*(n/a). https://doi.org/10.1002/jee.20574

Assouline, S. G., Mahatmya, D., Ihrig, L. M., Lynch, S., & Karakis, N. (2023). A theoretically based STEM talent development program that bridges excellence gaps. *Annals of the New York Academy of Sciences*, *1522*(1), 109-116. https://doi.org/10.1111/nyas.14978

Awais, A., Fu, N., & Jones, S. (2024). Developing students' resilience during the crisis: A moderated model linking college support, study demands, student resilience, and students' change-oriented behaviours. *Higher Education Quarterly*, *78*(3), 565-585. https://doi.org/10.1111/hequ.12468

Bates, T. C., & Gupta, S. (2017). Smart groups of smart people: Evidence for IQ as the origin of collective intelligence in the performance of human groups. *Intelligence*, *60*, 46-56. https://doi.org/10.1016/j.intell.2016.11.004

Borgonovi, F., Han, S. W., & Greiff, S. (2023). Gender differences in collaborative problem-solving skills in a cross-country perspective. *Journal of Educational Psychology*, *115*(5), 747-766. https://doi.org/10.1037/edu0000788

Bourdieu, P., & Passeron, J.-C. (2018). *La Reproduction: Éléments pour une théorie du système d'enseignement*. Minuit.

Buckley, J., O'Connor, A., Seery, N., Hyland, T., & Canty, D. (2019). Implicit theories of intelligence in STEM education: Perspectives through the lens of technology education students. *International Journal of Technology and Design Education*, *29*(1), 75-106. https://doi.org/10.1007/s10798-017-9438-8

Chan, R. C. H. (2022). A social cognitive perspective on gender disparities in self-efficacy, interest, and aspirations in science, technology, engineering, and mathematics (STEM): The influence of cultural and gender norms. *International Journal of STEM Education*, *9*(1), 37. https://doi.org/10.1186/s40594-022-00352-0

Charlesworth, T. E. S., & Banaji, M. R. (2022). Patterns of Implicit and Explicit Stereotypes III: Long-Term Change in Gender Stereotypes. *Social Psychological and Personality Science*, *13*(1), 14-26. https://doi.org/10.1177/1948550620988425

Crimmins, G., Marshall, E., & Read, G. J. M. (2024). Gender quotas are not enough: The need for multiple strategies to address gender equity in Australian universities. *Gender and Education*, *36*(6), 581-598. https://doi.org/10.1080/09540253.2024.2370270

Cvencek, D., Brečić, R., Sanders, E. A., Gaćeša, D., Skala, D., & Meltzoff, A. N. (2023). Am I a good person? Academic correlates of explicit and implicit self-esteem during early childhood. *Child Development*, *00*, 1-16. https://doi.org/10.1111/cdev.14052

CUECH. (2022). *Tendencias de brechas en las 18 Universidades del CUECH* (p. 25). https://genero.uestatales.cl/reel/tendencias-de-brechas-en-las-18-universidades-del-cuech/

Departamento de Evaluación, Medición y Registro Educacional. (2022). *Informe Técnico de las Pruebas de Admisión 2022* (p. 108). DEMRE. https://demre.cl/estadisticas/informe-tecnico

Dost, G. (2024). Students' perspectives on the 'STEM belonging' concept at A-level, undergraduate, and postgraduate levels: An examination of gender and ethnicity in student descriptions. *International Journal of STEM Education*, *11*(1), 12. https://doi.org/10.1186/s40594-024-00472-9

Dunlap, S. T., & Barth, J. M. (2019). Career Stereotypes and Identities: Implicit Beliefs and Major Choice for College Women and Men in STEM and Female-Dominated Fields. *Sex Roles*, *81*(9), 548-560. https://doi.org/10.1007/s11199-019-1013-1

Dunlap, S. T., & Barth, J. M. (2023). Career Identities and Gender-STEM Stereotypes: When and Why Implicit Gender-STEM Associations Emerge and How They Affect Women's College Major Choice. *Sex Roles*, *89*(1), 19-34. https://doi.org/10.1007/s11199-023-01381-x

ECLAC. (2019). *The 2030 Agenda and the Sustainable Development Goals: An opportunity for Latin America and the Caribbean. Goals, Targets and Global Indicators*. https://hdl.handle.net/11362/40156

Etheridge, B., & Spantig, L. (2022). The gender gap in mental well-being at the onset of the Covid-19 pandemic: Evidence from the UK. *European Economic Review*, *145*, 104114. https://doi.org/10.1016/j.euroecorev.2022.104114

Fine, C. (2018). *Testosterone Rex: Unmaking the Myths of Our Gendered Minds*. Icon Books.

