TESIS DOCTORAL

UCAM
UNIVERSIDAD CATÓLICA DE MURCIA

ESCUELA INTERNACIONAL DE DOCTORADO

Programa de Doctorado en Ciencias de la Salud

NEW PERSPECTIVES ON THE IMPLEMENTATION OF THE MAES© METHODOLOGY IN CLINICAL AND EDUCATIONAL SETTINGS

Autor:

Giulio Fenzi

Director:

Dr. D. José Luis Díaz Agea

Murcia, junio de 2025

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AUTORIZACIÓN DEL DIRECTOR DE LA TESIS
PARA SU PRESENTACIÓN

El Dr. D. José Luis Díaz Agea como Director [1] de la Tesis Doctoral titulada "New Perspectives on the Implementation of the MAES© Methodology in Clinical and Educational Settings" realizada por D. Giulio Fenzi en el Programa de Doctorado Ciencia de la Salud, **autoriza su presentación a trámite** dado que reúne las condiciones necesarias para su defensa.

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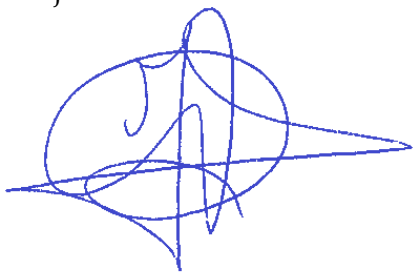

[1] Si la Tesis está dirigida por más de un Director tienen que constar y firmar ambos.

COMPENDIO DE PUBLICACIONES

El presente trabajo es una Tesis doctoral por compendio de publicaciones en la que se incluyen 4 artículos previamente publicados. A continuación, aparecen las referencias de los artículos y sus datos de calidad.

Artículo 1.

Giulio Fenzi, Adam D. Reuben, José Luis Díaz Agea, Tomás Hernández Ruipérez, César Leal Costa. (**2022**). Self-learning methodology in simulated environments (MAES©) utilized in hospital settings. Action-research in an Emergency Department in the United Kingdom. *International Emergency Nursing*. 61. 101128. Doi: **https://doi.org/10.1016/j.ienj.2021.101128**

DATOS INDEX: JCR 2022 Q3 (Category "Nursing": 71/125) IF 2022: 1.8

Artículo 2.

Giulio Fenzi, José Luis Díaz Agea, Dave Pethick, Rocio Bertolin Delgado, Noelia Hernández Donoso, Luis Lorente Corral. (**2022**). An Undergraduate Interprofessional Experience with Self-Learning Methodology in Simulation Environment (MAES©): A Qualitative Study. *Nursing Reports* 12(3), 446-463 Doi: **https://doi.org/10.3390/nursrep12030043**

DATOS INDEX: SCOPUS 2022 Q2 (Category "Nursing": 73/130) IF 2022: 1.6

Artículo 3.

Giulio Fenzi, Carolina Alemán Jiménez, Lucia López Ferrándiz, Cesar Leal costa, Jose Luis Diaz Agea. (**2024**). Enhancing Cardiopulmonary Resuscitation Training: An Interprofessional Approach with Undergraduate Medicine and Nursing Students Using Self-Learning Methodology in Simulated Environments (MAES)—A Qualitative Study. *Journal of Nursing Management*. Special Issue Revolutionizing Nursing Education: Cutting Edge Clinical Simulation Innovations. Doi: **https://doi.org/10.1155/jonm/9470402**

DATOS INDEX: JCR 2023 Q1 (Category "Nursing": 8/193) IF 2023: 3.7

Artículo 4.

Giulio Fenzi, Carolina Alemán Jiménez, Pedro Simón Cayuela Fuentes, Gabriel Segura López, Cesar Leal costa, Jose Luis Diaz Agea. (**2025**)**.** The Expository Phase of Debriefing in Clinical Simulation: A Qualitative Study. *BMC Nursing*. 24:476 Doi: **https://doi.org/10.1186/s12912-025-03067-z**

DATOS INDEX: JCR 2023 Q1 (Category "Nursing") IF 2023: 3.1

RESUMEN

Introducción: En el contexto actual de la formación sanitaria es necesario aplicar metodologías innovadoras. La Metodología de Autoaprendizaje en Entornos Simulados (MAES©) es una valida alternativa al más tradicional *Simulation Based Learning* (SBL). MAES© se basa en el aprendizaje entre pares, aprendizaje colaborativo y aprendizaje autónomo. Además, implementa una fase expositiva en el debriefing. Esta metodología pone al estudiante en el centro de su aprendizaje, garantizando una aplicación más activa y práctica. **Objetivo**: Analizar nuevas aplicaciones de MAES© en entornos clínicos, interprofesionales con escenarios complejos, además de la percepción de los participantes sobre la fase expositiva. **Metodología**: La presente Tesis es un compendio de publicaciones con mención internacional según normativa UCAM (3 artículos indexados en JCR y 1 en SCOPUS; estancia de más de 3 meses en el extranjero). **Resultados**: son el producto de los artículos que componen la presente Tesis: 1) Identificación de necesidades formativas en enfermeras recién contratadas y aceptación de MAES© como metodología formativa en entornos clínicos; 2) Valoración positiva de la aplicación de MAES© en combinación con la educación interprofesional con CRM; 3) Validación de MAES© como alternativa efectiva al método tradicional para entrenamiento en Reanimación Cardiopulmonar (RCP), alineada con las guías internacionales; 4) Certificación del valor de la fase expositiva del debriefing en MAES© por su efectividad en integrar teoría y práctica, fomentar el aprendizaje colaborativo y potenciar la autonomía. **Conclusión**: MAES© demuestra ser polivalente, adaptable, con un fuerte potencial para promover la colaboración interprofesional gracias a su enfoque y a la novedosa fase expositiva de debriefing.

PALABRAS CLAVE

Ciencias médicas, Metodología, Método educativo, Organización y planificación de la educación, Teoría y métodos educativos, Simulación.

ABSTRACT

Introduction: in the current context of healthcare education, it is essential to apply innovative methodologies. The Self-Learning Methodology in Simulated Environments (MAES©) is a valid alternative to the more traditional Simulation-Based Learning (SBL). MAES© is based on peer education, collaborative learning and self-learning and it implements an expository phase within the debriefing. This methodology places the student at the centre of the learning process, ensuring a more active and practical application. **Objective**: To analyse new applications of MAES© in clinical and interprofessional settings with complex scenarios, as well as the perceptions of the expository phase. **Methodology**: this thesis is international and a compendium of publications according to UCAM regulations (3 JCR-indexed articles, 1 SCOPUS-indexed article and a stay of more than 3 months abroad). **Results**: these are derived from the articles included in this thesis: 1) Identification of training needs among newly hired nurses and acceptance of MAES© as an educational methodology in clinical settings; 2) Positive evaluation of the application of MAES© in combination with interprofessional education and CRM; 3) Recognition of MAES© as an effective alternative to traditional methods for cardiopulmonary resuscitation (CPR) training, aligned with international guidelines; 4) Validation of the expository phase in MAES© debriefing for its effectiveness in integrating theory and practice, promoting collaborative learning, and enhancing student autonomy. **Conclusion**: MAES© proves to be versatile and adaptable, with strong potential to promote interprofessional collaboration thanks to its approach and the innovative expository phase of debriefing.

KEYWORDS

Medical Sciences, Methodology, Educational Methods, Organization and Planning of Education, Theory and Educational Methods, Simulation

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Esperando que encuentres motivación en lo que más te gusta

Y un día, mirando atrás, puedas estar orgulloso de tu papá.

"Prendete in mano la vostra vita e fatene un capolavoro".
Papa Giovanni Paolo II (1920-2005).

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SIGLAS Y ABREVIATURAS

A&E, Accident and Emergency

ABP, Aprendizaje Basado en Problemas

AECRESI, Aprendizaje en Entornos Clínicos Reales y Simulados

AHA, American Heart Association

AR, Realidad Aumentada (*Augmented Reality*)

COREQ, COnsolidated criteria for REporting Qualitative research

CPR, Cardiopulmonary Resuscitation

CRM, Crisis Resource Management

E-CRM, Emergency Crisis Resource Management

EIP-S, Educación Interprofesional con Simulación

ERC, European Resuscitation Council

GAS, Gather, Analyse, Summarise

HV, Hospital Virtual

ILCOR, International Liaison Committee on Resuscitation

INACSL, International Nursing Association for Clinical Simulation and Learning

IPE, Interprofessional Education

IST, Institute for Simulation and Training

JCR, Journal Citation Reports

MAES©, Metodología de Autoaprendizaje en Entornos Simulados

MR, Realidad Mixta (*Mixed Reality*)

OMS, Organización Mundial de la Salud

PEARLS, Promoting Excellence and Reflective Learning in Simulation

RCDP, Rapid Cycle Deliberate Practice

RCP, Reanimación Cardiopulmonar

RD&E, Royal Devon and Exeter Hospital

SBAR, Situation, Background, Assessment, Recommendation

SBL, Simulation Based Learning

SRQR, Standards for Reporting Qualitative Research

SSH, Society for Simulation in Healthcare

SVB, Soporte Vital Básico

TDT, Timeline Debriefing Tool

TGS, Teoría General de Sistemas

UCAM, Universidad Católica de Murcia

UCI, Unidad de Cuidados Intensivos

UCV, Universidad Católica de Valencia

VR, Realidad Virtual (*Virtual Reality*)

XR, Realidad Extendida (*Extended Reality*)

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I – INTRODUCCIÓN

I - INTRODUCCIÓN

1.1. LA TRANSFORMACIÓN DE LA EDUCACIÓN EN CIENCIAS DE LA SALUD

En las últimas décadas, la educación en ciencias de la salud ha experimentado una transformación profunda. Los desafíos globales y la creciente complejidad de los sistemas sanitarios han redefinido las competencias del personal sanitario. Los cambios sociales y tecnológicos han evidenciado la necesidad de reformar los modelos educativos tradicionales (Frenk et al., 2010; *Transforming and Scaling up Health Professionals' Education and Training*, n.d.).

Actualmente, tanto los estudiantes como los profesionales no se conforman con la educación pasiva tradicional en clases magistrales. Los alumnos de ciencias de la salud y los profesionales sanitarios demandan más interacción, más experiencias reales y significativas. Estos tienen que ser capaces de adaptarse a entornos dinámicos, interdisciplinares y centrados en el paciente. Por esta razón, resulta fundamental entender por qué aprenden algo y cómo lo van a aplicar en el mundo real (Bingen et al., 2024; Prashant et al., 2020). El rol del docente también ha cambiado. Ya no es suficiente con ser un experto que transmite información. Se pide ser facilitador del aprendizaje, guía para crear entornos seguros para que los estudiantes puedan aprender equivocándose, y reflexionando (Dyk et al., 2022).

En este contexto de transformación educativa, la Organización Mundial de la Salud (OMS) ha subrayado la importancia de adoptar enfoques educativos innovadores. No solo con el fin de fortalecer el dominio de habilidades técnicas, el pensamiento crítico y la toma de decisiones autónoma, también para reforzar la colaboración interprofesional (Organization, 2020).

En consecuencia, la formación en Ciencias de la Salud ha fortalecido la adopción de metodologías de enseñanza-aprendizaje basadas en la experiencia y la cooperación. Entre las más relevantes, destacan aquellas que impulsan y acompañan el cambio hacia un modelo formativo más dinámico, participativo y centrado en el estudiante (Martín-Alguacil & Avedillo, 2024)

1.1.1. Marco conceptual del aprendizaje en ciencias de la salud

En este periodo de transformación educativa, el aprendizaje en Ciencias de la Salud ha adaptado su enfoque pedagógico. Se ha cambiado de uno más tradicional con transferencia de conocimiento mediante clases magistrales, a una red de metodologías centradas en el estudiante y orientadas a la práctica clínica. Por ello, metodologías activas como el aprendizaje basado en problemas, el aprendizaje reflexivo y el aprendizaje experiencial han adquirido un rol más relevante. Estos enfoques promueven las habilidades críticas y colaborativas necesarias para enfrentar los desafíos de entornos sanitarios.

1.1.1.1. Aprendizaje Basado en Problemas (ABP)

El Aprendizaje Basado en Problemas (ABP) tiene su origen a finales de los años 60 en América del Norte, como respuesta a las limitaciones del enfoque tradicional en la enseñanza médica (Boud & Feletti, 2013). No obstante, aunque pueda parecer un método poco actual, continúa siendo aceptado por diferentes disciplinas gracias a las numerosas posibilidades para desarrollar actividades poniendo al estudiante al mando de su aprendizaje (J. Savery, 2006).

Para la implementación efectiva del ABP, es necesario respetar algunos principios claves definidos en su marco teórico. En primer lugar, la responsabilidad del aprendizaje debe recaer sobre los estudiantes. La motivación intrínseca aumenta cuando el aprendiz se responsabiliza, encontrando la solución de un problema (J. R. Savery & Duffy, 1995). En segundo lugar, el problema tiene que presentarse de forma abierta e indirecta, permitiendo la formulación de preguntas para la búsqueda de una solución. Finalmente, la verificación del aprendizaje se produce aplicando la solución propuesta al problema inicial, permitiendo analizar su efectividad y revisar la solución adoptada (J. Savery, 2006).

El ABP no puede prescindir de la colaboración entre los participantes. Todo discente, cuando se convierta en trabajador, se enfrentará a diferentes situaciones donde exista la necesidad de compartir eficazmente información en equipo. Por esta razón, el ABP se realiza sobre todo en pequeños grupos. El trabajo grupal permite la creación de la discusión, que llevará a la identificación de las necesidades de aprendizaje para resolver el problema (T. Li et al., 2024; Zheng et al., 2023). La

dimensión colaborativa en el ABP es una característica fundamental y resulta ser el verdadero enlace con el mundo del trabajo (Hmelo-Silver, 2004).

Con este método los estudiantes pueden realizar investigación, integrando la teoría con la práctica, aplicando conocimientos y habilidades para desarrollar diferentes soluciones con el fin de resolver los problemas previamente planteados. El ABP fomenta el pensamiento crítico, el trabajo colaborativo y la integración de la teoría con la práctica. Además, permite desarrollar razonamiento clínico, toma de decisiones y capacidad para enfrentar situaciones problemáticas en escenarios reales. Todos estos aspectos consolidan su importancia y eficacia en el ámbito de las Ciencias de la Salud, donde se puede ver aplicado en seminarios, discusiones de casos clínicos, simulación clínica etc. (Ren et al., 2023)

*1.1.1.2. **Aprendizaje Reflexivo***

El aprendizaje reflexivo se inspira en teóricos como John Dewey y Donald Schön. Estos identifican dentro de la capacidad de análisis de la experiencia, el motor para un conocimiento significativo. El pensamiento reflexivo es un proceso activo y crítico de evaluación de creencias y supuestos. En este modelo resulta fundamental la experiencia, la observación, la prueba de ideas y sus análisis (Dewey, 1910). La reflexión puede producirse tanto sobre la acción (reflexión después de una experiencia) como en la acción (reflexión durante la experiencia) (Schön, 2017).

El aprendizaje reflexivo se puede realizar de diferentes formas, pero no debería prescindir de algunos componentes fundamentales. En primer lugar, es necesaria la implicación activa del individuo en el proceso reflexivo (*Engagement of the Self*) con sus pensamientos y acciones (*Thoughts and Actions*). La interacción con los pensamientos tiene que ser atenta, crítica, exploratoria y repetitiva (*Attentive, Critical, Exploratory and Iterative Interactions*). Además, debe existir un marco conceptual subyacente (*Conceptual frame*), que consta de los conocimientos adquiridos por el alumno en sus estudios. Finalmente, es fundamental para que el modelo sea productivo, un deseo de cambio o de mejora por parte de quien reflexiona (*View of Change*). Aunque existan estos 5 componentes, el aprendizaje reflexivo resulta dependiente del contexto en el que se produce y, del desencadenante que lo inicia, siendo la motivación intrínseca más efectiva que la extrínseca (Nguyen et al., 2014).

La reflexión puede integrarse en los procesos formativos con varias modalidades (diarios reflexivos, debates estructurados, tutorías clínicas, simulación clínica etc.) (MacAskill et al., 2023). Utilizando la práctica del aprendizaje reflexivo, los futuros profesionales de la salud desarrollan la capacidad de interiorizar conocimiento. Cada una de sus actuaciones, ya sean positivas o mejorables, se convierten en una valiosa fuente de aprendizaje cuando están acompañadas de una reflexión propositiva y exhaustiva (Mann et al., 2009). En el entorno de Ciencias de la Salud, reflexionar sobre la práctica permite que los estudiantes identifiquen sus aciertos y áreas de mejora. Como consecuencia, el alumno genera una conciencia esencial para la toma de decisiones (Fragkos, 2016). De este modo, los estudiantes y profesionales se adaptan a escenarios complejos, lo que dará lugar a futuros cuidados en los pacientes con una atención más integral, empática y fundamentada (Patel & Metersky, 2022).

*1.1.1.3. **Aprendizaje Experiencial***

El aprendizaje experiencial se basa en la premisa de que el conocimiento se construye a partir de la experiencia directa, mediante un ciclo continuo de acción y reflexión. Este enfoque se utilizó por primera vez en 1984. El teórico de la educación, David Kolb, describió cómo las personas aprenden a través de cuatro etapas: experiencia concreta, observación reflexiva, conceptualización abstracta y experimentación activa (Kolb, 2014) (Figura 1).

En el ámbito de la educación en Ciencia de la Salud, este modelo se traduce en actividades que permiten a los estudiantes enfrentarse a situaciones similares a las reales. Una vez terminadas las actividades, se analizan para generar aprendizaje trasferible a contextos reales (S. Grace et al., 2017). Esta metodología garantiza un entorno de aprendizaje seguro, donde el error es visto como una oportunidad de mejora y crecimiento profesional. Algunos ejemplos de aprendizaje experiencial son: clases invertidas, talleres de actividades y simulación clínica (Burch et al., 2019).