Glück, J., & Weststrate, N. M. (2022). The Wisdom Researchers and the Elephant: An Integrative Model of Wise Behavior. *Personality and Social Psychology Review*, *26*(4), 342-374. https://doi.org/10.1177/10888683221094650

Gottlieb, J. J., Wiseman, A. W., & Hite, R. (2024). The cloak of equality in STEM education: Institutionalised masking of gender differences in STEM expectations, task values, and participation. *Compare: A Journal of Comparative and International Education*, *0*(0), 1-18. https://doi.org/10.1080/03057925.2024.2370293

Greenwald, A. G., & Banaji, M. R. (2017). The implicit revolution: Reconceiving the relation between conscious and unconscious. *American Psychologist*, *72*(9), 861-871. https://doi.org/10.1037/amp0000238

Grossmann, I., Brienza, J. P., & Bobocel, D. R. (2017). Wise deliberation sustains cooperation. *Nature Human Behaviour*, *1*(3), 1-6.

Guo, Y., Chen, X., Ma, J., Li, Y., & Hommey, C. (2022). How belief in a just world leads to prosocial behaviours: The role of communal orientation. *Personality and Individual Differences*, *195*, 111642. https://doi.org/10.1016/j.paid.2022.111642

Gupta, P., & Woolley, A. W. (2020). *The Emergence of Collective Intelligence Behavior*. 8th ACM Collective Intelligence (CI), Zurich, Switzerland. https://scholar.google.com/scholar_lookup?journal=Proceedings+of+the+Paper+presented+at+the+8th+ACM+Collective+Intelligence+(CI)+Conference,+Virtual+Event&title=The+Emergence+of+Collective+Intelligence+Behavior&author=P.+Gupta&author=A.W.+Woolley&

Hall, C. D. X., Wood, C. V., Hurtado, M., Moskowitz, D. A., Dyar, C., & Mustanski, B. (2022). Identifying leaks in the STEM recruitment pipeline among sexual and gender minority US secondary students. *PLOS ONE*, *17*(6), e0268769. https://doi.org/10.1371/journal.pone.0268769

Hargreaves, A. (2003). *Teaching in the knowledge society: Education in the age of insecurity*. Teachers College Press.

Hill, C., Corbett, C., & St. Rose, A. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. En *American Association of University Women*. American Association of University Women. https://eric.ed.gov/?id=ED509653

Hogan, M. J., Barton, A., Twiner, A., James, C., Ahmed, F., Casebourne, I., Steed, I., Hamilton, P., Shi, S., Zhao, Y., Harney, O. M., & Wegerif, R. (2023). Education for collective Intelligence. *Irish Educational Studies*, *0*(0), 1-30. https://doi.org/10.1080/03323315.2023.2250309

Hoskins, B., & Carrasco, D. (2024). Understanding Gender Inequality in Political Self-Efficacy in Early Adolescents: Different Measures, Different Gender Gaps. *Political Studies Review*, 14789299241264970. https://doi.org/10.1177/14789299241264970

Jergins, W. (2023). Gender equity and the gender gap in STEM: Is there really a paradox? *Journal of Population Economics*, *36*(4), 3029-3056. https://doi.org/10.1007/s00148-023-00959-9

Jones, E., Priestley, M., Brewster, L., Wilbraham, S. J., Hughes, G., & Spanner, L. (2021). Student wellbeing and assessment in higher education: The balancing act. *Assessment & Evaluation in Higher Education*, *46*(3), 438-450. https://doi.org/10.1080/02602938.2020.1782344

Lacoviello, V., Valsecchi, G., Vétois, M., & Falomir-Pichastor, J. M. (2024). Reducing the gender gap on adolescents' interest in study fields: The impact of perceived changes in ingroup gender norms and gender prototypicality. *Social Psychology of Education*. https://doi.org/10.1007/s11218-024-09909-z

Maeda, A., & Socha-Dietrich, K. (2021). *Skills for the future health workforce: Preparing health professionals for people-centred care*. OECD. https://doi.org/10.1787/68fb5f08-en

Mahajan, S., Hausladen, C. I., Argota Sánchez-Vaquerizo, J., Korecki, M., & Helbing, D. (2022). Participatory resilience: Surviving, recovering and improving together. *Sustainable Cities and Society*, *83*, 103942. https://doi.org/10.1016/j.scs.2022.103942

Malone, T. W., & Woolley, A. W. (2020). Collective Intelligence. En *The Cambridge handbook of intelligence, 2nd ed* (pp. 780-801). Cambridge University Press. https://doi.org/10.1017/9781108770422.033

Meltzoff, A., & Cvencek, D. (2019). *How Stereotypes Shape Children's STEM Identity and Learning.* (pp. 37-47).