Los estudiantes que se preparan con una metodología de aprendizaje experiencial mejoran la retención de conocimientos. Además, desarrollan competencias transversales técnicas y no técnicas, que se pueden aplicar en el contexto clínico como: la comunicación, el liderazgo y la empatía (Nurunnabi et al., 2022).

Figura 1 Ciclo de Kolb

Elaboración propria: elaboración grafica de los 4 pasos del ciclo de Kolb.

1.1.2. La simulación clínica como herramienta educativa

Una de las estrategias que mejor representa e incluye todos los modelos de aprendizaje expuestos es la simulación clínica. Aprender con Simulación (*Simulation Based Learning* – SBL) se ha consolidado como metodología que permite un aprendizaje ABP, reflexivo y experiencial (Hung et al., 2021; Rosen et al., 2008). Además, se alinea con estándares específicos reconocidos internacionalmente (*Healthcare Simulation Standards of Best PracticeTM - Clinical Simulation In Nursing*, n.d.).

Este enfoque, aplicado a Ciencias de la Salud a través de escenarios clínicos realistas, permite practicar procedimientos, tomar decisiones críticas, trabajar en equipo y reflexionar sobre las acciones sin poner en riesgo el paciente (Hurd et al., 2021). Esta metodología refuerza habilidades técnicas y fortalece competencias no

técnicas como la comunicación y el liderazgo (Cant & Cooper, 2017). El SBL también permite una evaluación formativa continua, a través del debriefing, una fase reflexiva donde el estudiante puede analizar lo ocurrido identificando fortalezas y áreas de mejora (Decker et al., 2021a).

1.2. LA SIMULACIÓN CLÍNICA EN CIENCIAS DE LA SALUD

La Simulación Clínica es una técnica que crea una situación o entorno para permitir que las personas experimenten una representación de un evento real con el propósito de practicar, aprender, evaluar, probar o comprender sistemas o acciones humanas (*Healthcare Simulation Dictionary*, 2025).

Aprender mediante simulación se ha consolidado como una estrategia pedagógica esencial. Ofrece un entorno seguro, donde los estudiantes y profesionales pueden practicar, equivocarse y reflexionar. Además, mejora la preparación clínica, incrementando la confianza y la seguridad del paciente. Esta metodología permite pasar de la teoría a la práctica y de un conocimiento pasivo al conocimiento activo (Alshehri et al., 2023). Los conceptos que forman la base del aprendizaje con simulación se vieron reforzados recientemente gracias al "*Global Consensus Statement on simulation-Basel Practice in Healthcare*" donde se subraya la necesidad de integrar la simulación como componente esencial en todos los niveles de formación y desarrollo profesional en salud (Diaz-Navarro et al., 2024).

Para comprender por qué la simulación se ha posicionado como estrategia pedagógica clave en la transformación de la enseñanza en Ciencia de la Salud, se abordará en este capítulo su evolución histórica, su estructura y las metodologías más utilizadas en la actualidad.

1.2.1. Evolución de la simulación

Las raíces de la simulación clínica se pueden encontrar en las prácticas de aprendizaje por imitación o repetición, presentes en las civilizaciones egipcia y griega. En aquel periodo ya se emplean modelos anatómicos para enseñar procedimientos médicos básicos (Bradley, 2006). Sin embargo, es desde el 1700 que se encuentran documentadas las primeras formaciones médicas con fantomas. En concreto, Madame de Coudray (Francia) realizó una formación en reanimación

obstétrica con un "fantoma" de pelvis realizados con almohadas (Scharf et al., 2022).

La evolución de la simulación en las ciencias médicas se vincula al mundo de la aviación. Es gracias a la creación de simuladores aéreos de alta fidelidad que inicia el desarrollo de simuladores clínicos. El primero se construye en los años 60 del novecientos, y permite entrenar la auscultación cardiaca. En la misma década, se idea también el más famoso "*Resusci Anne*", primer simulador para la resucitación cardiopulmonar (RCP) (Cooper & Taqueti, 2008).

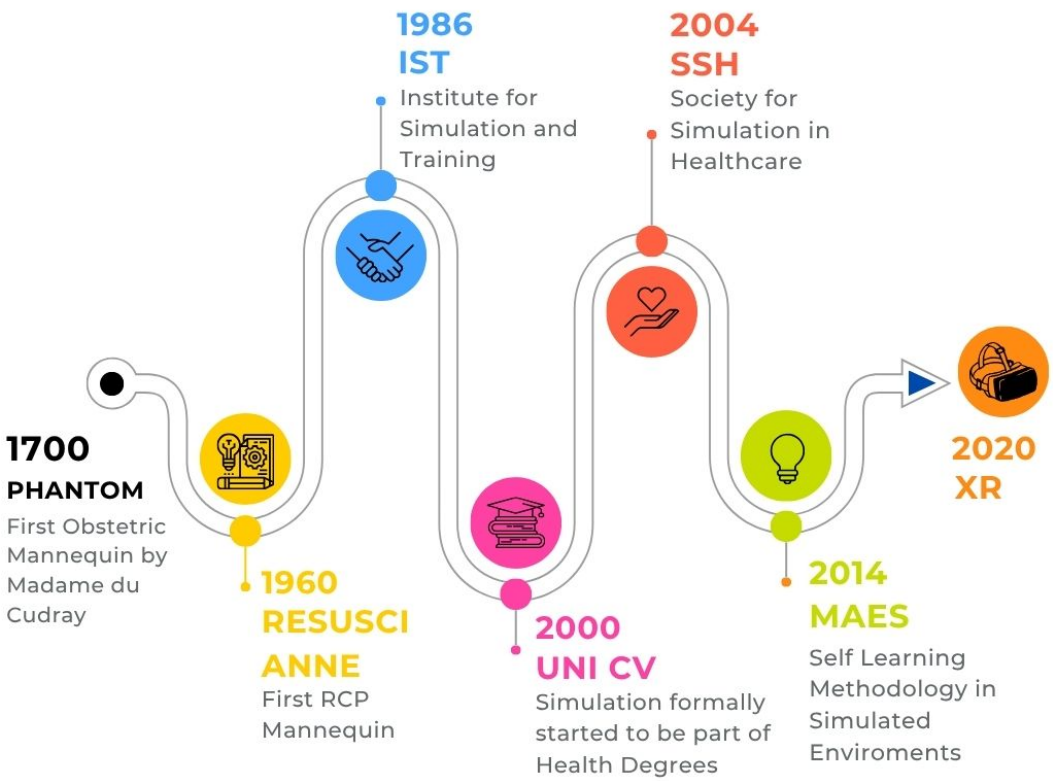
A partir de la década de 1980, la simulación clínica comienza a ganar relevancia en el ámbito de la formación en Ciencias de la Salud gracias a la fundación del *Institute for Simulation and Training* (IST). El impulso principal se obtiene por la creciente atención a la seguridad del paciente. La conexión simulación-formación médica aumenta con los años hasta que se empieza a considerar como una metodología válida en las universidades (Gaba, 2004). Unos de los hitos clave en la profesionalización de la simulación es la creación de organizaciones y sociedades científicas exclusivamente dedicadas a su desarrollo. En particular, se recuerda la formación de la *Society for Simulation in Healthcare* (SSH) en 2004 (referente internacional del movimiento actualmente).

En las últimas décadas, la simulación en la formación médica ha evolucionado y ha fortalecido su peso en la comunidad científica. Este acontecimiento se debe principalmente a la publicación de los primeros estándares de buenas prácticas en simulación por parte de la *International Nursing Association for Clinical Simulation and Learning* (INACSL) en 2011. Del mismo modo, se suma el más reciente consenso general que reafirma el papel estratégico de la simulación como herramienta esencial en la formación continua de los profesionales de la salud (Diaz-Navarro et al., 2024). El enfoque inicial centrado en el desarrollo de habilidades técnicas se ha transferido a un modelo integral que incluye habilidades comunicativas, toma de decisiones, trabajo en equipo y análisis de sistemas de salud (Alharbi et al., 2024). En este contexto se han ideado metodologías diferentes en las que se encuentran: el aprendizaje con simulación SBL (el método más clásico), la simulación in situ (M. A. Grace & O'Malley, 2024), la Simulación Interprofesional (*Interprofessional Education*-IPE) (Sezgin & Bektas, 2023) y la novedosa Metodología de Autoaprendizaje en Entornos Simulados (MAES©). Esta

última se ideó en el año académico 2012-2013 por 3 investigadores de la Universidad Católica de Murcia (UCAM) (Díaz Agea et al., 2014).

Desde 2020, paralelamente a los avances tecnológicos y a la necesidad de las clases a distancia como consecuencia de la pandemia COVID-19, se empieza a trabajar en simulación con recursos técnicos avanzados. En concreto. inician a idear escenarios de simulación o talleres con Realidad Extendida (XR), incluyendo entre los recursos: la Realidad Aumentada (AR), la Realidad Virtual (VR) y la Realidad Mixta (MR) (*Healthcare Simulation Dictionary*, 2025; Plotzky et al., 2021)

Figura 2 Historia de la Simulación



Producción propria: breve descripción grafica de los principales hitos de la historia de la simulación.

1.2.2. Las fases de la simulación

En los últimos años se han desarrollado varias metodologías de aprendizaje con simulación. Aunque cada una de ellas tenga sus peculiaridades, ninguna puede

prescindir de cuatro fases comunes: prebriefing, briefing, escenario simulado y debriefing (Sellberg, 2018).

*1.2.2.1. **Prebriefing***

Hay ciertos elementos clave que deben estar presentes en esta fase previa, conocida como prebriefing. Entre ellos se encuentran la presentación del contexto o escenario de la simulación, la definición de expectativas, la explicación del proceso de retroalimentación, la descripción detallada del caso o situación que se va a simular, la orientación sobre el espacio físico donde se desarrollará la actividad y, finalmente, un tiempo adecuado para que los estudiantes puedan prepararse.

Preparar a los estudiantes antes de una simulación es fundamental para asegurar una experiencia de aprendizaje exitosa y enriquecedora. Crear un ambiente seguro desde el inicio no solo marca el tono de toda la actividad, sino que también ayuda a reducir la inseguridad de los participantes. Esto les permite sentirse más cómodos al asumir riesgos y cometer errores, lo cual es esencial para el aprendizaje. Además, este entorno seguro previene actitudes defensivas y favorece una relación de confianza entre el facilitador y los estudiantes, lo que contribuye a un ambiente propicio para el aprendizaje, especialmente durante la fase de retroalimentación o debriefing.

Es importante que, desde el comienzo, se establezcan normas claras para la simulación. Estas reglas deben comunicar a todos los participantes cuáles son las expectativas compartidas respecto a la experiencia de aprendizaje, promoviendo así un compromiso mutuo (Rutherford-Hemming et al., 2019)

*1.2.2.2. **Briefing***

El briefing en simulación clínica es la fase inicial donde se contextualiza la actividad. En este momento, se presentan los objetivos de aprendizaje y se deja la información útil para la realización del caso de simulación. Esta etapa tiene el fin de mejorar el rendimiento, disminuir posibles errores técnicos y facilitar la inmersión de los participantes en la práctica. Su desarrollo es esencial para maximizar el valor educativo de la simulación (McDermott et al., 2021).

*1.2.2.3. **Escenario simulado***

La simulación de un escenario es al acto concreto de la experiencia simulada, en la que se produce el aprendizaje experiencial. En este momento (que no debería ser más largo de 12-15 minutos) es oportuno conocer y seguir unas recomendaciones, dependiendo del nivel de los participantes. De este modo, el grado de fidelidad y complejidad de la simulación se adaptará al objetivo de aprendizaje específico para cada grupo en concreto (Watts et al., 2021).

En simulación clínica, para desarrollar el escenario acorde con el grado de complejidad identificado previamente, se siguen unas directrices llamadas *SimZones (C. J. Roussin & Weinstock, 2017)*. Su estructura se organiza en 4 zonas: 0, 1, 2 y 3; con una progresiva distribución de materiales, complejidad, competencias, distracciones y fidelidad (Tabla 1). Algunos autores describen también una zona 4, que se suele asociar a un escenario real, donde se aprende y mejora gracias a un debriefing posterior (C. Roussin et al., 2020).

*1.2.2.4. **Debriefing***

El debriefing es la fase más importante de la simulación, en la que se produce el aprendizaje reflexivo analizando los acontecimientos de la sesión. En algunos modelos de debriefing se pueden analizar también las emociones y cómo estas se relacionan con las acciones de los participantes (Duff et al., 2024; Fegran et al., 2023).

Existen diferentes modelos de debriefing. En general, se pueden dividir en 2 grandes grupos, dependiendo de quién los realiza: debriefing guiado por el facilitador o debriefing guiado por el estudiante (Sawyer et al., 2016). No obstante, existen debriefings más rápidos y basados en feedbacks directos. Estos permiten corregir técnicas específicas según los objetivos de aprendizaje fijados durante la sesión de (de Castro et al., 2022) simulación.

Tabla 1 Las Sim Zones

Sim Zone	*Descripción*
0	*Basada en el auto-feedback. Suele realizarse con un solo estudiante (o en grupos pequeños) utilizando los recursos de tecnologías o simulación virtuales*
1	*Instrucciones prácticas y pruebas para entrenar habilidades clínicas fundamentales o habilidades técnicas básicas. Los recursos principales suelen ser piezas de simuladores de entrenamiento (ej: brazo para practicar la canalización de vía o pelvis para practicar sondaje vesical).*
2	*Situación simulada en un contexto clínico, con el aumento de la fidelidad y de las distracciones del escenario. Los participantes trabajan y entrenan con una simulación utilizando unos protocolos pre-establecidos o entrenando técnicas específicas. Se pueden utilizar recursos como simuladores básicos, con feedback específicos (ej: simuladores con feedback de calidad de las compresiones torácicas) o actores.*
3	*Aumento del realismo, de la fidelidad y autenticidad de la situación simulada. Los participantes son profesionales sanitarios que entrenan o aprenden habilidades que practican (o podrían practicar) en sus trabajos diarios.*
4	*No se refiere a una situación simulada. La zona 4 coincide con el debriefing después de una situación clínica real. Enfatiza la oportunidad de aprendizaje de este momento en la práctica clínica.*

Elaboración propia: descripción de las zonas de simulación.

1.2.3. Diferentes metodologías de Simulación clínica en formación sanitaria

En el mundo del aprendizaje basado en la simulación clínica, existen diferentes metodologías. Todas tienen un desarrollo en entornos seguros y controlados, permitiendo a los estudiantes reforzar habilidades técnicas y no técnicas. Asimismo, facilitan la adquisición de competencias sin poner en riesgo a pacientes reales (Alharbi et al., 2024).

1.2.3.1. ***Simulation Based Learnign (SBL)***

Entre las diferentes metodologías, la más antigua y utilizada es el *Simulation Based Learning* (SBL). El SBL es un método más tradicional, que mantiene al profesor o instructor al mando del proceso de aprendizaje. La figura del instructor se percibe por parte de los alumnos como un "experto" que tiene el control sobre los objetivos de aprendizaje, los tiempos y las planificaciones (Tamilselvan et al., 2023). Esta metodología es la que más se asocia a evaluaciones con simulación, manteniendo una motivación para el aprendizaje principalmente extrínseca (Henrique-Sanches et al., 2024).

1.2.3.2. ***Interprofessional Education***

La necesidad de formación entre distintas disciplinas para entrenar la colaboración y comunicación ha aumentado en los últimos años. La metodología de educación interprofesional con simulación (EIP-S) nace en respuesta a esta mayor complejidad de demanda del sistema sanitario actual (Reeves et al., 2013). La EIP-S se realiza cuando participantes e instructores de dos o más disciplinas se involucran en una experiencia simulada para conseguir o compartir objetivos de aprendizaje (*Healthcare Simulation Dictionary*, 2025).

La metodología interprofesional se fundamenta principalmente en SBL, permitiendo a estudiantes y profesionales de diferentes áreas realizar prácticas en entornos simulados y seguros. Así se desarrollan competencias colaborativas en situaciones clínicas realista ('INACSL Standards of Best Practice', 2016; Oandasan & and Reeves, 2005). La EIP-S, no solo incrementa la eficacia del trabajo en equipo, sino que también reduce errores y mejora los resultados clínicos (Hernández et al., 2021; Raurell-Torredà et al., 2024). Además, la Organización Mundial de la Salud (OMS) recomienda su implementación para fortalecer la formación sanitaria y la adaptación a las necesidades del entorno asistencial (*Framework for Action on Interprofessional Education & Collaborative Practice*, n.d.).

1.2.3.3. ***Simulación In-Situ***

La simulación *In-Situ* se ha consolidado como una metodología clave en la formación continua de profesionales sanitarios (Finstad et al., 2023). Permite un aprendizaje directamente en el entorno laboral, recreando escenarios clínicos realistas en lugar de trabajo con recursos y equipos habituales (Sundelin et al.,

2023). Estos aspectos incrementan la fidelidad de la experiencia y facilitan la identificación de amenazas latentes para la seguridad del paciente. Por esta razón asume un alto valor preventivo además de educativo (Gómez-Pérez et al., 2023).

La simulación *In-Situ* ha demostrado mejorar la respuesta ante situaciones críticas, optimizando la toma de decisiones clínicas. Asimismo, se ha observado que este tipo de formación contribuye a la detección y corrección de errores sistemáticos, mejorando la calidad asistencial. Representa una estrategia eficaz para la formación sanitaria con simulación tradicional o, también adaptada a la simulación interprofesional (Rojo et al., 2022b).

1.2.3.4. ***Metodología de Autoaprendizaje en Entornos Simulados (MAES©)***

Otra metodología de aparición más reciente (2014) y desarrollada en España es la Metodología de Autoaprendizaje en Entornos Simulados (MAES©). La característica principal de MAES© es poner al alumno en el centro del aprendizaje. A diferencia del SBL, el instructor pasará a ser facilitador, acompañando a los alumnos en la formación, sin imponer su rol. Son los alumnos quienes eligen los objetivos de aprendizaje, diseñan los casos y buscan la información teórica para, posteriormente exponerla al resto de compañeros. Con MAES©, la estructura briefing-simulación-debriefing varía ligeramente. Nos encontraremos con 3 fases más: pre-briefing (formación de identidad grupal y creación de línea basal de aprendizaje), diseño del escenario y fase expositiva del debriefing para contestar a los objetivos de aprendizaje previamente acordados. Además, el briefing se incluye en la fase de simulación (Díaz et al., 2016).

1.2.4. Conexión entre diferentes metodologías

Las distintas metodologías de simulación clínica no son excluyentes entre sí. Al contrario de lo que se podría pensar, su combinación puede potenciar significativamente los resultados de aprendizaje. Todas pueden ser aplicadas tanto en contextos universitarios como clínicos, a excepción el modelo MAES©, cuya implementación se ha documentado principalmente en entornos académicos hasta la fecha.

Enfoques orientados al trabajo en equipo, en entrenamiento de habilidades técnicas, resolución de conflictos y basados en escenarios complejos, permiten

integrar distintas metodologías de simulación (Putz et al., 2022). El *Crisis Resource Management* (CRM) y el entrenamiento con escenario complejos de resucitación cardiopulmonar (RCP), son temas que ayudan al aprendizaje interprofesional y colaborativo. Además, cuando estos escenarios se desarrollan in situ, se maximiza su efectividad al entrenar con los mismos recursos humanos y materiales que en el entorno clínico (Grasto & Leonardsen, 2024).

1.2.4.1. ***La importancia del Crisis Resource Management (CRM)***

El Crisis Resource Management (CRM) es un enfoque educativo y organizativo originado en la aviación a finales de los años 70. Su fin es mejorar el rendimiento de equipo en situaciones críticas (Kanki et al., 2010). La aplicación en Ciencias de la Salud llega en los años 80, cuando se comienza a utilizar para formación en el campo de la anestesia (Gaba et al., 2014). En los últimos años se aplica a entrenamiento interprofesional en varias disciplinas y especializaciones, como, por ejemplo, en Urgencias y Emergencias con el *Emergency Crisis Resource Management* (E-CRM). Independientemente del ámbito donde se utilice, el CRM se centra en optimizar el uso de todos los recursos disponibles, mediante habilidades técnicas y no técnicas (liderazgo, comunicación, toma de decisiones y trabajo en equipo) (Casal Angulo et al., 2020).

El CRM se enfoca en la colaboración, comunicación efectiva, toma de decisiones, liderazgo y gestión de los recursos. Su entrenamiento se adapta principalmente a situaciones clínicas complejas, como pueden ser una parada cardiorrespiratoria o, la gestión de la vía aérea difícil. En estos escenarios nunca encontraremos un solo profesional actuando. Para un buen manejo de estas situaciones, será necesaria la actuación de equipos interprofesionales. Por esta razón, la metodología de educación interprofesional con simulación se beneficia especialmente del CRM para su aplicación. La integración de CRM y EIP-S, permite que los estudiantes de medicina y enfermería se entrenen juntos en escenarios simulados, favoreciendo la mejora de la comunicación, la delegación efectiva de tareas y el desarrollo de entornos colaborativos (Carne et al., 2012). Actualmente CRM y EIP-S se han aplicado ampliamente tanto en entornos académicos como *in situ*, pero no existe evidencia sobre su aplicación con la metodología MAES© (Bochatay et al., 2025).

*1.2.4.2. **Escenarios complejos: la Parada Cardiorrespiratoria***

La parada cardiorrespiratoria representa un problema con elevadas tasas de morbimortalidad, lo que exige una respuesta inmediata, eficaz y coordinada. La simulación en este tipo de emergencias favorece la adquisición de habilidades técnicas y no técnicas (Lauridsen et al., 2022). Como en CRM, aspectos como la toma de decisiones, el liderazgo, la comunicación efectiva y el trabajo en equipo constituyen un punto clave en el entrenamiento con escenarios de Resucitación Cardiopulmonar (RCP). Estas habilidades, clave en situaciones de alta tensión, se entrenan de forma eficaz cuando el escenario es realista y desafiante, como en el caso del entrenamiento con escenarios complejos de la simulación clínica (Alshehri et al., 2023).

El entrenamiento con escenarios de RCP aplicados a la simulación de alta fidelidad permite la integración de distintas metodologías como el SBL y el aprendizaje interprofesional, ofreciendo una experiencia formativa más rica y transferible a la práctica real, aumentando así la seguridad del paciente (Bentley et al., 2022). Además, cuando un escenario de RCP se desarrolla en el entorno clínico habitual y con los mismos recursos humanos, materiales y espaciales (simulación *In-Situ*), se incrementa la fidelidad del aprendizaje (Sundelin et al., 2023). Esta modalidad no solo mejora la preparación técnica, sino que fortalece la colaboración entre profesionales de distintas disciplinas al permitir entrenar con equipos reales. Por esta razón, la simulación en RCP resulta ser una posibilidad concreta para integrar metodologías activas y colaborativas como el aprendizaje con simulación interprofesional *In-Situ (*Rojo et al., 2022*).* Actualmente no existe evidencia que analicen la aplicación de la metodología MAES© en entrenamiento de RCP con equipos interprofesionales.

1.3. MAES©

La Metodología de Autoaprendizaje en Entornos Simulados (MAES©) se idea en la Universidad Católica de Murcia (UCAM) en 2012 por Díaz, Leal y García, 3 investigadores que poseen su propiedad intelectual y pertenecían al grupo de investigación Aprendizaje en Entornos Clínicos Reales y Simulados (AECRESI). Se aplica por primera vez en el grado de enfermería de la misma universidad en el año académico 2012-2013. Sucesivamente, en 2014, se publica el primer artículo que

define el modelo MAES© y explica sus principios y fundamentos. Esta metodología promueve un aprendizaje liderado por los estudiantes, fundamentándose en teorías grupales e integrando múltiples enfoques pedagógicos (Díaz Agea et al., 2014).

1.3.1. Cambio de enfoque en la simulación de Ciencias de la Salud

En respuesta al cambio necesario en la formación de Ciencias de la Salud, MAES© se presenta como una alternativa válida a los modelos tradicionales. Transforma la educación unidireccional profesor-alumno en un modelo en el que el alumno pasa a ser el centro de su mismo aprendizaje. La ruptura del paradigma tradicional del instructor al mando del proceso permite al alumno asumir un rol activo en su aprendizaje, promoviendo la orientación de su conocimiento hacia necesidades reales (Finn et al., 2025; Wong et al., 2021). Centrar la atención sobre el alumno implica reconocerlo como protagonista activo de su proprio proceso formativo, favoreciendo su autonomía, pensamiento crítico, responsabilidad y motivación intrínseca (Qian et al., 2023; Roberts et al., 2024).

MAES©, de acuerdo con su enfoque de aprendizaje autodirigido, fomenta la motivación intrínseca, ya que los estudiantes deciden qué y cómo aprender, dentro del marco de los objetivos establecidos por la asignatura. La libertad controlada que se encuentra en MAES©, no solo incrementa la implicación y el compromiso de los estudiantes, sino que también estimula el deseo de aprender. Asimismo, los alumnos desarrollan una mayor conciencia sobre la complejidad de los problemas que encontrarán en sus prácticas o en el mundo laboral (Díaz-Agea et al., 2021). Con el nuevo enfoque que permite MAES©, los alumnos no solo aprenden habilidades técnicas o no técnicas, también se preparan a nivel personal para tomar decisiones fundamentales y adaptarse con mayor eficacia a entornos clínicos dinámicos (Díaz et al., 2016).

1.3.2. Principios pedagógicos

La metodología MAES© se fundamenta en una sólida base pedagógica que integra múltiples enfoques educativos. Aunque comparta con SBL los pilares (aprendizaje basado en simulación, ABP, el aprendizaje reflexivo y el aprendizaje experiencial) MAES© va más allá. La metodología de autoaprendizaje en entornos

simulados incorpora principios de la educación entre pares (*Peer-Education*), aprendizaje colaborativo y del modelo educativo de autoaprendizaje. Además, uno de los aspectos diferenciadores de MAES© es su énfasis en el trabajo en equipo y la dinámica grupal para garantizar un entorno seguro como motor del aprendizaje (Díaz et al., 2016). En conjunto, estos principios convierten MAES© en una propuesta metodológica transformadora que, no solo forma en competencias clínicas, también en habilidades sociales, comunicativas y de gestión (Leal Costa et al., 2019).

1.3.2.1. ***Educación entre pares (Peer-Education)***

La *Peer-Education* surge en la década de 1960 como estrategia de programas de salud pública. Se basa en el hecho de que los estudiantes puedan aprender eficazmente de sus iguales. La fuerza pedagógica de este modelo está en la cercanía generacional, el lenguaje común y la confianza mutua que facilitan el intercambio de conocimientos (Topping, 2022). Este enfoque es una estrategia en la que los estudiantes asumen roles activos. Son los mismos estudiantes quienes, en su grupo de coetáneos, se encargan de transferir conocimientos, realizando un aprendizaje significativo (Keller et al., 2011).

Esta metodología ha demostrado ser eficaz para mejorar la comprensión de conceptos complejos y desarrollar habilidades clínicas (Markowski et al., 2021). Los programas de educación entre pares han mejorado la competencia y la confianza de los estudiantes en entornos clínicos simulados. Además, la interacción entre alumnos promueve la reflexión crítica y la autoevaluación (Chovriy et al., 2024). Este método facilita también la creación de un entorno de aprendizaje inclusivo, participativo, donde el estudiante se sienta más cómodo compartiendo dudas y experiencias (Ramm et al., 2015). Este enfoque puede mejorar el rendimiento académico y preparar a los estudiantes para trabajar en equipo, competencia clave en las prácticas actuales (İncesu & Ulupinar, 2023; Keller et al., 2011).

1.3.2.2. ***Aprendizaje colaborativo***

El aprendizaje colaborativo tiene sus raíces en los años 80 de novecientos en la teoría sociocultural de Vygotsky. En ella resalta la importancia de la interacción social en la construcción del conocimiento (Mota de Cabrera & Villalobos, 2007; Williamson et al., 2020). Es un enfoque educativo que enfatiza la cooperación entre

estudiantes para alcanzar objetivos comunes. Promueve el desarrollo de habilidades sociales y cognitivas como medio para adquirir o reforzar conocimientos (Owen & Ward, 2014; Zhang & Cui, 2018).

Esta metodología ha sido implementada con éxito en Ciencias de la Salud sobre todo para mejorar o adquirir habilidades prácticas (Williamson et al., 2020). La alta implicación de los estudiantes mediante este método mejora la competencia clínica y la motivación. De igual modo, fomenta la responsabilidad individual hacia el grupo y la capacidad de resolución de problemas en equipo (Haugland et al., 2022). La colaboración facilita la integración de conocimientos teóricos, el desarrollo de competencias interpersonales (como la comunicación efectiva) preparando a los estudiantes para los futuros desafíos del mundo laboral (Ramdani et al., 2022).

1.3.2.3. ***Autoaprendizaje y Factor Grupal***

El autoaprendizaje es un modelo pedagógico fundado en teorías constructivistas y humanistas, especialmente en las propuestas de Knowles sobre el aprendizaje autodirigido (años 70). En esta metodología los estudiantes asumen la responsabilidad de su proprio aprendizaje. Identifican sus necesidades, establecen los objetivos y evalúan su proceso (Charokar & Dulloo, 2022).

Fomentar el autoaprendizaje en Ciencias de la Salud se ha demostrado crucial para desarrollar capacidad de pensamiento crítico y autoconfianza. Además, aumenta la autonomía del estudiante hacia el enfrentamiento de problemas (Finn et al., 2025; Liu & Sullivan, 2021). Este enfoque también se asocia a una mayor motivación intrínseca y una mayor preparación en competencias básicas (S. Li et al., 2024).

Aunque MAES© se basa en el autoaprendizaje, no es una metodología individualista. Su enfoque considera que el grupo de simulación tiene competencias e intereses comunes que resultan determinantes para el aprendizaje. Por esto se considera que MAES© va más allá del individuo y mira hacia el grupo como unidad funcional de la simulación. Este enfoque toma el nombre de factor grupal (García-Méndez et al., 2022). Para entender mejor este concepto, que constituye la base de la metodología MAES©, es importante conocer las teorías que lo componen.

1.3.2.4. Teorías del factor grupal aplicadas a MAES©

MAES© es una metodología que utiliza unidades grupales pequeñas para que los estudiantes realicen el trabajo. Al mismo tiempo, cada uno de los grupos involucrados en el aprendizaje es parte de un grupo-clase (Díaz Agea et al., 2014). Cuando hablamos de factor grupal en MAES©, no se trata solo de crear un entorno seguro para permitir a un grupo trabajar de la mejor forma creando su identidad. El sentido del enfoque de la metodología MAES© es más profundo y se funda en la unión de unas teorías complejas que se desarrollaron a lo largo del siglo XIX (Díaz et al., 2016; García-Méndez et al., 2022).

En primer lugar, es importante considerar la Teoría General de Sistemas (TGS) de Bertalanffy, desarrollada en la década del 1940. Esta teoría destaca que un sistema debe entenderse como un conjunto de elementos que actúan como un todo. En el ámbito educativo, promueve la visión del estudiante como parte de un sistema donde interactúa el entorno, los compañeros, el contenido y el facilitador/profesor (*Teoría general de sistemas de Ludwig Von Bertalanffy*, 1999). En MAES© la TGS es clave para comprender cómo los grupos funcionan como organismos dinámicos, donde cada miembro aporta y se retroalimenta del resto (Díaz et al., 2016) (Figura 3).

De igual modo, es fundamental mencionar el trabajo de Kurt Lewin que, entre los años 30 y 40 del novecientos, desarrolla la "Teoría del cambio". Este psicólogo alemán plantea que el comportamiento humano está determinado por un campo de fuerza que actúan sobre el individuo. Para lograr un cambio es necesario modificar estas fuerzas (Mayo, 2022). En la educación se traduce en la importancia de crear un ambiente grupal donde se facilite el aprendizaje, gracias a las dinámicas de grupo. En MAES©, el grupo de trabajo se entiende como un sistema dinámico donde las interacciones, roles y motivación individual afectan directamente el rendimiento colectivo. Por esto, la teoría de Lewin apoya la importancia de preparar el grupo para el cambio y promover con las dinámicas grupales un entorno donde los participantes sean capaces de asumir responsabilidades (Hussain et al., 2018).

Figura 3 Factor Grupal

Elaboración propria. Foto de una dinámica grupal realizada en el curso de capacitación internacional en Simulación Clínica en la Pontificia Universidad Católica de Ecuador (PUCE) S. Domingo

Otra teoría fundamental del factor grupal de MAES© es la Identidad Social de Tajfel, desarrollada en los años 70. El psicólogo británico sostiene que las personas definen su identidad en función de los grupos a los que pertenecen. Esta teoría explica cómo se forman las categorías sociales, los prejuicios y los comportamientos dentro y fuera del grupo (Tajfel, 1974). MAES© se apoya en esta teoría por su implicación en el trabajo colaborativo y en el desarrollo de un sentido de pertenencia grupal que potencia la motivación (Díaz-Agea et al., 2021). Al trabajar en equipos autogestionados, los estudiantes desarrollan lealtad al grupo, mayor implicación con las tareas y sentido de responsabilidad compartida (Arizo-Luque et al., 2022).

En la misma década (1970) se desarrolla también la Teoría del Flow llevada a cabo por el psicólogo Csíkszentmihályi como consecuencia de sus estudios sobre la felicidad y la motivación intrínseca. Csíkszentmihályi describe un estado mental óptimo en el que la persona está completamente inmersa en una actividad, experimentando concentración total (Csikszentmihalyi, 2009). En educación y en MAES© de forma más específica, se logra esta sensación cuando las tareas suponen un reto adecuado a nivel de habilidad en el estudiante. Al permitir a los alumnos elegir y construir sus proprias simulaciones, se incrementa su implicación emocional y cognitiva, lo que potencia el rendimiento y la satisfacción personal. El Flow en MAES© es una herramienta para fomentar el aprendizaje profundo en autonomía (Díaz et al., 2016).

Finalmente, es importante mencionar el concepto de competitividad positiva que nace en respuesta a los efectos de la competencia mal gestionada. Esta visión propone una competencia saludable cuando se orienta hacia el logro común y la superación personal y no hacia la comparación destructiva (Fülöp et al., 2025). Una competencia bien estructurada estimula la motivación intrínseca y el compromiso. En MAES© se fomenta mediante la creación de desafíos grupales e intergrupales. Esta dinámica impulsa a los equipos a superarse constantemente mientras se mantiene la colaboración ética y el respeto (Arizo-Luque et al., 2022).

1.3.3. Las fases MAES© y sus elementos

En el modelo novedoso de MAES© se encuentra una estructura secuencial que amplía la estructura tradicional (briefing, simulación, debriefing). MAES© rompe el paradigma del instructor al mando del aprendizaje, promoviendo un aprendizaje colaborativo y orientado a las necesidades reales (Cangás et al., 2024). Para conseguirlo, concede mucho espacio en su estructura a el pre-briefing, deja la responsabilidad del diseño de los escenarios a los estudiantes, incluye el briefing en la fase de la simulación, contempla una fase expositiva finalizado el debriefing y pone mucha relevancia en el cierre con una evaluación consciente (Díaz Agea, Megías Nicolás, et al., 2019).