Ministerio de Ciencia, Tecnología, Conocimiento e Innovación. (2022). *Segunda Radiografía de género en ciencia, tecnología, conocimiento e innovación* (p. 17). https://observa.minciencia.gob.cl/estudios/segunda-radiografia-de-genero-en-ciencia--tecnologia--conocimiento-e-innovacion

OECD. (2021). *Learning from the Past, Looking to the Future: Excellence and Equity for all*. Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/education/learning-from-the-past-looking-to-the-future_f43c1728-en

ONU. (2021). *Progress on the Sustainable Development Goals: The gender snapshot 2021*. UN Women Data Hub. https://data.unwomen.org/publications/progress-sustainable-development-goals-gender-snapshot-2021

Petzel, Z. W., Farrell, L., McCormack, T., Turner, R. N., Rafferty, K., & Latu, I. M. (2024). A collective action approach to improving attitudes and self-efficacy towards gender equality among male STEM academics. *European Journal of Psychology of Education*. https://doi.org/10.1007/s10212-024-00844-3

Philipp, J. (2022). Gendered university major choice: The role of intergenerational transmission. *Journal of Population Economics*. https://doi.org/10.1007/s00148-022-00900-6

Ratliff, K. A., & Smith, C. T. (2024). The Implicit Association Test. *Daedalus*, *153*(1), 51-64. https://doi.org/10.1162/daed_a_02048

Reidy, D. E., & Wood, L. (2023). The mental health of undergraduate women majoring in STEM. *Journal of American College Health*, *0*(0), 1-6. https://doi.org/10.1080/07448481.2023.2299426

Schmader, T. (2023). Gender Inclusion and Fit in STEM. *Annual Review of Psychology*, *74*(Volume 74, 2023), 219-243. https://doi.org/10.1146/annurev-psych-032720-043052

Schwab, K. (2017). *The Fourth Industrial Revolution*. Currency.

Sertyesilisik, B. (2023). Women Empowerment as a Key to Support Achievement of the Sustainable Development Goals and Global Sustainable Development. En C. Chakraborty & D. Pal (Eds.), *Gender Inequality and its Implications on Education and Health* (pp. 153-163). Emerald Publishing Limited. https://doi.org/10.1108/978-1-83753-180-620231014

Speer, J. D. (2023). Bye bye Ms. American Sci: Women and the leaky STEM pipeline. *Economics of Education Review*, *93*, 102371. https://doi.org/10.1016/j.econedurev.2023.102371

UMCE. (2023). *Instructivo de tesis por compendio de artículos.* https://doctorado.umce.cl/index.php/doc-interes

UNESCO-IBE. (2017). *Future Competences and the Future of Curriculum*. IBE. http://www.ibe.unesco.org/sites/default/files/resources/future_competences_and_the_future_of_curriculum.pdf

United Nations Women. (2022). *Progress on the Sustainable Development Goals: The Gender Snapshot 2022* (p. 31). https://data.unwomen.org/publications/progress-sustainable-development-goals-gender-snapshot-2022

van den Hurk, A., Meelissen, M., & van Langen, A. (2019). Interventions in education to prevent STEM pipeline leakage. *International Journal of Science Education*, *41*(2), 150-164. https://doi.org/10.1080/09500693.2018.1540897

Verge, T. (2021). Gender Equality Policy and Universities: Feminist Strategic Alliances to Re-gender the Curriculum. *Journal of Women, Politics & Policy*, *42*(3), 191-206. https://doi.org/10.1080/1554477X.2021.1904763

Woolley, A. W., Aggarwal, I., & Malone, T. W. (2015). Collective Intelligence and Group Performance. *Current Directions in Psychological Science*, *24*(6), 420-424. https://doi.org/10.1177/0963721415599543

Woolley, A. W., Chow, R. M., Mayo, A. T., Riedl, C., & Chang, J. W. (2023). Collective Attention and Collective Intelligence: The Role of Hierarchy and Team Gender Composition. *Organization Science*, *34*(3), 1315-1331. https://doi.org/10.1287/orsc.2022.1602

Woolley, A. W., & Gupta, P. (2024). Understanding Collective Intelligence: Investigating the Role of Collective Memory, Attention, and Reasoning Processes. *Perspectives on Psychological Science*, *19*(2), 344-354. https://doi.org/10.1177/17456916231191534

World Economic Forum. (2023). *Global Gender Gap Report 2023*. https://www.weforum.org/publications/global-gender-gap-report-2023/digest/

World Economic Forum. (2024). *Global Gender Gap 2024. Insight Report*. https://www.weforum.org/publications/global-gender-gap-report-2024/digest/

Anexos

- Carta Comité de Ética USACH.
- Certificado de Progreso de Investigación en Pasantía en la University of Florida, Estados Unidos.
- Cartas de Proceso de Revisión por Pares de los Papers.
- Certificado de Participación en Congresos Año 2024.
- Convalidación Avance de Tesis II

UMCE
VICERRECTORIA ACADÉMICA.
DIRECCIÓN DE POSTGRADO
PROGRAMA DOCTORADO EN EDUCACIÓN

1. Carta Comité de Ética USACH.

COMITÉ DE
ÉTICA INSTITUCIONAL
UNIVERSIDAD DE SANTIAGO DE CHILE

SANTIAGO 13 de enero de 2023
INFORME ÉTICO N° 024/2023
Emitido por el Comité Ético Científico Acreditado por 3 años según
Resolución N°011494 SEREMI DE SALUD, de fecha 13 de octubre de 2020