Paralelamente a sus fases, introduce también 6 elementos (Tabla 2) que se distribuyen en las diferentes fases.

Tabla 2 Las fases MAES© y sus elementos

Fases	*Descripción*	*Elementos*
Prebriefing	*Primer encuentro altamente participativo. Se proponen las bases para el desarrollo de las siguientes sesiones.*	*(1) Identidad grupal* *(2) Elección de temas de estudio* *(3) Establecer línea basal de aprendizaje*
Diseño de casos	*Los estudiantes realizan el trabajo autónomo diseñando un escenario siguiendo la plantilla MAES©.*	*(4) Trabajo autónomo*
Simulación	*El grupo que ha diseñado el caso expondrá un breve briefing del mismo y simulará un caso de otros compañeros.*	*(5) Escenario simulado*
Debriefing	*Se realiza un debriefing estructurado, dirigido por los estudiantes que han diseñado el caso. Se analizan las emociones, se cumple una descripción de los acontecimientos y un análisis de estos con el método Plus/Delta.*	*(6) Aprendizaje reflexivo*
Fase expositiva	*Los estudiantes que han diseñado el caso proceden a exponer la evidencia científica que lo respalda para responder a los objetivos de aprendizaje puestos en la primera sesión.*	
Cierre	*Dinámica de cierre dirigida por el facilitador para asegurarse de que el grupo ha cumplido con los objetivos de aprendizajes*	

Elaboración propia: descripción de las fases de MAES© en relación con sus elementos.

En primer lugar, se trabaja la identidad grupal siendo el grupo la nueva unidad de trabajo en MAES© (elemento 1). También se procede a una elección voluntaria del tema de estudio (elemento 2) y a establecer la línea basal de competencias a adquirir (elemento 3), fomentando el aprendizaje autodirigido. En casa se trabaja de forma autónoma (elemento 4) para diseñar del caso de simulación que se ejecuta en el escenario simulado (elemento 5). Finalmente, se procede con el aprendizaje reflexivo en el debriefing con exposición (elemento 6) (Díaz Agea, Ramos-Morcillo, et al., 2019).

1.3.3.1. ***Prebriefing***

El prebriefing constituye el primer encuentro de los estudiantes con la metodología MAES©. Se caracteriza por ser altamente participativo, emocionalmente seguro y motivacional. La duración aproximada es de cuatro horas y el desarrollo se basa en las teorías del factor grupal (García-Méndez et al., 2022). Durante esta sesión inicial no se realiza aun la simulación, pero se ponen las bases para un aprendizaje significativo a través de tres momentos fundamentales: la elección de grupos e identidad grupal, elección voluntaria de tema de aprendizaje y la definición de la línea basal de aprendizaje (Díaz et al., 2016).

1.3.3.1.1. Elección de grupos e identidad grupal

MAES© es una metodología que trabaja con grupos de mínimo 12 hasta un máximo de 18 personas. Estos grupos-clase se dividirán en equipos de trabajo pequeños de 2-3 componentes. Por esta razón, la formación de los grupos es un pilar esencial de esta metodología. La creación de los equipos de trabajo está guiada por un facilitador que, mediante dinámicas grupales, diseña los grupos por afinidad y valores compartidos (Díaz Agea, Megías Nicolás, et al., 2019). La identidad grupal actúa como motor motivacional y cohesivo (Tajfel, 1974). El grupo de trabajo tendrá que elegir un nombre proprio, una característica que lo unifique, identificar sus fortalezas y debilidades y un compromiso hacia el grupo-clase. Todos estos aspectos permiten que el equipo de trabajo se conciba como una entidad que se diferencia del resto y le otorga una misión compartida. A partir de este momento el equipo se convierte en un ente autónomo, con estrategia operativa e identidad colectiva que supera la individual (Díaz Agea et al., 2014).

1.3.3.1.2. Elección del tema de aprendizaje

Una vez formados los grupos, se presentan una serie de temas o epígrafes en forma de titulares llamativos extraídos de noticias reales, testimonios, películas, documentales o redes sociales. Los títulos están estratégicamente elegidos para que sean vinculados a competencias profesionales previamente definidas en los programas académicos de la asignatura en la que se desarrolla MAES© (Díaz et al., 2016). Cada grupo elige voluntariamente el título y tema subyacente, aunque inicialmente desconozca el contenido detallado. Así, con la libre elección y la información facilitada, se promueve la motivación intrínseca y el autoaprendizaje (Arizo-Luque et al., 2022; Díaz-Agea et al., 2021).

1.3.3.1.3. Definición de la línea basal de aprendizaje

Después de la elección del tema a trabajar, el facilitador proyecta el material asociado a cada caso completando la información (video, noticia, testimonio etc.). En este momento, de acuerdo con la base metodología de MAES© (aprendizaje colaborativo, entre pares y autodirigido) se lleva a cabo una lluvia de ideas entre todos los equipos (Díaz Agea, Megías Nicolás, et al., 2019). Cada equipo analiza qué sabe y qué no sabe en relación con el tema elegido y define las competencias que desea adquirir con la simulación. El resultado será el nivel basal de conocimientos, habilidades y actitudes relacionados con el tema elegido (Díaz et al., 2016; Wong et al., 2021). La autorreflexión guiada que se cumple permite construir objetivos realistas, personalizados y consensuados que serán sucesivamente el eje de la simulación (Leal Costa et al., 2019).

*1.3.3.2. **Diseño del escenario***

El diseño del escenario clínico simulado tiene que reflejar las competencias a desarrollar y permitir el entrenamiento de las habilidades elegidas. Esta tarea se realiza como trabajo autónomo, fuera del aula, por parte del equipo de simulación definido en la primera sesión. Para realizar este trabajo, los alumnos tienen que disponer de mínimo 7 días (Díaz et al., 2016).

Los estudiantes cuentan con una plantilla de diseño de escenario para rellenar (Anexo 1). Anteriormente, en la primera sesión, habrán recibido una preparación sobre cómo rellenar esta plantilla creando casos clínicos alineados a los objetivos de aprendizaje. Además, disponen de recursos como audios y videos

de soporte. Las competencias del caso de simulación se tienen que individualizar utilizando un lenguaje estandarizado y científicamente aprobado usando un conjunto de clasificaciones empleadas en el campo de la enfermería para identificar diagnósticos, intervenciones y resultados de enfermería (Herdman et al., 2021; Moorhead et al., 2023; Wagner et al., 2023). Este trabajo, de acuerdo con la metodología ABP, implica la búsqueda de evidencia científica actualizada en bases de datos fiables, con el objetivo de sustentar tanto el diseño como el posterior debriefing (Díaz Agea et al., 2014). Además, los estudiantes, completando la plantilla, deben tener en cuenta el material específico y las necesidades logísticas (caracterización, uso de simuladores o actores, etc.) útiles para alcanzar los objetivos elegidos. El trabajo que se realiza durante la cumplimentación de la plantilla es fundamental, puesto que no solo ayuda a estimular al estudiante sobre los problemas planteados en su caso clínico (aprendizaje basado en problemas), también implica una reflexión profunda de todos los componentes del grupo (aprendizaje reflexivo, colaborativo y factor grupal) (Díaz Agea, Ramos-Morcillo, et al., 2019; Díaz et al., 2016).

1.3.3.3. ***Briefing y escenario simulado***

Durante la segunda sesión MAES© se lleva a cabo el escenario simulado. Realiza la simulación un equipo distinto al que ha diseñado el caso, fomentando así la implicación colectiva. En esta fase es importante que se trabajen las competencias previamente identificadas y no se ponga el punto de mira únicamente en la resolución correcta del caso (Díaz Agea et al., 2014; Díaz et al., 2016).

Antes que un grupo entre a la simulación del caso diseñado, el equipo que se ha encargado del diseño del escenario lo presentará mediante un breve briefing estructurado. El modelo utilizado es el modelo SBAR (*Situation, Background, Assessment, Recommendation*) (Haig et al., 2006). Este formato permite una transferencia clara, segura y efectiva de la información clínica y es el mismo que se utiliza en la plantilla para el diseño de escenarios MAES©. El hecho de que se utilice en diferentes momentos el mismo modelo estructurado permite que los estudiantes entrenen la comunicación efectiva en la transferencia del paciente (Díaz et al., 2016; Farzaneh et al., 2023).

La duración aproximada de cada simulación es de 12-15 minutos máximo. Siempre se busca que la situación sea realista, retadora, emocionalmente significativa y centrada en los objetivos propuestos por el equipo que ha diseñado el caso. Todos estos aspectos fomentan el aprendizaje experiencial, reflexivo y basado en simulación (Díaz Agea, Megías Nicolás, et al., 2019).

1.3.3.4. ***Debriefing***

Tras la ejecución del escenario, se da paso a una fase esencial de la metodología MAES© y, más en general, del aprendizaje con simulación: el debriefing (Duff et al., 2024). En esta fase se promueve el aprendizaje reflexivo, el análisis crítico y la consolidación del aprendizaje (Fanning & Gaba, 2007). En la Metodología de Autoaprendizaje en Entornos Simulados, el debriefing no se centra en identificar errores. Con esta metodología se analizan los objetivos de aprendizaje definidos en la primera sesión y cómo se abordan durante la simulación. Además, se estimula la elaboración de las vivencias y de los modelos mentales a partir de lo vivido (Díaz Agea et al., 2018; Díaz et al., 2016). En MAES© el facilitador adopta una posición de moderador, interviniendo solo cuando es necesario para mantener el foco o estimular la discusión (Díaz-Agea et al., 2017).

El modelo adoptado para realizar el debriefing con MAES© es un modelo estructurado a 3 o 5 fases. Su base metodológica se encuentra en, lo más conocido como, GAS (3 fases: Reacción, Análisis, Resumen) y PEARLS (5 fases: Reacción, Descripción, Análisis, Resumen, Aplicación a la Práctica) (Cheng et al., 2016; Phrampus & O'Donnell, 2013). Ambos, analizan las primeras emociones, los acontecimientos de la simulación y realizan una síntesis. El segundo, a diferencia del primero, enfoca su análisis contextualizándola a las emociones de los participantes en el caso simulado y resaltando posibles conexiones con vivencias personales externas a la sesión de simulación (Eppich & Cheng, 2015).

1.3.3.5. ***Fase expositiva***

A diferencia de otros métodos de simulación donde el instructor lidera la exposición de contenidos, en MAES© son los alumnos los que tienen este cargo (Calle Domínguez et al., 2022). Con esta metodología, al final de la fase de análisis del debriefing, se introduce una fase expositiva donde cada equipo debe presentar la evidencia científica que respalda su caso y responde a sus objetivos de

aprendizaje. Estas exposiciones pueden adoptar múltiples formatos: presentaciones orales, PowerPoint, entrevistas grabadas a profesionales, demonstraciones prácticas, cuestionarios interactivos, etc. La creatividad y el compromiso con el contenido son elementos clave que son característicos de MAES© y del autoaprendizaje (Díaz-Agea et al., 2017).

Esta fase permite reforzar las competencias cognitivas y favorece el aprendizaje entre pares. El rol del facilitador es asegurar la veracidad de la información presentada y vincularla con las guías clínicas o recomendaciones basada en evidencia (Rodríguez-Herrera et al., 2023).

*1.3.3.6. **Cierre y evaluación***

Después de la fase expositiva del debriefing, es esencial realizar un cierre. En MAES©, como en otras metodologías, este rol corresponde al facilitador que tiene la responsabilidad de asegurarse de que se hayan alcanzado los objetivos de aprendizaje y que hayan quedado claro a los alumnos. La peculiaridad de MAES© es que el cierre no tiene que ser unidireccional, sino que también se puede alcanzar con alguna dinámica que prevé la participación de los alumnos (Díaz et al., 2016; Garre-Baños & Díaz-Agea, 2021).

Al final de la experiencia MAES© se produce la evaluación. En esta metodología la evaluación resulta ser formativa y sumativa. Involucra tanto al facilitador como a los compañeros observadores. Se utilizan rúbricas específicas para valorar:

- Competencias clínicas: conocimientos técnicos, razonamiento clínico, conocimientos procedimentales
- Competencias no clínicas: comunicación, liderazgo, trabajo en equipo, toma de decisiones.
- Actitudes: puntualidad, respeto, iniciativa, capacitad reflexiva, responsabilidad con el cuaderno de campo.

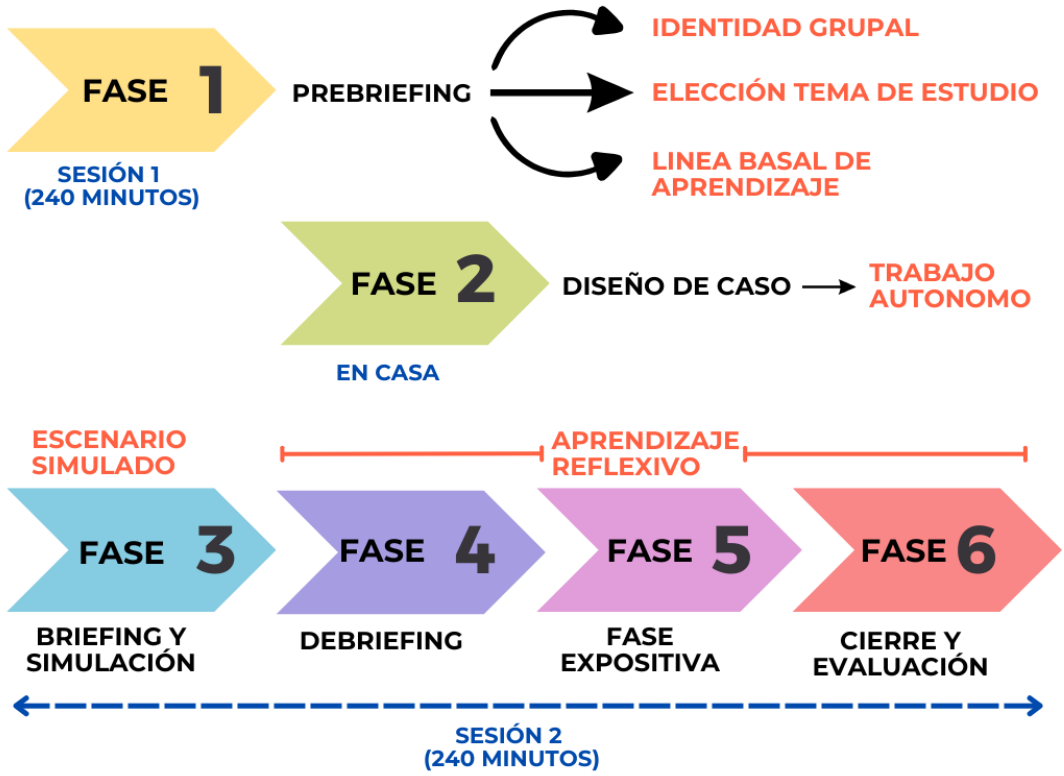
La evaluación no se limita a la ejecución de la simulación, sino que incluye el diseño del caso, la participación en el debriefing, la calidad de la exposición científica y la actitud mantenida durante todo el proceso (Díaz Agea et al., 2014).

1.3.4. Organización práctica de las sesiones

La metodología MAES© se estructura en 6 fases distribuidas en mínimo dos sesiones presenciales intensivas de 240 minutos (4 horas) cada una (Figura 4).

La necesidad de distribuir la metodología en dos sesiones mínimo se debe a la importancia del trabajo autónomo realizado antes de la segunda sesión. Cada una de las sesiones está cuidadosamente diseñada para fomentar los pilares metodológicos de MAES© (el aprendizaje activo, colaborativo, significativo y autodirigido) (Díaz Agea, Megías Nicolás, et al., 2019).

Figura 4 Las sesiones MAES© con sus fases y elementos



Elaboración propria. Descripción y relación de las fases MAES© con sus elementos dentro de las sesiones de simulación.

*1.3.4.1. **Sesión 1 y trabajo autónomo***

El objetivo de la primera sesión es crear los grupos de trabajo, individuar el tema de estudio y elegir la línea basal de aprendizaje. Además, el facilitador introducirá los conceptos de la metodología MAES©, explicará el funcionamiento, pondrá a disposición del alumnado los diferentes recursos y definirá los tiempos para la ejecución (Leal Costa et al., 2019).

El desarrollo de la primera sesión se centra en el factor grupal y cumple con los objetivos del prebriefing. El grupo de estudiantes (no debería superar los 18 elementos como máximo) se divide en seis equipos de trabajo. En esta primera parte de la sesión se trabaja la identidad grupal, entendida como la construcción colectiva basada en valores compartidos, para reforzar la cohesión y promover la competitividad positiva entre los equipos. Sucesivamente, tras la explicación de MAES© y de su desarrollo por parte del facilitador, cada equipo de trabajo elige voluntariamente el tema de estudio. Finalmente, se realiza una lluvia de ideas por parte de todo el grupo, identificando el dominio previo y detectando los vacíos de conocimiento relacionados con el caso seleccionado (Rodríguez-Herrera et al., 2023). En este momento se permite la programación conjunta del aprendizaje autodirigido, aumentando la responsabilidad y la motivación (Díaz et al., 2016). La sesión terminará con las indicaciones del facilitador sobre el diseño de escenario.

El periodo entre las dos sesiones (7 días mínimo), cada equipo diseña un escenario de simulación siguiendo una plantilla puesta a disposición por el facilitador. Los estudiantes tienen que aplicar los conocimientos adquiridos sobre el diseño de simulaciones, buscar evidencia científica relevante para respaldar el diseño y planificar los detalles técnicos y pedagógicos del caso. En cada momento, los estudiantes pueden contar con el soporte del facilitador mediante tutorías o contacto por correo electrónico. El diseño final se tiene que enviar con, al menos, un día de antelación a la segunda sesión, para que el facilitador pueda revisarlo, corregirlo y organizar el material solicitado (Díaz Agea, Megías Nicolás, et al., 2019; Díaz Agea, Ramos-Morcillo, et al., 2019).

*1.3.4.2. **Sesión 2***

En la segunda sesión se realiza el escenario simulado. Cada simulación inicia con un briefing realizado por el equipo que lo ha diseñado, seguido por la simulación realizada por un equipo distinto. Esta estrategia, garantiza la

participación activa por parte de los diferentes grupos y una comprensión más profunda de las competencias trabajadas. Al final de cada simulación se procede con el aprendizaje reflexivo y significativo, realizando el debriefing estructurado (siguiendo los modelos GAS o PEARLS). Para enriquecer el proceso de debriefing, en MAES©, se cumple también la fase expositiva (Díaz Agea, Megías Nicolás, et al., 2019). En este momento el equipo que ha diseñado el caso puede contestar a los objetivos de aprendizaje utilizando diferentes métodos (presentaciones, juegos de preguntas, demonstraciones prácticas, entrevistas a pacientes reales etc.) (Díaz-Agea et al., 2017).

A final de cada escenario con su respectivo debriefing y exposición (duración de unos 60 minutos) se produce el cierre por parte del facilitador. El cierre tendrá una duración corta, donde el facilitador resumirá en píldoras informativas el contenido clave de la sesión. En esta fase se pueden utilizar dinámicas grupales que garanticen la participación de los estudiantes (Díaz Agea, Megías Nicolás, et al., 2019).

1.3.5. El rol del Facilitador

En la metodología MAES©, el rol del facilitador es esencial para garantizar un entorno de aprendizaje activo, autónomo y significativo. A diferencia del modelo tradicional, con MAES© el facilitador asume un papel de guía y acompañante del proceso formativo (Garre-Baños & Díaz-Agea, 2021). Su función principal consiste en promover un clima de confianza, respeto y motivación que facilite la participación de los estudiantes y estimule el aprendizaje autorregulado. No se trata de impartir clases o contenido, sino de ayudar a los estudiantes para que construyan ellos mismos los contenidos (Fukamizu et al., 2021; Rodríguez-Herrera et al., 2023). De esta forma, se fomenta el pensamiento crítico, la toma de decisiones y la búsqueda autónoma de información basada en evidencia científica. El facilitador actúa también como dinamizador de aprendizaje bidireccional, reconociendo el valor del conocimiento previo de los alumnos y realizando sus propios aportes (García-Méndez et al., 2022).

Asimismo, el facilitador se encarga de construir y promover un entorno seguro, libre de prejuicios. Es posible conseguirlo gracias al manejo de las distintas dinámicas grupales y conociendo las diferentes teorías que la componen. El

facilitador tiene que guiar el prebriefing y la composición de los grupos, teniendo en cuenta las características individuales de cada componente. Además, tiene que realizar dinámicas de activación o relajación, dependiendo de las necesidades del conjunto de alumnos, para asegurar en todo momento que el grupo siga fluyendo en su aprendizaje (Madsgaard et al., 2022). En las distintas etapas de MAES© el facilitador orienta sin imponer, permitiendo que los estudiantes asuman responsabilidades desde la elección del tema a estudio hasta la creación de escenarios. Para conseguirlo, permite una asesoría metodológica continua, apoya la formulación de objetivos de aprendizaje y garantiza que el diseño de escenarios responda a competencias profesionales concretas (Rodríguez-Herrera et al., 2023). Durante la ejecución de los escenarios, supervisa la actividad para asegurar un desarrollo adecuado, sin interferir directamente. Posteriormente, lidera el debriefing estructurado realizando preguntas motivadoras y estimuladoras. Esto le permite guiar la reflexión y el análisis crítico, dejando que sean los estudiantes quienes pongan los contenidos y reflexionen sobre su aprendizaje (Lervik et al., 2025). También estimula la presentación de evidencias y el uso de recursos creativos (Díaz-Agea et al., 2017).

El facilitador se convierte en un modelo de las competencias que se espera que los estudiantes desarrollen: comunicación, liderazgo, actitud empática y ética. Su rol va más allá de lo técnico y más en profundidad de un instructor que transfiere conocimientos teóricos. Su presencia, comportamiento y su forma de interactuar, actúan directamente en el aprendizaje. Aunque su rol sea visible en toda la aplicación de MAES©, donde probablemente asume un peso específico mayor para el aprendizaje del alumno es en el debriefing. Durante esta fase, que es la más crítica y compleja del proceso, acompaña con sensibilidad y estrategia, promoviendo la reflexión. Su intervención no impone, sino que potencia la comprensión. Así, el facilitador cierra el ciclo formativo con respeto y equilibrio (Fey et al., 2022). Por todas estas razones, el facilitador MAES© no será solo un guía pedagógico, sino también será un referente clave en la construcción de conocimiento y desarrollo profesional del alumno (Garre-Baños & Díaz-Agea, 2021).

1.4. INNOVACIÓN EN EL DEBRIEFING MAES©

El rol del facilitador en la simulación se entrelaza de forma natural con el proceso de debriefing (Sawyer et al., 2016). Esta fase es la más determinante en el aprendizaje con simulación clínica (Decker et al., 2021a). A lo largo del tiempo, esta etapa ha evolucionado y se ha perfeccionado gracias a avances pedagógicos y al desarrollo de metodologías cada vez más inclusivas y centradas en la reflexión profunda de(Duff et al., 2024). Un componente distintivo de MAES© es su enfoque del debriefing con la integración de una fase expositiva en su estructura. Esta etapa potencia el autoaprendizaje y el facilitador adopta un rol secundario, dejando mayor protagonismo al estudiante (Calle Domínguez et al., 2022; Díaz-Agea et al., 2017).

1.4.1. Modelos de debriefing

El debriefing actualmente es descrito como un proceso formal, colaborativo y reflexivo, dirigido por un facilitador tras una experiencia de simulación. Su propósito es analizar el desempeño, explorar emociones, fomentar el pensamiento crítico y promover la asimilación del aprendizaje para futuras situaciones mediante la retroalimentación y la reflexión guiada (*Healthcare Simulation Dictionary*, 2025).

El debriefing ha evolucionado significativamente desde sus orígenes, consolidándose como un componente esencial del aprendizaje con simulación. Su concepción inicial es como una herramienta vital que se centra en la identificación de errores, generando tensiones entre los participantes y limitando la efectividad de la retroalimentación (Duff et al., 2024). Uno de los avances clave es el desarrollo del modelo *Debriefing with Good Judgment*, que combina una postura de curiosidad genuina con retroalimentación esencial y constructiva. Este enfoque permite respetar la perspectiva individual explorando el razonamiento clínico detrás de las acciones (Rudolph et al., 2007). La crítica constructiva y el respeto entre los participantes se unen a la necesidad de una estructura delineada, encontrando respuesta con el modelo GAS (*Gather, Analyze, Summarize*) que organiza el debriefing en tres etapas lógicas progresivas. Con este modelo se permite analizar tanto los aspectos positivos como los mejorables de una forma clara y efectiva (Phrampus & O'Donnell, 2013). Paralelamente, se puede encontrar el debrieifng estructurado PEARLS (*Promoting Excellence and Reflective Learning in Simulation*)

que incorpora la dimensión emocional al análisis, favoreciendo discusiones más profundas a través de 5 fases: escena, reacción, descripción, análisis y resumen (Eppich & Cheng, 2015).

Existen también modelos alternativos que se basan en formatos más visuales como, por ejemplo, el *Debriefing Diamond* que permite un análisis organizado (reacciones, descripción, análisis y aplicación) facilitando un equilibrio entre la exploración de aspectos técnicos y emocionales. Esta herramienta, por su carácter muy visual, es útil tanto para la reflexión individual como para la discusión grupal (Jaye et al., 2015). Otro modelo de debriefing que aporta una metodología novedosa es el *Rapid Cycle Deliberate Practice* (RCDP). Este último, sustituye el debriefing final por interrupciones durante la simulación con el fin de corregir errores de inmediato. Este enfoque se utiliza principalmente para entrenamiento de habilidades técnicas (Hunt et al., 2014). Existen también modelos de debriefing que adoptan una perspectiva centrada en el desempeño grupal y en las dinámicas del equipo, como el *Team Gains*. Esta metodología es específica para abordar la cohesión, la comunicación y los marcos mentales compartidos, identificando áreas de mejora a nivel colectivo (Kolbe et al., 2013). En contraste con las metodologías de debriefing grupales se encuentran el *self-debriefing* y el *videodebriefing*. Ambas metodologías, impulsadas por la pandemia COVID-19, promueven la reflexión autónoma, con o sin intervención del facilitador, integrando componentes visuales para fortalecer la autoevaluación (Isaranuwatchai et al., 2017).

Todos los modelos de debriefing previamente expuestos se identifican como guiados por un instructor (instructor-lead debriefing). Recientemente la literatura sugiere que el instructor-lead debriefing no siempre contiene aspectos positivos (He et al., 2024). Como alternativa se encuentra el debriefing MAES©, que destaca por el papel activo que asume el estudiante durante todo el proceso de aprendizaje, debriefing incluido (Díaz Agea, Megías Nicolás, et al., 2019).

1.4.2. Debriefing MAES©

El debriefing en MAES©, constituye una fase crucial dentro del proceso de aprendizaje (Díaz et al., 2016). A diferencia de los modelos tradicionales donde el instructor es el eje principal, en MAES© el enfoque se centra en el estudiante. Su papel activo le permite ser protagonista durante el análisis y reflexión (Díaz-Agea

et al., 2017). MAES©, se encuentra alineada con todos los estándares *International Nursing Association for Clinical simulation and Learning* (INACSL), estructura su debriefing en cinco fases: emocional, descriptiva, analítica, expositiva y resumen final (Decker et al., 2021; *Healthcare Simulation Standards of Best PracticeTM - Clinical Simulation In Nursing*, n.d.).

La fase emocional da inicio al debriefing. Esta fase permite investigar las emociones inmediatamente después del escenario simulado y resulta fundamental ya que tiene un impacto directo sobre la capacidad de reflexión. Reconocer las emociones al inicio del proceso de debriefing ayuda también a la retención de información y crea un ambiente seguro, empático y abierto al diálogo, favoreciendo el aprendizaje significativo (Rudolph et al., 2014). En estos primeros momentos se permite a los estudiantes expresar brevemente, en una sola palabra, la emoción que mejor representa cómo se sintieron durante la simulación. También se pueden utilizar herramientas visuales como tarjetas ilustradas, emoticonos u objetos simbólicos para facilitar la identificación y expresión de sentimientos (LeBlanc & Posner, 2022).

La fase descriptiva tiene como objetivo reconstruir los hechos ocurridos durante el escenario simulado. Los estudiantes relatan lo sucedido de forma cronológica, sin juicios, para crear la base común de entendimiento. Habitualmente se utiliza una línea del tiempo dibujada (*Timeline Debriefing Tool* – TDT), donde se representan los eventos claves, permitiendo una referencia visual rápida durante el resto del debriefing. El recurso gráfico facilita la organización del análisis posterior y favorece la participación de todos los miembros del grupo (Secheresse & Nonglaton, 2019).

En la fase analítica, se realiza la reflexión crítica de la simulación. En la fase analítica de MAES© se utiliza el *Plus/Delta*. Esta técnica promueve la identificación de los aspectos positivos (*Plus*) que deben mantenerse, y de aquellos elementos que pueden mejorarse (*Delta*) (Cheng et al., 2021). A través del dialogo entre los participantes, se fomenta el análisis autónomo de las decisiones clínicas, habilidades de comunicación, liderazgo y trabajo en equipo, guiado por preguntas estratégicas de los estudiantes que diseñaron el caso y del facilitador que se mantiene al margen de la discusión (Christiansen et al., 2023). Esta fase resulta clave para desarrollar el pensamiento crítico (Paige et al., 2021).

La fase expositiva (Figura 5) es la innovación central del debriefing MAES©, que lo diferencia de los modelos estructurados más clásicos, como PEARLS o GAS (Díaz-Agea et al., 2017; Guerrero et al., 2022). En esta etapa, conducida por los estudiantes responsables del diseño del caso, se presenta la evidencia científica relacionada con los objetivos de aprendizaje definidos inicialmente (Díaz Agea, Megías Nicolás, et al., 2019). Se promueve así el aprendizaje colaborativo y el intercambio activo de información. Los estudiantes pueden utilizar herramientas variadas como presentaciones interactivas, talleres breves o incluso pueden invitar a un experto o pacientes reales para que realicen testimonios (Díaz-Agea et al., 2017). Esta dinámica fomenta la autonomía, el pensamiento crítico y la integración del conocimiento teórico-práctico de forma creativa y motivadora (Díaz-Agea et al., 2021).

Figura 5 Fase Expositiva

Elaboración propria: grupo de alumnos que decidieron realizar su fase expositiva con talleres en un entorno de playa para explicar mejor sus objetivos de aprendizaje de un caso de un paciente ahogado

La fase de resumen es la última del debrieifng MAES©. En este caso está a cargo el facilitador. En la fase de resumen es importante asegurarse que todos los estudiantes hayan comprendido y alcanzado los objetivos de aprendizaje (Lee et al., 2020). En ella se puede incluir una recapitulación mediante píldoras informativas: mensajes breves, claros y significativos que refuercen los aprendizajes claves. Además, se pueden aplicar dinámicas grupales participativas (como lluvia de ideas o frases de cierre) que integren a los estudiantes en la conclusión del proceso, reforzando así los principios de la base de MAES© (Díaz-Agea et al., 2017). El cierre contribuye a consolidar la experiencia, asegurando una apropiación activa del conocimiento (Díaz et al., 2016).

En la metodología de debriefing MAES© destacan la mayor responsabilidad y protagonismo del estudiante, que conduce a una mayor motivación intrínseca y compromiso con su proceso educativo (Arizo-Luque et al., 2022). Además, el facilitador asume un rol de guía y moderador permitiendo que el grupo se autorregule y profundice en el análisis. Todo esto favorece un ambiente seguro y reflexivo (Garre-Baños & Díaz-Agea, 2021). La inclusión de pacientes reales como co-debriefers añade valor al proceso, enriqueciendo la experiencia con vivencias auténticas que potencian la empatía y la conexión emocional, aspectos claves en la formación sanitaria (Díaz-Agea et al., 2017). No obstante, el cambio de rol del facilitador en el debriefing requiere formación específica para manejar el apoyo sin asumir el control total. Además, implica una habilidad en la gestión grupal importante y una complejidad adicional en la preparación y gestión del tiempo (Tosterud et al., 2020). Todos estos aspectos se tienen que considerar en la elección de esta metodología de debriefing frente a otras.

1.5. APLICACIÓN DE MAES© E IMPACTO EN CIENCIAS DE LA SALUD

La Metodología de Autoaprendizaje en Entornos Simulados ha demostrado ser una valida alternativa a las metodologías tradicionales de simulación. Además, gracias a su alta practicidad y la utilización de varios modelos de aprendizaje, MAES© demuestra ser una herramienta versátil y adaptada para el cambio pedagógico actual en Ciencias de la Salud. Su aplicación se ha estudiado principalmente en entornos académicos españoles, con alguna aplicación en universidades extranjeras (Díaz Agea, Ramos-Morcillo, et al., 2019; García-Méndez

et al., 2022). A continuación, se presentan los principales hallazgos sobre MAES© y su impacto en la práctica de simulación en Ciencias de la Salud.

Uno de los aspectos básicos que hay que analizar es la percepción de la metodología MAES© en los participantes. Quin aprenda involucrándose directamente viviendo el "Flow" de lo que está realizando, obtendrá unos resultados mejores (Csikszentmihalyi, 2009). La percepción de los participantes hacia MAES© ha sido ampliamente positiva en diversos estudios. Los estudiantes valoran positivamente esta metodología por su carácter participativo, flexible y centrado en el alumno (Díaz Agea, Ramos-Morcillo, et al., 2019). Resaltan que MAES© les permite aprender de manera autónoma, desarrollar habilidades prácticas en un entorno controlado y mejorar su confianza profesional (Arizo-Luque et al., 2022). También cabe destacar la utilidad del trabajo colaborativo, el aprendizaje desde el error y la oportunidad de construir su proprio conocimiento a partir de experiencias significativas (Díaz Agea, Megías Nicolás, et al., 2019). La inclusión de un debriefing grupal con la presencia de un facilitador (y no un instructor tradicional) se percibe como enriquecedor para la reflexión y consolidación de aprendizajes (Díaz Agea et al., 2018).

La relevancia de analizar la percepción de los participantes en la metodología MAES© se debe a la directa asociación entre una valoración positiva y los múltiples beneficios en el proceso de aprendizaje y en los resultados obtenidos (Díaz et al., 2016). En el caso específico de MAES©, cuando es percibida de manera favorable por los estudiantes, se traduce en: mejoras de rendimiento académico con simulación, aumento de motivación, desarrollo de competencias y una mayor posibilidad de aplicación de la metodología a otros modelos pedagógicos. Además, una percepción positiva fomenta una actitud más abierta y proactiva hacia la formación, un aspecto clave para profesionales sanitarios a los que se les pide una actualización constante (D'Arrietta et al., 2024).

1.5.1. Mejora del rendimiento en Simulación Clínica

La metodología MAES© ha demostrado una eficacia significativa en la mejora del rendimiento de los estudiantes durante simulaciones clínicas. Esta metodología permite trabajar tanto las habilidades técnicas como las no técnicas a lo largo de sus sesiones (Peñataro-Pintado et al., 2021). Los alumnos, gracias a los

fundamentos pedagógicos de MAES©, podrán trabajar a lo largo de todas las sesiones, habilidades como la comunicación efectiva, liderazgo, trabajo en equipo y toma de decisiones (Díaz Agea et al., 2014).