Tesista
Francisca Beroíza Valenzuela
Doctorado en Educación
Universidad Metropolitana de Ciencias de la Educación
Presente

UNIVERSIDAD DE SANTIAGO DE CHILE - COMITE DE ETICA -

Estimado(a) Sr(a) Beroíza Valenzuela:

Se hace llegar a usted el presente informe emitido por el Comité de Ética Institucional, en relación con:

I. IDENTIFICACIÓN

TÍTULO DEL PROYECTO	: "El impacto de los determinantes de la brecha y sesgos de género sobre la inteligencia colectiva en carreras universitarias de stem: hacia un trabajo colaborativo inclusivo"
TIPO DE PROYECTO	: Proyecto Tesis doctorado en Educación, con financiamiento externo ANID.
INVESTIGADOR(A) RESPONSABLE	: Francisca Beroíza Valenzuela
PROFESORA GUÍA RESPONSABLE	**: ANA GÁLVEZ COMANDINI**
LABORATORIO/ UNIDAD ACADÉMICA	: Vicerrectoría Académica, Doctorado en Educación - UMCE
SITIO Y DURACIÓN DE INVESTIGACIÓN	**:** Universidades públicas y Privadas (instrumentos psicométricos, encuesta y entrevista semiestructurada).

II. DOCUMENTOS TENIDOS A LA VISTA PARA LA EMISIÓN DE ESTE INFORME

- Proyecto tesis doctoral (75 páginas) y preguntas de encuestas (31 páginas)
- Carta al Comité USACH
- Modelo carta consentimiento informado profesionales y académicos - entrevista
- Modelo carta consentimiento informado estudiantes universitarios – encuesta
- Modelo carta consentimiento informado estudiantes universitarios – Tarea de Inteligencia Colectiva y Tarea de Asociación Implícita
- Carta compromiso profesor guía

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PROGRAMA DOCTORADO EN EDUCACIÓN

COMITÉ DE
ÉTICA INSTITUCIONAL
UNIVERSIDAD DE SANTIAGO DE CHILE

SANTIAGO 13 de enero de 2023
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Emitido por el Comité Ético Científico Acreditado por 3 años según
Resolución N°011494 SEREMI DE SALUD, de fecha 13 de octubre de 2020

III. HIPÓTESIS, OBJETIVOS Y METODOLOGÍA DEL PROYECTO

El objetivo principal de este trabajo es analizar los efectos de los determinantes de la brecha y sesgos de género sobre el trabajo colaborativo de estudiantes universitarios/as en carreras de educación STEM de universidades públicas y privadas de Chile.

La metodología consiste en 2 estudios: El primero vinculado al desarrollo y validación de un instrumento psicométrico que formalice los determinantes de la brecha y permita su medición, junto con el estudio de otras covariables. Mientras que el segundo está destinado a vislumbrar el impacto de la brecha y sesgos de género en la inteligencia colectiva como un proxy del impacto sobre el trabajo colaborativo. Estos permitirán aumentar la comprensión de la problemática y proyectar medidas que aportarán al desarrollo de medidas de mitigación

IV. ANÁLISIS ÉTICO

Tiene coherencia el proyecto de investigación con la documentación ética.

Los consentimientos informados para profesores y académicos, y para estudiantes, son claros y completos y resguardan la voluntariedad de los participantes.

Se resguarda debidamente la confidencialidad.

V. CONCLUSIONES

Conforme a la reunión de deliberación del Comité de Ética, se emite: **Certificado Ético en cumplimiento de la Ley 20.120 y Certificado Ético en cumplimiento de la Ley 19.628.**

En virtud de **Ley Nº20.120** *sobre la investigación científica en el ser humano, su genoma, y prohíbe la clonación humana*, su Reglamento y demás cuerpos normativos internacionales relacionados y tenidos a la vista.

El proyecto de investigación queda en estado "**APROBADO**" que faculta realizar investigación científica en el ser humano, por cuanto cumple con la exigencia de la normativa nacional de probidad científica de considerar modelo de consentimiento informado hacia los participantes.

En virtud de **Ley Nº19.628** *sobre protección de la vida privada, su* reglamento, la **Ley 21.096 Reforma Constitucional** *que consagra el derecho a protección de los datos personales y el derecho a la honra y a la vida privada de la persona y de su familia* y tenidos a la vista.

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COMITÉ DE
ÉTICA INSTITUCIONAL
UNIVERSIDAD DE SANTIAGO DE CHILE

SANTIAGO 13 de enero de 2023
INFORME ÉTICO N° 024/2023
Emitido por el Comité Ético Científico Acreditado por 3 años según
Resolución N°011494 SEREMI DE SALUD, de fecha 13 de octubre de 2020

El proyecto de investigación queda en estado "**APROBADO**", que faculta realizar investigación científica en **bases de datos sensibles y datos personales como extensión del ser humano**. Por lo demás, el/la investigador/a responsable cumple con la normativa del cuidado de los datos al informar en el modelo de consentimiento informado: los fines de la recolección de datos; la custodia del responsable del registro o banco de datos; tratamiento de anonimización o la disociación de datos de la persona determinada o determinable; y la eliminación de los datos personales cuando su almacenamiento carezca de fundamento.

Téngase presente que este informe aprobatorio tiene vigencia según tiempo estimado en el proyecto para recolectar información en los participantes.

Les saluda atentamente,

Dr. Marco Villalta Paucar
Coordinador
Área Ciencias Sociales y Económicas, y Humanidades
Comité de Ética Institucional

UNIVERSIDAD DE SANTIAGO DE CHILE - COMITE DE ETICA

Analista Internacional Alexis Garrido Núñez
Coordinador Alterno
Área Ciencias Sociales y Económicas, y Humanidades
Comité de Ética Institucional

2. Certificado de Progreso de Investigación en Pasantía en la University of Florida, Estados Unidos.

UF UNIVERSITY of FLORIDA

Gainesville, Florida, U.S.A.
Agosto 8, 2024.

Certificate of Completion of Doctoral Internship

Recipient: National Agency for Research and Development of Chile,

This is to certify that Ms. Francisca Beroíza Valenzuela (17763864-1) has completed her internship at the Attitudes & Social Cognition Lab, University of Florida, United States.

The work developed by the doctoral candidate was as follows:

Articles Published 2024

1. Beroíza-Valenzuela, F., & Salas-Guzmán, N. (2024). STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022). *Frontiers in Education, 9*, 1378640. doi: 10.3389/feduc.2024.1378640
2. Beroíza-Valenzuela, F. (2024). The challenges of mental health in Chilean university students. *Frontiers in Public Health, 12*, 1297402. doi: 10.3389/fpubh.2024.1297402

Articles Under Peer Review

1. Empowering Futures: Analyzing the Factors and Impacts of the Gender Gap on STEM Higher Education. Submitted to *International Journal of Sustainability in Higher Education.*
2. Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education. Submitted to *Frontiers in Education.*
3. What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors. Submitted to *Humanities & Social Sciences Communications.*
4. STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes. Submitted to *Cogent Education.*

Draft Articles:

1. How Does Gender Bias Impact STEM Careers? Analyzing Gender Differences in Reaction Times Using the Implicit Association Test.

Participation in International Conferences 2024 to date

1. III International Congress: Education and Knowledge (ICON-edu 2024), held from June 6-7, 2024, at the University of Alicante-Spain.
2. CI'24: Collective Intelligence Conference held from June 27-28, 2024. ACM Northeastern University, Boston, USA.
3. Thirty-First International Conference on Learning, 10-12 July 2024. Utrecht University, Utrecht, Netherlands.

The candidate participated as a listener in academic courses, which allowed her to share knowledge with international students and researchers, receive valuable feedback on her work, and learn about the university system's experience in the United States. Additionally, her participation in the Attitudes and Social Cognition Lab was enriching and formative, deepening her study of attitudes and social cognition in higher education STEM. This cutting-edge research environment gave her access to advanced resources and innovative methodologies, enriching her understanding of implicit gender stereotypes and their impact on education.

K. Ratliff

Kate Ratliff.
Associate Professor.
Department of Psychology.
Director of the Attitudes and Social Cognition (ASC) Lab.
University of Florida.

3. Carta Aceptación Paper

05-Sep-2024

Dear Beroíza-Valenzuela, Francisca; Salas-Guzmán, Natalia

It is a pleasure to accept your manuscript IJSHE-02-2024-0129.R3, entitled "Redefining Academic Trajectories: A Comprehensive Analysis of the Factors and Impacts of the Gender Gap in STEM Higher Education" in its current form for publication in International Journal of Sustainability in Higher Education. Please note, no further changes can be made to your manuscript.

This email will be followed by a second message containing a copy of your author accepted manuscript (AAM) which is the version that we will typeset and publish in the journal.

Your article will now go through editorial checks by Emerald's editorial team to ensure it meets our publication standards. These checks can take up to five days; we'll be in touch if we have any queries at this stage. Once this step has been completed you will receive an email directing you to Emerald Submit to select your publishing licence and submit your article to production. If you are publishing in one of our subscription journals and wish to make your article open access you can choose this option in Emerald Submit.

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https://www.emeraldgrouppublishing.com/journal/ijshe

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Thank you for your contribution. On behalf of the Editors of International Journal of Sustainability in Higher Education, we look forward to your continued contributions to the Journal.

Yours sincerely,
Dr. Mihaela Sima
International Journal of Sustainability in Higher Education
ijsheeditorialteam@gmail.com

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4. Paper en Revisión de Pares

Routledge
Taylor & Francis Group

Dear Francisca Beroíza-Valenzuela,

Thank you for your submission.