A diferencia de los métodos más tradicionales, MAES© se basa en el autoaprendizaje con un diseño de escenario autónomo, y un debriefing que permite a los participantes involucrarse activamente en su proceso formativo. Las mayores posibilidades de inclusión en el proceso de aprendizaje por parte de los alumnos se trasladan en unos mejores resultados en evaluaciones de desempeño clínico y una mayor preparación para el entorno real. Además, se ha observado una mayor retención del conocimiento y conexión con situaciones clínicas reales (Díaz Agea, Megías Nicolás, et al., 2019).

El enfoque progresivo de MAES©, que empieza con un análisis de lo que el alumno conoce sobre un tema y lo acompaña hacia la resolución autónoma de problemas, potencia el aprendizaje significativo y favorece una preparación más completa (Díaz et al., 2016).

1.5.2. Fomento de la motivación y pensamiento crítico

Una de las fortalezas más destacadas de MAES© es su capacidad para incrementar la motivación intrínseca del estudiante y fomentar el desarrollo del pensamiento crítico. Los estudiantes que utilizan MAES© para su preparación en Ciencias de la Salud experimentan una mejora significativa en su disposición para el aprendizaje y su capacidad de análisis, síntesis y toma de decisiones (García-Méndez et al., 2022).

El impacto de MAES© está directamente relacionado con su estructura, que otorga al estudiante un rol de protagonista en su formación. En consecuencia, aumenta también la exploración activa de su conocimiento (Díaz-Agea, Manresa-Parres, et al., 2022). El diseño de un escenario, la asunción de roles y la participación activa en los debriefing con enfoque reflexivo, permite un desafío saludable constante de los estudiantes. Estos se ven motivados a razonar, evaluar y justificar sus acciones de forma continua (Arizo-Luque et al., 2022). Igualmente, la posibilidad de realizar talleres o relacionarse directamente con expertos o pacientes reales en una sesión MAES© permite una participación positiva (Díaz-Agea et al., 2017).

Esta dinámica justifica el cambio pedagógico que aporta MAES© en Ciencias de la Salud, alineándose con las necesidades de la educación moderna. El estudiante pasa de agente pasivo a activo en su proceso de aprendizaje y su motivación sigue este cambio pasando de extrínseca a intrínseca. El cambio eleva el compromiso, la satisfacción y el desarrollo de habilidades cognitivas superiores, fundamentales para el ejercicio profesional sanitario (Díaz et al., 2016).

1.5.3. Desarrollo de competencias en seguridad del paciente

La aplicación de MAES© en entornos de formación especializada, ha evidenciado resultados positivos en el desarrollo de competencias clave como la seguridad clínica y del paciente (García-Méndez et al., 2022).

Un ejemplo de esta aplicación se ha realizado en entornos quirúrgicos o perioperatorios. Los estudiantes que participan en simulaciones clínicas con MAES© bajo este enfoque, demuestran un mejor manejo de protocolos de seguridad. Además, mejora la comunicación efectiva y la toma de decisiones, dos aspectos fundamentales para el profesional sanitario en general (Peñataro-Pintado et al., 2021). Otros entornos que han sido importantes para verificar cómo MAES© mejora las competencias en seguridad han sido Urgencias, Emergencias, Obstetricia y Ginecología. Es importante subrayar que MAES© es una metodología que se basa en la elección libre de temas de aprendizaje, por lo que el entorno de simulación varía continuamente. La atención a la seguridad del paciente es un hilo conductor de todos los escenarios de la metodología MAES© (Díaz-Agea, Ayensa-Arano, et al., 2022; Hernández et al., 2021).

MAES© se adapta a contextos complejos mediante la construcción colectiva de casos que imitan la realidad clínica con alto nivel de fidelidad, lo que permite al estudiante experimentar situaciones límite sin poner en riesgo a paciente reales. Además, el debriefing facilita la identificación de posibles mejoras, promoviendo el aprendizaje reflexivo y reforzando la conciencia sobre estándares de calidad y seguridad (Díaz Agea, Ramos-Morcillo, et al., 2019).

1.5.4. Aplicación en entornos interprofesionales

Unas de las aplicaciones más relevantes de MAES© es su implementación en contextos de formación universitaria de posgrado interprofesional. Con este método, profesionales de distintas disciplinas de la salud colaboran en simulaciones clínicas con escenarios altamente realistas (Hernández et al., 2021). En la investigación sobre MAES© interprofesional se explora cómo la metodología facilita la colaboración efectiva entre miembros de equipos interprofesionales, promoviendo la colaboración, el liderazgo compartido y el respeto por las funciones de cada disciplina. Al generar de manera conjunta escenarios y debriefings, los participantes desarrollan una comprensión más profunda del trabajo en equipo, lo que impacta positivamente en la calidad y humanización de la atención a pacientes reales (Díaz-Agea, Ayensa-Arano, et al., 2022). Esta práctica ayuda a reducir errores asociados a fallos de comunicación y a mejorar los resultados clínicos, además de fomentar un cuidado más holístico del paciente (Sezgin & Bektas, 2023). MAES©, gracias a su enfoque centrado en el factor grupal, permite un entrenamiento en Ciencias de la Salud no jerárquico, favoreciendo la simulación interprofesional (García-Méndez et al., 2022).

1.5.5. Un nuevo rol y un nuevo debriefing

La metodología MAES© plantea una transformación profunda en el rol tradicional del docente, que pasa de ser transmisor de conocimientos a facilitador del aprendizaje autónomo y colaborativo. Este nuevo perfil se caracteriza por fomentar la motivación intrínseca de los estudiantes, promover su autonomía y estimular la búsqueda activa de conocimiento (Díaz-Agea & Garre-Baños, 2020). El facilitador MAES© no lidera el proceso de manera directiva, sino que actúa como guía, respetando la autogestión del grupo. Este enfoque implica retos importantes, ya que requiere formación específica para mantener el equilibrio entre facilitar y no controlar, así como dinámicas grupales complejas y adaptativas (García-Méndez et al., 2022).

La figura del facilitador resulta fundamental en el debriefing MAES© que evoluciona hacia una herramienta más abierta, reflexiva y centrada en el grupo (Díaz-Agea, Manresa-Parres, et al., 2022). Con MAES©, gracias a una fase de exposición de contenidos, se puede incluir la participación de pacientes reales o

talleres que permiten a los estudiantes un aprendizaje significativo (Díaz-Agea et al., 2017). Es, sobre todo, en esta fase, cuando el facilitador tiene que tener una preparación ética y metodología rigurosa (Rodríguez-Herrera et al., 2023). En conjunto, MAES© propone una nueva forma de enseñar y una manera distinta de reflexionar y aprender acompañando el estudiante en su autoaprendizaje (Cangás et al., 2024).

II – JUSTIFICACIÓN

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A pesar de los avances tecnológicos y metodológicos, los estudiantes de Ciencias de la Salud y profesionales sanitarios siguen teniendo un rol pasivo en su formación (Gruppen et al., 2019; *Transforming and Scaling up Health Professionals' Education and Training*, n.d.). Por ello, se hace necesaria la implementación de metodologías innovadoras que respondan a los desafíos actuales. Resulta importante en el modelo actual fomentar formación significativa, segura y adaptada a las necesidades reales de quien se forma. Es necesario pasar a unos modelos más prácticos que permitan a los estudiantes entender por qué están aprendiendo algo y cómo aplicarlo en la vida laboral (Yardley et al., 2012).

Los avances en la ideación de modelos de aprendizaje alternativos al tradicional han garantizado el adviento de nuevas metodologías en la educación sanitaria. En los modelos actuales han adquirido una especial relevancia el aprendizaje con simulación y el aprendizaje autónomo (McCarthy et al., 2020; Ricotta et al., 2022). Estos dos modelos consisten en crear alternativas más prácticas a las tradicionales clases teóricas y mejoran la implicación de los estudiantes (Gordon et al., 2012).

En respuesta a la necesidad de unir estas dos metodologías (simulación y aprendizaje autónomo) nace la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) (Díaz et al., 2016). MAES© es un método de aprendizaje que tiene mayor impacto con respecto a otras metodologías que usan la simulación clínica en el contexto universitario de Enfermería en España (Peñataro-Pintado et al., 2021). También se ha visto que aumenta la motivación de los participantes y su pensamiento crítico (Arizo-Luque et al., 2022). Actualmente, diversos estudios han demostrado que el método MAES© es bien aceptado por los estudiantes y facilitadores (Díaz-Agea et al., 2021). Sin embargo, no se encontraron estudios sobre el uso de este método con profesionales en entornos clínicos fuera de España.

Los investigadores coinciden en la importancia de utilizar la simulación como vehículo para la formación interprofesional de los profesionales sanitarios (Rosen et al., 2021). En los últimos años ha aumentado la investigación sobre la posibilidad de aplicar la EIP-S en el plan de estudios de las universidades

(Hernández et al., 2021; Sezgin & Bektas, 2023). En concreto se ha analizado cómo el CRM y la RCP son escenarios complejos fundamentales en la simulación interprofesional. Estos entornos simulados ayudan a mejorar la comunicación, el liderazgo y la toma de decisiones, sobre todo en situaciones críticas y bajo presión (Coppens et al., 2018; Hung et al., 2021). Si la formación interprofesional aplicada a grado y posgrado resulta explorada con metodología SBL, es inferior el volumen de investigaciones sobre la EIP-S con MAES©. Existe evidencia sobre su aplicación en posgrado (Díaz-Agea, Ayensa-Arano, et al., 2022), pero es ausente su aplicación en grado. Viendo la relevancia de la instrucción interprofesional queda, sin duda, la importancia de proceder con el estudio en este campo. Para que los alumnos puedan ambientarse con habilidades técnicas y no técnicas de la forma más parecida posible a lo que enfrentaran en su trabajo del futuro, los enfoques de CRM y RCP pueden ser óptimos temas para posibles investigaciones con escenarios MAES©.

MAES© se basa en diferentes modelos de aprendizaje y se aplica a la simulación clínica (García-Méndez et al., 2022). La simulación en la actualidad es muy válida para la enseñanza en Ciencias de la Salud y en la formación de profesionales sanitarios. Este enfoque pedagógico se funda en el debriefing, momento en el que se realiza el aprendizaje reflexivo (Lee et al., 2020). Esta fase con MAES© resulta aún más importante en el momento en que se cumple, no solo el aprendizaje reflexivo, sino también el aprendizaje colaborativo y la educación entre pares (Díaz et al., 2016). Para conseguir un buen debriefing MAES© cobra especial relevancia la afirmación de la figura del facilitador (Díaz-Agea et al., 2017; Díaz-Agea & Garre-Baños, 2020). Considerada la importancia del debriefing en MAES© y sus novedades, un análisis profundo de la fase expositiva parece fundamental para validar aún más esta metodología.

Como consecuencia de lo anteriormente expuesto, se plantea llevar a cabo esta investigación con el propósito de ayudar al desarrollo de MAES©, aumentar su peso académico y su difusión a nivel nacional e internacional. Validando la metodología en las áreas todavía inexploradas y reforzando el debriefing con fase expositiva, que permitirá a futuros facilitadores una aplicación de MAES© con directrices más claras. Además, se posibilitará la implementación e instauración de programas formativos en entornos clínicos y académicos asegurando una mayor adaptación de la formación en Ciencias de la Salud a las necesidades actuales.

III – OBJETIVOS

III - OBJETIVOS

3.1. OBJETIVO GENERAL

El presente estudio tiene como objetivo principal valorar las nuevas aplicaciones de la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en contextos clínico-formativos. Asimismo, se investigará el debriefing con fase expositiva, realizando un análisis comparativo de este modelo con el convencional, evaluando su aceptación en Ciencias de la Salud.

3.2. OBJETIVOS ESPECÍFICOS

Para la consecución del objetivo general de la presente Tesis Doctoral, se establecieron los siguientes objetivos específicos:

1. Comparar la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) con Simulation Based Learning (SBL) y analizar su implementación en un entorno clínico real

2. Implementar la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en equipos interprofesionales formados por estudiantes de grado de medicina y enfermería

3. Estudiar la aplicación de la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en escenarios clínicos complejos, enfocados en reanimación cardiopulmonar y Crisis Resource Management, con equipos interprofesionales de grado

4. Evaluar la aceptación del debriefing estructurado con fase expositiva por parte de estudiantes de grado y posgrado.

IV - MATERIAL Y MÉTODO

IV -MATERIAL Y MÉTODO

El presente trabajo de Tesis Doctoral es un compendio de publicaciones según normativa de la Universidad Católica San Antonio de Murcia (UCAM). La normativa cumplida, prevé la posibilidad de presentar el trabajo de tesis con 3 artículos científicos, indexados en el *Journal Citation Reports* (JCR), incluidos en cualquier cuartil y 1 en Scopus (*Compendio de Publicaciones | UCAM | Vicerrectorado de Investigación*, n.d.). Para la elaboración de este trabajo se realiza una estancia internacional de 3 meses en la *Universitá degli Studi di Padova* (Italia) y se redacta parte de la tesis (abstract, resultados y conclusiones) en el idioma científico de referencia: el inglés. Todos estos aspectos se realizan para cumplir, también, con los requisitos de mención internacional contemplado en las normativas UCAM (*Mención Internacional | UCAM | Vicerrectorado de Investigación*, n.d.).

Cada artículo, incluido en esta Tesis Doctoral, sigue una metodología propria dentro del marco teórico de la investigación cualitativa. Además, todos los artículos tienen una línea común acorde con los objetivos del presente trabajo: nuevas implementaciones de la simulación clínica con la metodología MAES© y su debrieifng.

4.1. ESTUDIO Nº1

Self-learning Methodology in Simulated Environments (MAES©) utilized in hospital settings. Action-research in an Emergency Department in the United Kingdom

"Metodología de Autoaprendizaje en Entornos Simulados (MAES©) utilizado en entornos hospitalarios. Investigación-acción en un Departamento de Urgencias en el Reino Unido"

4.1.1. Contexto

El estudio se llevó a cabo en el "*Royal Devon & Exeter Hospital* (Reino Unido) (actualmente llamado *Royal Devon University Healthcare*). El programa de capacitación para el personal recién contratado en el hospital consiste en un mes de

formación supervisada, donde deben asistir a sesiones semanales (4 en total) sobre el funcionamiento general del hospital, documentación, seguridad, prevención y trato del paciente. Sin embargo, no se incluye formaciones específicas para el personal que accede a servicios especiales. En el caso del servicio de Urgencias, el equipo directivo demostró interés en desarrollar un plan de formación.

4.1.2. Diseño del estudio, procedimiento y participantes

Para realizar el estudio se empleó una investigación-acción en tres fases. Esta metodología, basada en un paradigma cualitativo, es muy utilizada en Ciencias de la Salud (Efron & Ravid, 2019). El estudio se realizó en los meses comprendidos entre diciembre 2019 y marzo 2020 en el servicio de Urgencias del hospital anteriormente mencionado.

4.1.2.1. ***Fase 1: detección de necesidades (investigación)***

En esta fase se aplicó un cuestionario cualitativo al personal gestor del servicio y de la formación, para poder individualizar las necesidades formativas. Además, se realizó un grupo focal con el personal recién contratado y sin experiencia en urgencias. El cuestionario se envió por correo electrónico y estuvo disponible durante enero y febrero 2020. Las respuestas sirvieron para identificar casos de situaciones clínicas frecuentes o críticas en urgencias, útil en el servicio en el que se cumplía el estudio. El grupo focal se llevó a cabo el 23 de marzo 2020 durante la primera sesión MAES©. En esta sesión, de acuerdo con la metodología MAES©, se trabajaron dinámicas para garantizar seguridad psicológica, se explicaron las normas de MAES© y se propusieron 16 situaciones clínicas, entre las cuales se eligieron 3. Tras elegir los escenarios, se realizó una lluvia de ideas para poner la línea basal de aprendizaje y se explicaron los pasos para diseñar un caso MAES©. Finalmente, cada equipo diseño un escenario con objetivos de aprendizaje y evidencia científica a soporte, siempre con el apoyo del facilitador.

Para seleccionar los participantes clave en la fase 1, se utilizó un muestreo por conveniencia. Se invitaron a 37 personas, entre ellas se encontraban jefes de servicios, supervisores y enfermeras encargadas de la formación. Finalmente participaron 15 personas. Al mismo tiempo se formó un grupo focal de 7 enfermeras recién contratadas (todas mujeres, media de edad: 30 años, con

experiencias hospitalarias de 3 a 10 años y sin experiencia previas en urgencias). Su trayectoria previa era diferente: ictus y neurología, cardiología, pediatría, traumatología y medicina interna.

4.1.2.2. ***Fase 2: acción***

En la fase de acción se diseña y aplica la metodología MAES© para entrenar en situaciones clínicas de urgencias con el personal recién contratado, cumpliendo con las necesidades formativas preferentemente individualizadas. En esta segunda fase metodológica, se realizaron los escenarios simulados (31 de marzo 2020). Se utilizaron las estructuras y recursos del servicio en el que los profesionales empezaron su nueva experiencia laboral (urgencias). Se emplearon tanto simuladores como pacientes estandardizados. Los equipos no participaron en el caso que diseñaron (para evitar sesgos y para seguir la metodología MAES©). Tras cada simulación se realizó un debriefing estructurado. En la fase 2 del estudio, los participantes fueron los mismos del grupo focal inicial.

4.1.2.3. ***Fase 3: evaluación***

Se recogieron las percepciones de los participantes en un grupo focal de una hora de duración, en el que se exploraron aspectos como el trabajo colaborativo, las experiencias, la utilidad del aprendizaje basado en simulación (SBL) y en particular el método MAES©. En esta fase, como en la fase de acción, los participantes coincidieron con los 7 del grupo focal de la fase inicial.

4.1.3. Análisis de datos

El estudio se grabó y transcribió para realizar el análisis de contenido con el soporte del software MaxQDA v18 (Kuckartz & Rädiker, 2020). Se identificaron unidades de significado, agrupadas en categorías y subcategorías. Para cumplir con un análisis riguroso se utilizó el método cualitativo Colaizzi, con validación por parte de los participantes (Colaizzi, 1971). Para el estudio se siguieron las directrices *COnsolidated criteria for REporting Qualitative research* (COREQ) (Tong et al., 2007).

4.1.4. Consideraciones éticas

Antes de iniciar el estudio, los investigadores obtuvieron la autorización del Servicio de Urgencias del hospital RD&E (Anexo 2) y del Comité de ética correspondiente (número de referencia CE012107: Anexo 3). En la primera sesión MAES©, se entregó a los participantes un formulario de consentimiento informado para autorizar su participación (Anexo 4).

Para garantizar el anonimato, los participantes del cuestionario cualitativo seleccionaron esta opción en el formulario. Durante la transcripción, se asignaron códigos (I1, I2, etc.) para identificar a los encuestados. En los grupos focales se usaron códigos como PS1, PS2 (profesional 1, 2 etc.) así como GF1 y GF2 para diferenciar los dos grupos focales.

A todos los participantes se les recordó que podían retirarse del estudio en cualquier momento, garantizando así la voluntad y confidencialidad durante todo el proceso.

4.2. ESTUDIO Nº2

An Undergraduate Interprofessional Experience with Self-Learning Methodology in Simulation Environment (MAES©): A Qualitative Study

"Una Experiencia Interprofesional en el Grado con la Metodología de Autoaprendizaje en Entornos Simulados (MAES©): Un Estudio Cualitativo"

4.2.1. Contexto y participantes

La Universidad Católica de Valencia (UCV) (España) cuenta con un "Hospital Virtual (HV) dedicado a la simulación clínica, donde se entrenan estudiantes y profesionales en un entorno que imita espacios hospitalarios reales (triaje, reanimación, observación, quirófanos, etc.). Aunque estudiantes de medicina y enfermería compartan estos espacios, no realizan actividades ni simulaciones conjuntas.

El estudio se realizó entre enero y marzo de 2022. Participaron en el estudio un total de 14 personas. Los participantes estaban constituidos por un experto clave en simulación clínica (enfermero, profesor y coordinador de simulación de la

Universidad Católica de Valencia) y 13 estudiantes (6 de enfermería y 7 de medicina). Los estudiantes fueron todos voluntarios (12 mujeres y 1 hombre con una edad media de 24,5 años). Todos los participantes entraron en todas las fases del estudio, acompañados por un facilitador MAES© con experiencia en esta metodología y en educación interprofesional.

4.2.2. Diseño del estudio y procedimiento

Se realizó un estudio cualitativo con acción formativa (Colorafi & Evans, 2016), desarrollado en tres fases.

4.2.2.1. ***Fase 1: investigación***

En este primer paso se detectaron las necesidades educativas. Para conseguirlo se realizó una entrevista semiestructurada online al experto en simulación de la universidad donde se realizó el estudio. Con él se acordaron las necesidades de los grados de medicina y enfermería en la formación interprofesional y se seleccionaron los posibles escenarios más adecuados. Paralelamente se organizó una fase de prebriefing MAES© con los estudiantes, para definir objetivos de aprendizaje sobre Crisis Resource Managemente (CRM).

4.2.2.2. ***Fase 2: acción***

En la segunda fase se realizó la intervención formativa aplicando la metodología MAES© para la educación interprofesional en el grado. El 4 de febrero de 2022 se llevó a cabo la primera sesión MAES© (240 minutos), donde se formaron grupos de trabajo mixtos (enfermería y medicina) en base a afinidades personales. Se conformaron 3 equipos definitivos: un equipo se encargó del diseño del escenario, otro lo ejecutó y otro fue observador. Todos colaboraron en definir los objetivos de aprendizaje. El día 10 de marzo se realizó la segunda sesión MAES© en la que se llevó a cabo la simulación, el debriefing y la fase expositiva (1 hora en total). Se utilizó un simulador, material de reanimación y una sala de simulación de Unidad Cuidados Intensivos (UCI).

4.2.2.3. ***Fase 3: evaluación***

En esta última fase se evaluó el impacto de la fase formativa y se recogieron las evaluaciones de los participantes. El mismo día de la segunda sesión MAES©, una vez finalizado el estudio, se procedió a realizar un grupo focal con todos los participantes (estudiantes y experto). Se recogieron percepciones sobre: experiencia de simulación, trabajo colaborativo, competencias mostradas, aprendizaje interprofesional y valoración general del método MAES©.

4.2.3. Análisis de los datos

El estudio se grabó y transcribió por parte de dos investigadores expertos en metodología cualitativa. Para realizar el análisis de contenido con el soporte del software MaxQDA v18 (Kuckartz & Rädiker, 2019). El análisis siguió el método cualitativo Colaizzi que implica la transcripción literal, identificación de afirmaciones significativas, categorización y validación por parte de los participantes (Colaizzi, 1971). Para el estudio se siguieron las directrices COREQ (Tong et al., 2007).

4.2.4. Consideraciones éticas

El estudio se llevó a cabo conforme a la declaración de Helsinki. Antes de iniciarlo se obtuvo el permiso de las universidades implicadas y del Comité de Ética correspondiente (número de referencia CE012107: Anexo 3).

En la primera sesión MAES©, se entregó a todos los participantes un formulario de consentimiento informado (Anexo 5) para su participación en el estudio. Se decidió preservar el anonimato tanto de los estudiantes como del experto universitario. Para garantirlo durante la trascripción se asignaron códigos alfanuméricos (I1 para el experto entrevistado; S1, S2 etc. Para el estudiante 1, el estudiante 2 etc.).

4.3. ESTUDIO Nº3

Enhancing Cardiopulmonary Resuscitation Training: An Interprofessional Approach with Undergraduate Medicine and Nursing Students Using Self-Learning Methodology in Simulated Environments (MAES)—A Qualitative Study

"Mejorando la Formación en Reanimación Cardiopulmonar: un Enfoque Interprofesional con Estudiantes de Medicina y Enfermería de Grado utilizando la Metodología de Autoaprendizaje en Entornos Simulador (MAES©) – Un Estudio Cualitativo"

4.3.1. Contexto y participantes

El estudio se llevó a cabo en la Universidad Católica de Murcia (UCAM) y la Universidad Católica de Valencia (UCV) en 2022. El estudio multicéntrico fue posible gracias a la similitud en los programas de medicina y enfermería de ambas universidades. Además, en los dos centros se utiliza el aprendizaje con simulación clínica (mínimo de 20 horas anuales). Ambos programas de enfermería incluyen sesiones con metodología MAES© (mínimo 8 horas en 3º y 4º año. Ningún participante tenía experiencia previa de simulación interprofesional. Las sesiones se realizaron entre marzo (UCV) y julio (UCAM) de 2022.

Para seleccionar a los participantes se utilizó un muestreo por conveniencia. Los criterios de inclusión fueron: experiencia previa en simulación y formación en Soporte Vital Básico (SVB), estar en el último año de medicina (6º año) o en el último de enfermería (4º año). DE 180 estudiantes elegibles (110 de enfermería y 70 de medicina), participaron 23 (según interés y disponibilidad). Los grupos se distribuyeron de la siguiente forma: 13 en la UCV (7 medicina, 6 enfermería) y 10 en UCAM (5 medicina, 5 enfermería). Ningún participante tenía experiencia previa de simulación interprofesional.

4.3.2. Diseño del estudio y procedimiento

Se utilizó un diseño cualitativo descriptivo con análisis temático inductivo (Braun & Clarke, 2021; H. Kim et al., 2017).

El entrenamiento interprofesional con simulación MAES© de RCP se realizó en dos sesiones por cada universidad. Las sesiones se realizaron entre marzo (UCV) y Julio (UCAM) de 2022. En la primera sesión se explicó el objetivo del estudio y de la estructura MAES©, se formaron grupos de trabajo interprofesionales estableciendo un entorno seguro mediante dinámicas grupales. Sucesivamente, se eligieron los temas de los escenarios basándose en casos reales, definiendo los

objetivos de aprendizaje personales. En la UCV se eligieron casos especiales de parada cardiocirculatoria, ritmos de RCP y liderazgo; en la UCAM eligieron RCP en ahogamiento e hipotermia. A continuación, se dejó un periodo mayor de 7 días para que los alumnos pudieran diseñar los escenarios. En la segunda sesión se implementó el escenario diseñado por los estudiantes y se realizaron los debriefing estructurados guiados por un facilitador MAES©. Sucesivamente se realizaron grupos focales para evaluar las percepciones y aprendizajes. La organización del estudio respetó en todo momento los elementos y características de las sesiones MAES© (Díaz et al., 2016).

4.3.3. Análisis de datos

Los datos se recopilaron mediante debriefings estructurados y grupos focales, todos grabados en audio y video. El debriefing siguió el modelo GAS (gather, analyze, summarize) con la técnica plus/delta y reflexión profunda sobre los modelos mentales (Abulebda et al., 2025). Los resultados se organizaron en tablas visibles para todos. Las sesiones de grupo focal se realizaron al final de cada jornada. Todos los datos (grabaciones, notas y fotos) fueron transcritos para el análisis temático. La codificación fue independiente por parte de varios investigadores, quienes posteriormente consensuaron los temas y subtemas. Se utilizó la lista *Standards for Reporting Qualitative Research* SRQR para guiar el proceso de análisis (O'Brien et al., 2014).

4.3.4. Consideraciones éticas

Todos los participantes firmaron un consentimiento informado con posibilidad de retirarse en cualquier momento (Anexo 6). Se garantizó el respeto, la privacidad y el trabajo en equipo durante las simulaciones. Para garantizar la calidad del estudio se aplicaron estrategias que incluyan triangulación de datos, verificación por los participantes y auditoría del proceso. El comité de ética de UCAM aprobó el estudio (referencia CE052308: Anexo 7). Para preservar el anonimato, los participantes fueron codificados como S1, S2 etc. (estudiante 1, estudiante 2 etc.).

4.4. ESTUDIO Nº4

The expository phase of debriefing in clinical simulation: a qualitative study

"La fase expositiva del debriefing en Simulación Clínica: un estudio cualitativo"

4.4.1. Diseño del estudio

Se utilizó un diseño cualitativo descriptivo con enfoque inductivo mediante análisis de contenido de un cuestionario abierto (H. Kim et al., 2017). El fin principal fue explorar las experiencias y opiniones de los participantes sobre la fase expositiva del debriefing MAES©.

Los cuestionarios abiertos tienen una estructura poco rígida que permite a los participantes expresar sus opiniones de forma libre y anónima. Aunque no es una técnica común en investigación cualitativa, es útil para explorar temas específicos en profundidad. En este caso, se quiso comprender fenómenos complejos desde la experiencia vivida, ofreciendo flexibilidad de contenido. El estudio siguió las directrices *Standards for Reporting Qualitative Research* (SRQR) (O'Brien et al., 2014).

4.4.2. Participantes

El estudio se realizó en la Universidad Católica San Antonio de Murcia (UCAM) en grado y posgrado de Enfermería. En una primera instancia, se seleccionaron participantes mediante muestreo no probabilístico intencionado. Se incluyeron estudiantes de cuarto año de Enfermería (en Practicum V) y estudiantes de posgrado en Enfermería de Urgencias, Emergencias y Cuidados Especiales. Se excluyeron estudiantes en programas de intercambio y aquellos no inscritos en cursos con simulación. Los participantes seleccionados fueron:

1. Practicum V: 304 estudiantes divididos en 20 grupos de simulación (con una media de 16 estudiantes por grupos). En este practicum los estudiantes realizan un mínimo de 20 horas de simulación MAES© (4 horas de prebriefing y 4 sesiones con 3 escenarios por sesión). Cada debriefing incluía, según metodología MAES©, cinco fases: reacciones, descripción, análisis, exposición y cierre.

2. Posgrado: 36 estudiantes divididos en 2 grupos de 18 estudiantes cada uno. Realizaron 24 horas de simulación MAES©.

Una vez seleccionados los participantes, se aplicó una estrategia de muestreo sistemático dentro de una muestra por conveniencia, seleccionando 8 grupos de grado y 2 de posgrado (10 grupos en total, 164 participantes elegibles). Finalmente, 151 estudiantes completaron el cuestionario (tasa de respuesta del 92%). Con esta estrategia se garantizó diversidad experiencial, riqueza de datos y rigor metodológico.

4.4.3. Procedimiento y análisis de datos

Se realizaron sesiones MAES© entre septiembre de 2022 y julio de 2023. Las sesiones siguieron la estructura de la metodología de autoaprendizaje en entornos simulados. Los cuestionarios incluyeron una sesión inicial de datos demográficos obligatoria (edad, género, nivel académico, experiencia previa con MAES© y recursos utilizados); y una segunda sesión con dos preguntas abiertas:

1. ¿Cuál considera que es la principal fortaleza de la fase expositiva del debriefing?
2. ¿Cuáles son sus limitaciones y qué sugerencias propondría para mejorarlas?

Todos los cuestionarios se entregaron al finalizar cada sesión de simulación tanto en papel como online (Google Forms). Los participantes optaron por completarlo mediante esta última opción.

Las respuestas fueron transcritas en un solo documento, organizadas por participante y por dimensión (fortalezas y sugerencias de mejora). Se aplicó un análisis temático inductivo con orientación descriptiva (Hsieh & Shannon, 2005). Dos investigadores codificaron los datos de forma independiente, utilizando el software MaxQDA v18, creando códigos, subcategorías y visualizando patrones (Mayring, 2014). Un tercer investigador, experto en metodología cualitativa, facilitó el consenso para resolver discrepancias (Graneheim & Lundman, 2004). Se calcularon frecuencias absolutas y relativas de cada categoría, para fortalecer el rigor y comparar datos entre los grupos (grado y posgrado). Se incluyeron en el análisis todos los códigos, también los que tenían una aparición inferior al 5%.

4.4.4. Consideraciones éticas

Los participantes fueron informados del objetivo del estudio y firmaron un consentimiento informado (Anexo 6) al inicio de la primera sesión de simulación. Se respetó la confidencialidad mediante el uso de códigos anónimos de un solo uso. El estudio fue aprobado por el comité de ética de la UCAM (referencia CE052308: Anexo 7) y cumplió con la legislación española en protección de datos. Las respuestas se presentaron mediante códigos alfanuméricos indicando si quién respondía era estudiante de grado o posgrado. En todos momentos los participantes podían renunciar a la participación al estudio.

V – RESULTADOS

V - RESULTADOS

This chapter presents the research findings from the four published articles that compose this doctoral thesis. In accordance with the regulations for obtaining the International Mention, part of the thesis must be written using a language other than Spanish. For this reason, this section is presented in English.

The chapter begins with a comprehensive summary of the key results, offering an integrated view of all studies. The full texts of the four individual articles are included following the overall summary of the results, to ensure transparency and facilitate a deeper understanding of the study and outcomes.

5.1. OVERALL SUMMARY OF THE RESULTS

The four studies forming the core of this thesis examined the implementation and impact of the MAES© methodology in clinical settings (Accident and Emergency – A&E), and interprofessional education (IPE) for healthcare students. Emphasis was placed on both technical and non-technical competencies using complex simulation scenarios (Crisis Resource Management – CRM and Cardiopulmonary Resuscitation – CPR). This study also enhanced collaborative practice focusing on the MAES© structured debriefing process that included a expository phase. The finding illuminated the transformative potential of MAES© as learner-cantered, self-directed approach helping to activate students in their autonomous and interprofessional learning.

The research identified sixteen specific training needs in clinical settings. It groups them into four domains reflecting specifical learning settings in A&E: Majors (e.g.: seizure, stroke, cardiology), Minors (e.g.: burns, plaster), Resus (e.g.: major trauma, cardiac arrest, airway management), and General (e.g.: mental health, infectious diseases). These were used in a formative intervention in A&E with newly hired nurses, following MAES© methodology.

The integration of IPE with MAES© was explored using complex scenarios (CRM and CPR) with Medicine and Nursing students. The choice of these themes was based on their focus on team dynamics rather than individual technical execution. Nursing and medical students collaboratively designed complex, high-

stress scenarios requiring effective communication, leadership and decision-making. Roles were constructed to simulate real-word tensions, to simulate teamwork, CRM skills and CPR realistic scenarios. The scenarios designed were an authoritarian doctor and a passive anaesthetist with nurse participation in airway management (CRM), CPR algorithm, CPR rhythms, special CPR case with drowning patient.

The previous experience of participants with SBL and MAES© was also analysed in the studies. Notably, prior familiarity with MAES© was minimal. Only three participants of the first study have heard of it before, none of the students at the Catholic University of Valencia used MAES© before, neither the Medicine students at the Catholic University of Murcia. On the other hand, nursing students from Catholic University of Murcia had experience with MAES©. This aspect was important to implement our last study performing an analysis of the expository phase of debriefing with 151 students. Knowing MAES© and its characteristics, they had the possibility to give opinions with a deeper understanding of this new phase of the debriefing. The analysis of previous simulation experiences of the participants also helped to better understand their idea about the traditional simulation methodology. Most participants had experienced this method for evaluations in university settings providing concerns regarding realism and anxiety:

> "Most of the time you know what you are simulating, it loses realty" (GF1-PS2)

> "I was terrified when I had to do the exam with simulation" (GF1-PS3).