Submission ID	**246799990**
Manuscript Title	**Academic Resilience and Its Relationship with Anxiety and Depression in STEM Students: A Structural Equation Modeling Approach**
Journal	**Environmental Education Research**

If you made the submission, you can check its progress and make any requested revisions on the Author Portal

Thank you for submitting your work to our journal.
If you have any queries, please get in touch with CEER-peerreview@journals.tandf.co.uk.

Kind Regards,
Environmental Education Research Editorial Office

Taylor & Francis is a trading name of Informa UK Limited, registered in England under no. 1072954.
Registered office: 5 Howick Place, London, SW1P 1W.

5. Paper en Revisión de Pares

Taylor & Francis
Taylor & Francis Group

Dear Francisca Beroíza-Valenzuela,

Thank you for your submission.

Submission ID	**249089035**
Manuscript Title	**STEM in Higher Education: The Role of Collective Intelligence in Surpassing Individual Barriers Imposed by Gender Stereotypes**
Journal	**Cogent Education**
Article Publishing Charge (APC)	**USD $1680.0 (plus VAT or other local taxes where applicable in your country)**

**APC only payable if your article is accepted*

If you made the submission, you can check its progress and make any requested revisions on the Author Portal.

Thank you for submitting your work to our journal.
If you have any queries, please get in touch with OAED-peerreview@journals.tandf.co.uk.

For any queries relating to your APC, please get in touch with APC@tandf.co.uk

Kind Regards,
Cogent Education Editorial Office

6. Paper en Revisión de Pares

Dear Dr Beroíza-Valenzuela,

On 10th Jul 24, the manuscript entitled "What Drives Academic Wisdom in STEM Higher Education? Exploring the Role of Psychosocial Factors" by Francisca Beroíza-Valenzuela, Natalia Salas-Guzmán, and David Huepe was approved by the staff.

Your manuscript has been assigned the following ID #: HSSCOMMS-28541.

You may check on the status of this manuscript by selecting the "Check Manuscript Status" link under the following URL:

https://mts-palcomms.nature.com/cgi-bin/main.plex?el=A5Cd2MMK4A1puP2F5A9ftdf6zen5FDWIqxrv5ZGSPWAZ

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Sincerely,

The Editorial Office
Humanities & Social Sciences Communications

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7. Paper en Revisión de Pares

28-Aug-2024

Dear Dr. Beroíza-Valenzuela:

Your manuscript entitled "Gender Stereotypes and Career Choices in STEM: The Role of Implicit Associations among University Students" by Beroíza-Valenzuela, Francisca; Salas-Guzmán, Natalia; Huepe-Artigas, David, has been successfully submitted online and is presently being given full consideration for publication in Review of Education.

Co-authors: Please contact the Editorial Office as soon as possible if you disagree with being listed as a co-author for this manuscript.

Your manuscript ID is RoE-2024-08-1413.

Please mention the above manuscript ID in all future correspondence. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc.manuscriptcentral.com/roe and edit your user information as appropriate.

CRediT Taxonomy: authors' contribution(s) to the submitted manuscript are attributed as below. Submitting Authors should provide At revision submission, all authors should check the contributions carefully as, if your manuscript is accepted, this information will be included in the published article:

Our journal is currently transitioning to Wiley's Research Exchange submission portal. If you submitted this manuscript through our Research Exchange site, you can view the status of your manuscript by logging into the submission site at wiley.atyponrex.com/journal/REV3.

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Thank you for submitting your manuscript to Review of Education.

Sincerely,
Review of Education Editorial Office

8. Paper en Revisión de Pares

Dear Dr Beroíza-Valenzuela

We are pleased to inform you that we have received the manuscript "Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education" to be considered for publication in Frontiers in Education, section Higher Education.

You can access the review forum and track the progress of your manuscript using the following link:
https://www.frontiersin.org//Journal/MySubmission.aspx?stage=100

Your manuscript is now in the initial validation stage to determine its suitability for peer review. Should your manuscript be sent out for peer review, you will receive a notification once we receive the reports from reviewers and the interactive review forum is activated. You will then be able to read the review reports and exchange directly with the reviewers in the interactive review forum as well as submit a revised manuscript, if appropriate. If the required number of reviewers endorse your manuscript in the Independent Review stage, their tabs will be closed and the manuscript will be forwarded to the Review Finalized stage, where you will be able to interact with the handling editor via the Editor tab.

Please note that in line with our authorship policy (https://www.frontiersin.org/guidelines/policies-and-publication-ethics#:~:text=Changes%20in%20authorship), the version of the authors' list that appears in the submission system at this stage is considered final except in exceptional circumstances, for example when the revision process requires additional expertise. If you need to change the author list at any stage of the review process, please submit and authorship change form to the editorial office using the authorship change form [https://www.frontiersin.org/files/pdf/Authorship_change_form_CRediT.pdf] . Changes to the author list in the uploaded manuscript files will not be recognized.

Best regards,
Your Frontiers in Education Team,

Frontiers | Editorial Office - Collaborative Peer Review Team
www.frontiersin.org
Avenue du Tribunal Fédéral 34
1005 Lausanne Switzerland

For technical issues please contact our IT Helpdesk (support@frontiersin.org) or visit our Frontiers Help Center (helpcenter.frontiersin.org)

----------MANUSCRIPT DETAILS----------
Manuscript title: Design and Validation of a Psychometric Instrument: Assessing Gender Gap Factors in Higher Education
Manuscript ID: 1456085
Authors: Francisca Beroíza-Valenzuela, Natalia Salas Guzmán and David Huepe
Journal: Frontiers in Education, section Higher Education
Article type: Original Research
Submitted on: 28 Jun 2024
Research Topic: Institutional Impact Measurement in Higher Education

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9. Paper en Revisión de Pares

07-Jul-2024

Dear Dr. Beroiza-Valenzuela:

We have reviewed your manuscript ID EJED-2024-0455 entitled "The Influence of Gender Stereotyped Beliefs on Language Processing (2012-2023)." which you submitted to European Journal of Education. The comments of the reviewer(s) are included at the bottom of this letter.

The reviewer(s) have recommended some revisions to your manuscript. Please respond to the reviewer(s)' comments and revise your manuscript by 05-Oct-2024.

Our journal is currently transitioning to Wiley's Research Exchange submission portal. Please read these instructions carefully.

If you submitted your manuscript through our Research Exchange site, you will see a link below to submit your revised manuscript: https://wiley.atyponrex.com/submissionBoard/1/4f9bf9ee-46d4-42ba-a75c-04277730fa44/current (If no link appears, follow the instructions in the next paragraph.)

Click on the link or go to wiley.atyponrex.com/journal/EJED. Sort by journal and submission status to locate this manuscript, then click the "Revise submission" button to submit your revision. You will be able to respond to the reviewer comments when asked to "Upload your Author Response". All supplementary and additional files will be carried over when you submit a revised manuscript. You may be required to provide additional files at the revision stage.

If you submitted your manuscript through ScholarOne, please use this link to submit your revised manuscript: *** PLEASE NOTE: This is a two-step process. After clicking on the link, you will be directed to a webpage to confirm. ***

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This journal offers a number of license options for published papers; information about this is available here: https://authorservices.wiley.com/author-resources/Journal-Authors/licensing/index.html. The submitting author has confirmed that all co-authors have the necessary rights to grant in the submission, including in light of each co-author's funder policies. If any author's funder has a policy that restricts which kinds of license they can sign, for example if the funder is a member of Coalition S, please make sure the submitting author is aware.

Once again, thank you for submitting your manuscript to European Journal of Education and I look forward to receiving your revision.

Yours sincerely,
Dr. Gurpinder Lalli
Editor in Chief, European Journal of Education
Glalli@wlv.ac.uk

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10. Certificado Conferencia ICSEI, Dublín, Irlanda.

ICSEI - University of Melbourne - Faculty of Education - 3010, Australia

Francisca Beroíza
Agencia Nacional de Investigación y Desarrollo de Chile

International Congress for School
Effectiveness and Improvement
University of Melbourne - Faculty of Education
100 Leicester Street
Parkville Victoria 3010, Australia

Dublin - Ireland, 16/Jan/2024

To Whom It May Concern

This is to confirm that **Francisca Beroíza** is welcome to participate in the **37th International Congress for School Effectiveness and Improvement (ICSEI)** 2024, to be held in Dublin - Ireland from January 9 until January 12, 2024. The pre-conference takes place on January 8, 2024. Please note that registration fees, travel, living and accommodation expenses will not be supported by the conference organizers.

The theme of the congress is "Quality Professional Education for Enhanced School Effectiveness and Improvement: International Perspectives and Approaches". ICSEI 2024 aims to encourage regional and international researchers, practitioners and policy makers to come together to reflect on issues of school effectiveness and school improvement in a global context. More information about ICSEI 2024 is available at https://2024.icsei.net/ .

If you have any questions, please do not hesitate to contact the ICSEI Conference Team at conference@icsei.net.

The local hosts of ICSEI 2024 are the School of Education at Trinity College Dublin, the University of Dublin (Trinity) and the Marino Institute of Education (MIE).

Francisca Beroíza is author/co-author of the following accepted contribution(s):

Breaking Barriers in STEM: The Impact of Gender Stereotypes on Collaborative Work
Author(s): Beroíza-Valenzuela, Francisca
Presenting Author: Beroíza-Valenzuela, Francisca
Submission Type / Conference Track: Educational Leadership Network
Status: Accepted

All ICSEI contributions are peer reviewed by at least two reviewers.

We look forward to seeing Francisca Beroíza.

With kind regard, on behalf of ICSEI and the local organizing committee

Professor James P. Spillane PhD BA
President of the International Congress for School
Effectiveness and School Improvement (ICSEI)
Northwestern University, 633 Clark Street
Evanston, IL 60208, USA
E-mail: j-spillane@northwestern.edu
Phone: +1 (0) 847 491-3741

Note: International Congress for School Effectiveness and Improvement is a legally recognized charity based in Australia.

11. Certificado Conferencia Internacional de Inteligencia Colectiva en Boston, Massachusetts, Estados Unidos.

Certificate of Attendance

Attendee Name: Francisca Beroíza-Valenzuela

Company/Organization: Agencia Nacional de Investigación y Desarrollo de Chile

Address:

Confirmation Number: R6NVTT2S8QD

Registration Type: Student Non-Member

This certificate is confirmation of Francisca Beroíza-Valenzuela attendance at CI'24: Collective Intelligence Conference held from June 27, 2024 - June 28, 2024.

12. Certificado Conferencia sobre aprendizaje en la Universidad de Utrecht, Países Bajos.



CERTIFICATE OF ATTENDANCE AND PRESENTATION

Francisca Beroíza-Valenzuela

of Agencia Nacional de Investigación y Desarrollo de Chile, Chile, attended (as an online participant) the Thirty-First International Conference on Learning, Utrecht University, Utrecht, Netherlands, 10-12 July 2024 (24 hours). Francisca Beroíza-Valenzuela presented the paper

STEM en Educación Superior: El impacto de los estereotipos de género sobre el trabajo colaborativo

We thank you for your valuable contribution. The annual conference is an integral component of The Learner Research Network.

Dr. Kristi Jauregi-Ondarra
Utrecht University, The Netherlands
Conference Chair

Dr. Christopher Jenks
Utrecht University, The Netherlands
Conference Chair

Utrecht University

13. Certificado Conferencia sobre Educación y Conocimiento, Universidad de Alicante, España.



International Congress: Education and Knowledge
Congreso Internacional: Educación y Conocimiento
Congrés Internacional: Educació i Coneixement

CERTIFICATE

Francisca Beroíza Valenzuela
177638641

has given the oral presentation entitle:

STEM in Higher Education: The Impact of Gender Stereotypes on Collaborative Work

at the ***3rd International Congress: Education and Knowledge*** (ICON-edu 2024) [III Congreso Internacional: Educación y Conocimiento], held from 6 to 7 June 2024, with a duration of 30 hours, at the University of Alicante.

In witness
whereof and for all relevant purposes, this certificate is stamped and signed
in Alicante, 7 June 2024.

Profa. Dra. Rosabel Roig Vila
President ICON-edu 2024

Prof. Dr. Jordi Antolí
Secretary ICON-edu 2024

Organised by:

14. Certificado Conferencia sobre Educación y Conocimiento, Universidad de Alicante, España.



International Congress: Education and Knowledge
Congreso internacional: Educación y Conocimiento
Congrés internacional: Educació i Coneixement

CERTIFICATE

Francisca Beroíza Valenzuela
177638641

has given the poster entitle:

A Systematic Review of Literature on Gender Gap in STEM Education: Analysis of Factors Contributing to the Gap and Strategies for Overcoming Biases

at the ***3rd International Congress: Education and Knowledge*** (ICON-edu 2024) [III Congreso Internacional: Educación y Conocimiento], held from 6 to 7 June 2024, with a duration of 30 hours, at the University of Alicante.

In witness
whereof and for all relevant purposes, this certificate is stamped and signed
in Alicante, 7 June 2024.

Profa. Dra. Rosabel Roig Vila
President ICON-edu 2024

Prof. Dr. Jordi Antolí
Secretary ICON-edu 2024

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15. Convalidación Avance de Tesis II

Convalidación de Avance de Tesis II
4 mensajes

JORGE CRISTIAN JOO NAGATA <jorge.joo@umce.cl> 24 de julio de 2024, 10:53
Para: ANA CAROLINA GALVEZ COMANDINI <ana.galvez@umce.cl>, Francisca Beroiza <francisca.beroiza2021@umce.cl>
Cc: CESAR ALBERTO OSORIO FUENTEALBA <cesar.osorio@umce.cl>, Doctorado Educacion <doctorado.educacion@umce.cl>

Estimada Dra. Gálvez,

Junto con saludar y esperando que se encuentre bien, el presente correo es para informar que la actividad curricular "Avance de Tesis II" de Francisca Beroíza Valenzuela ha sido convalidada con el desarrollo de su pasantía. Ahora bien, es importante que inscriba los hitos finales curriculares (Tesis Final y Defensa de Grado) en este periodo de inscripción de cursos en UCampus.

Estaremos atentos a cualquier consulta que pudiera tener al respecto.

Reciba un cordial saludo.

--

UMCE

Dr. Jorge Joo Nagata
Secretario Académico interino
Programa Doctorado en Educación
Avda. José Pedro Alessandri #774 - Ñuñoa Santiago
Código Postal 7760197 - Teléfono: +56 223229049
www.umce.cl
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"" No sienta la obligación de contestar este mensaje fuera de su horario laboral ""