This highlighted a need for simulations that authentically replicate clinical stressors while maintaining psychological safety. It also questioned if simulation is useful if associated to exams.

The study underlined several positive aspects of MAES© methodology. In first instance students reported that preparing and presenting materials fostered autonomy, scientific literacy and deeper learning. Many also highlighted the innovation of this approach over traditional formats, underlining the autonomy to create realistic, relevant scenarios increasing motivation and ownership:

> "Preparing material involves greater dedication and learning" (A5-postgraduate)

"Searching for information helps you learn" (A7-undergraduate).

"A different way of learning and, in my opinion, more effective and dynamic than conventional" (A35-postgraduate)

"It increases the motivation to face the chosen topic. We feel more responsible towards the knowledge" (S2, S6).

"With MAES© students not only solve the scenario, but also decide what they want to learn and then design it" (I)

The structured debriefing with the exposition phase was highly appreciated, reinforcing learning objectives through active peer-led discussion and multimedia presentation. Students described this phase as essential for consolidating concepts and closing the learning cycle:

"The expository phase helped to better fix the ideas and answer our own questions. It was the best way to close the learning circle" (GF1, GF12).

Students praised the collaborative, interactive nature of the exposition, which facilitated exchange of perspectives and collective reflection on errors. The phase also enhanced communication and public speaking skills:

"Discuss different points of view with classmates, see the mistakes and how to improve" (A2-undergraduate)

"It helps to present in public and gives us confidence for other presentations like the Final Degree Project" (A12-undergraduate).

The interprofessional dimension was particularly impactful, addressing gap in traditional curricula where medical and nursing students have limited shared learning opportunities. MAES© facilitated mutual respect, empathy and deeper understanding of roles. Students also acknowledged that IPE mirrored clinical reality more closely, and prepared them better to work collaboratively:

"It accentuated teamwork, helped communication, and raised our mutual respect" (GF8)

> "The dynamics help us to get to know each other better and to work as a team. We can train non-technical skills that with other methodologies may not get the same attention" (S3).

IPE, MAES© and complex scenarios were used in our study. CRM was seen essential for developing non-technical skills. CPR training with MAES© offered a deeper learning experience with higher knowledge retention than conventional methods. These trainings bridged experience gaps, especially for final-year students, reinforcing the value of high-fidelity simulated scenarios in preparing future professionals.

> "With CRM we can reduce risk for both patients and professionals" (GF4)

> "CRM helped us to better understand decision-making, very useful when thinking of professional future" (GF3)

> "With MAES© I have the feeling of learning CPR, whereas when we do it without MAES it seems that we only focus on the technique" (S21).

However, some suggested some improvements. It was noted an increased workload as well as increased pressure of ensuring accurate peer teaching. Others gave relevance to debriefing and suggested to limit the use of Power Point or to make shorter and more dynamic presentation in the expository phase. Finally, it was suggested to better organize the homework to give more time to design the scenario, especially for professionals who must match their work with formations and training experiences.

5.2. COMPENDIUM

The following pages present the four articles in their complete and integral form. In addition, the scientific validity data of the studies are provided. This ensures the transparency of the results of the thesis.

5.2.1. Article Nº1

Self-learning methodology in simulated environments (MAES©) utilized in hospital settings. Action-research in an Emergency Department in the United Kingdom.

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Self-learning methodology in simulated environments (MAES©) utilized in hospital settings. Action-research in an Emergency Department in the United Kingdom

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ABSTRACT

Introduction: This article describes the impact of a simulation-based learning method on emergency nurses at the Royal Devon Hospital (Exeter, United Kingdom).
Objectives: To determine the training needs of nurses who were recently hired, as well as to evaluate the perception on the acquisition of emergency nurse competencies after the educational intervention.
Method: The study was composed of 3 phases.
First phase: The training needs were analysed from the point of view of the participants (through a focus group), and the institution (by consulting experts through an online questionnaire).
Second phase: Various simulations were implemented and designed by the participants themselves according to their needs, using the Self-Learning Methodology in Simulated Environments (MAES©).
Third phase: The results of the education program were evaluated.
Results: Many categories were obtained that served to determine the training needs of the participants, and to design various self-directed simulation scenarios. Three simulation scenarios were performed and afterwards discussed.
Conclusion: The experience was positively evaluated by the participants. The participants believed that the MAES© method was adequate, given that at all times, they were the protagonists of their own learning according to their training needs, and considering their previous knowledge.

1. Introduction

The need of new health workers in specialized units is frequently high. These new workers can be both with previous experience or newly graduated. What makes them equal is to be unfamiliar with the units, or the hospital where they are starting. The unfamiliarity with the unit can be worse for the new health professionals who find themselves on a specialized ward (ED/ER, ICU, CCU etc). It has been demonstrated that maintaining the quality of care in emergency units were difficult due to overcrowding, specialised care required by patients and the need of quick action in emergency situation. Face these challenges added up to be a new member of staff can increase the difficulties for new hired health workers [1].

New health professionals are needed to cover workers on leave, to increase the staff, or strengthen the existing one, and they require specific training prior to starting. In the current context of the global pandemic due to COVID-19, the hospital centres find themselves overloaded with work, and the need for new support staff is therefore evident. Not all hospitals and care centres have the same training programs available to train the recently-hired staff at specialized units. On some occasions, it is assumed that they possess the necessary qualifications in accordance to the characteristics of each centre or unit. The training programs at hospitals tend to include theoretical presentations and some type of simulated experience.

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High-fidelity clinical simulation is currently one of the best-evaluated training methodologies [2] in university contexts and also in real work environments. When one learns with simulation, what is observed is that different individuals (either different professionals or students) are trained on situations or environments that are very close to reality through a method that implies that they would behave just as they would at work (professionals) or how they would behave in their future profession (students) [3].

Training with simulation is considered a reflexive and experiential learning method [4]. The participants perform the simulation trying to apply the scientific evidences, studies and guidelines they have. Simulation also allows "learning by doing" in a safe environment. It helps participants being able to make mistakes and analysing what can be improved, without risk for the patients [5,6]. The use of clinical scenarios allows improving and acquiring both technical and non-technical skills (communication, leadership, coordination, prioritization etc) in all areas and with multidisciplinary teams [7].

Training of the participants, when working on their competences with simulation, is better than traditional learning without experiential or reflective elements [8]. Another consequence of simulation-based learning derives from the assumption that the teams that are well-trained and up-to-date will provide better care to their patients. Many of the events that lead to damage to the patient (most of them) are associated to human factors [9] such as communication errors, leadership, deficient teamwork, etc., which are aspects that could worked on and perhaps improved with simulation.

Learning with simulation can also have some limitations, as it requires a large organization, materials and human resources that could make it an expensive method for the institution that adopts this method [10].

The *SimZones* [11] are part of a recommendation for gradually learning with simulation, depending on the degree of fidelity and the training of the participants. They are a manner of structuring the simulation according to learning areas, and were described in 2017 within the context of the simulation program at Boston Children's Hospital. According to this approach, the simulations can be structured into four zones (Zones 0–3) with a progressive distribution of complexity and the number of competences, distraction, and fidelity. It is an approach that is focused on programs developed within the clinical settings at hospitals. In the caregiving settings, along with the health professionals, the work is performed in zones 2 and 3. While Zone 0 is based on auto feedback and Zone 1 include hands-on instruction of foundation clinical skills, in Zone 2 the simulations include situations with context (increase the noise with respect to the previous zone). The participants work in acute situations with set protocols (such as cardiopulmonary resuscitation, learning scenarios with clinical situations, etc.). The simulations in Zone 3 imply a greater degree of realism and authenticity. The participants are real health professionals who train on their habitual competences (very similar to those they use in their day-to-day work). The authors also described Zone 4, which referred to the learning that could be obtained from group reflection (*debriefing*) after a real event experienced in a real work situation.

The simulation-based training with teams is normally conducted by considering the learning objectives [12] which are set by the education centre, by the course instructor, or by the training needs at an educational (university or course), or health (hospital) context. The simulation instructor is normally the one who manages and plans the session, sets the time, and ensures that the learning objectives are achieved [13].

However, other alternative models exist for the planning and execution of the simulation session, such as the MAES© methodology (Spanish acronym of *Self-learning methodology in simulated environments*). The MAES© methodology [14] was designed in 2012. The essential characteristic of this method is that it is a self-directed and collaborative type of simulation-based learning. Thus, the students, advised or guided by a facilitator, are the protagonists of learning. They are the ones in charge of choosing the cases and the competences that should be worked on (thanks to a prior session in which they decide what they know or do not know about a specific problem or case extracted from a real-life situation). They are also the ones in charge of the design of the scenarios, of participating in the simulation-based experience, and of providing the knowledge needed to close the gap or eliminate the deficiencies detected in the first session. The structure of MAES©, based on simulation and on putting participants at the centre of their own learning, makes it a valuable interpretation of both situational and constructivist learning methods [15,16].

Diverse studies have shown that the MAES© method is well accepted by the students and facilitators [17,18]. It has also been shown to be a learning method that has a stronger impact than other types of method using simulation in Nursing university context in Spain. [17,19,20]. However, no studies were found on the use of this method with professionals in real contexts (non-university) outside of Spain.

Thus, the objectives of the present study were: to determine the training needs of nurses who were recently hired at the unit of emergencies at a hospital. To implement a pilot training experience based on simulation with the MAES© method. To evaluate the participant's perception on the acquisition of emergency nurse competencies after the educational intervention, as well as the opinions on the MAES© simulation learning method.

2. Method

2.1. Settings

At the Royal Devon Hospital in Exeter (UK), the training program is comprised of a month where the workers are in a training period (they will always be supervised and accompanied by another health professional from the unit). In this period, they have the obligation of attending training sessions (1 per week for 4 weeks) on the general inner-workings of the hospital, documentation, safety, occupational risk prevention, and another session related to dealing with patients or "*compassion*". The specific training situations (technical skills, critical situations) would be developed throughout the training period of the contract, without a previous training phase on emergency-related skills themselves.

2.2. Design

Action-research in 3 phases. The qualitative paradigm of Action-Research was chosen, as it is commonly utilized in the education and social sciences context [21]. It consists in not only studying the phenomenon, but also on changing a reality and improving it, so that the researchers are also agents of change [22] (Fig. 1).

1st phase: Detection of training needs (Research). This was conducted through a qualitative questionnaire created with Google Forms© (see supplementary file 1). This questionnaire was provided to the individuals in charge (doctors and nurses) of the emergency unit at the Royal Devon Hospital at Exeter, and a directed focus group comprised by a sample of personnel who had been recently hired and who did not have prior experience in emergencies.

2nd phase: Preparation and application of the simulation MAES© methodology for training on situations associated to emergencies (Action).

3rd phase: Evaluation and collection of evidence related to the results from the training with MAES©.

2.3. Participants

The study was conducted in the Emergency Department at the Royal Devon Hospital located in Exeter (UK) between the months of December 2019, and March 2020.

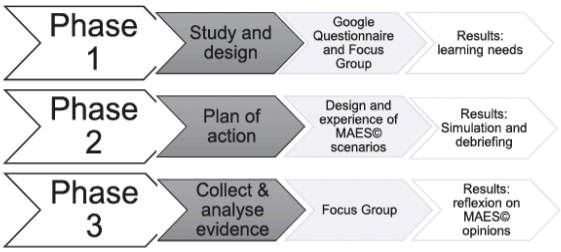

Fig. 1. Action-Research method applied to the study.

2.4. Participants 1st phase

To obtain information on the training needs, on the one hand, we considered the opinions from the experts at the unit, and on the other hand, the education experience participants. A convenience sampling method was utilized, thereby selecting the informants according to criteria of suitability or pertinence. To obtain answers to the qualitative poll, it was sent to consultants, matrons, charge nurses and nurses in charge of the training at the emergency unit. In total, it was sent to 37 individuals, of which 15 provided answers.

To discover the training needs of the newly-hired nurses, a focus group was created which coincided with the first MAES© session. This group included 7 individuals who were recommended by the unit's matrons. They were included for having the following characteristics: newly-hired nurses, who had previous hospital experience (stroke unit, cardiology unit, medicine, traumatology, and two paediatric nurses), but not in emergencies. The 7 participants were women with an average age of 30 (SD = 6.45). All of them had a period of experience in hospital setting between 3 and 10 years.

2.4.1. Participants in the 2nd and 3rd phases

The participants in these phases were the same individuals from the focus group in the 1st phase.

2.5. Procedure

2.5.1. 1st Phase

The poll was sent via email to those selected, and they had two months to complete it (January and February 2020). We designed the poll with open-ended questions so that the participants could write their opinions without a limit on the number of words. The results of the polls were used to obtain a set of "case types" that could be used with the MAES© session participants, in accordance with the perspectives of those in charge of the emergency unit needs (more frequent cases but also rare cases that must be known). The research team validated the poll questions after many meetings (content validity).

As for the focus group, this took place on March 23rd, 2020. The focus group was convened during the first MAES© session (*prebriefing*). A male researcher (RN), who had experience on the management of simulations with this method (MAES© facilitator), facilitated the session. The session lasted 240 min. At this meeting, the work was performed according to the MAES© standards, operational work groups were established, the psychological safety of the participants was worked on through group dynamics, and the simulation norms and the MAES© structure were explained. Lastly, 16 situations were proposed (Fig. 2), extracted from the needs that emerged from the poll. Each team chose the one they considered attractive or stimulating (a total of 3 situations). Then, the group started a debate in which the participants decided what they knew and what they did not know about each situation (*brainstorming*). The debate lasted 1 h. Also, the evaluations of the

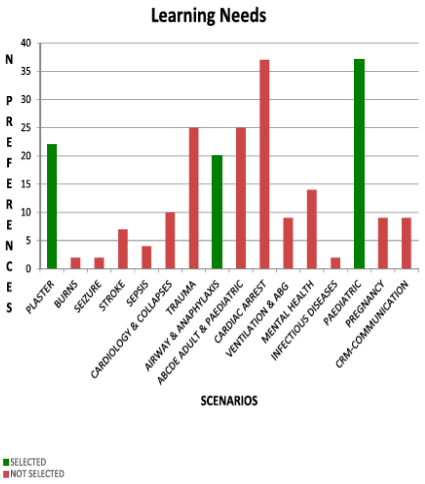

Fig. 2. Learning needs described by the experts and chosen by the participants (green).

participants of their previous experience with simulation learning were examined. The debate was recorded in an audio recorder for its posterior analysis.

In this phase, the facilitator explained how to design a MAES© case to the participants, providing them with resources for this (a template for the design and management of scientific evidence). Each team committed themselves, cooperatively, to design a scenario and provide evidence about the learning objectives that were decided upon by the entire group. A week was given for this work. During this time, the facilitator was available to resolve doubts or provide support for the design of the scenarios and the search of scientific evidence.

2.5.2. 2nd phase

In this phase, the simulated experience was performed in accordance to the needs of the group. The simulation session took place on March 31st, 2020 at the hospital installations. For the simulation, equipment and patient simulator (manikin), and a standardized patient (actor) were provided, as well as a *simulation room* that allowed all the participants to watch the simulations directly. Three simulation scenarios designed by the participants were developed. The facilitator received the cases ahead of time and checked them. The session lasted 1 h per scenario and team

(a total of 3 h). In agreement with the MAES© standard, the team who took part in the simulation was not the team that had designed it. The team who designed the case committed themselves to presenting the competences that they selected in phase 1 after it had been analysed through a structured *debriefing* which took place after the simulation session.

2.5.3. 3rd phase

After their participation in the learning program with the MAES© method, the participants were asked for their perceptions on the experience. The focus group for this lasted one hour. Information was collected about how they had felt during the sessions, aspects about collaborative work, their opinion about the scenarios that they worked on, the simulation experience and the competences shown. Also, their overall idea about simulation-based learning in general, and with MAES© in particular, was recorded.

2.5.4. Analysis of data

The audio files were transcribed verbatim into a single document which, after the careful and independent reading by two different members of the research team (with a broad experience on qualitative research) served as the basis for categorization and content analysis [23]. The qualitative analysis software MaxQDA® v18 [24] was utilized for the coding of the results. The units of significance that emerged from the independent analysis of the text were identified and coded, and then these were grouped into categories and subcategories, as a function of their similarity. Likewise, for the interpretation of data, the contrasted method by Colaizzi [25,26] was utilized, as it is recommended for social research. This style of analysis basically consists on the following steps:

1. Literal transcription of the data. Various readings of the description of the phenomenon by each participant.
2. Return to the original transcription and re-read it to extract significant statements.
3. Identify units of significance for each of the significant statements.
4. Organize the units of significance, group them into greater comprehensive categories (defined a priori as general themes).
5. Write an exhaustive description of the phenomenon of study, describing categories and the units of significance constructed.
6. Return it to the participants to validate the description.
7. If new data is revealed after the validation, this has to be added to the exhaustive description.

At all times, the researchers sought to maintain a reflective attitude to minimize the impact of their subjectivity on the process of data collection and analysis. To present this research, the transparency and quality guidelines proposed by the COREQ (Consolidated Criteria for Reporting Qualitative Research) [27] checklist were followed (Supplementary file 1).

The theoretical saturation of the data was agreed upon when the interventions and opinions on the themes were recurrent.

3. Ethical considerations

Before the start of the study, the researchers obtained the permission from the RD&E Emergency Department and Ethics Committee from the *(blinded for revision)* (Reference number CE012107). During the first MAES© session, the researcher provided an informed consent form to all the participants in order for them to participate in the study. For the qualitative poll, they chose the options to maintain their anonymity from the Google Questionnaire. During the transcription of the poll, the researcher assigned a letter and a number to each participant (I1, I2: interviewee 1, interviewee 2, etc.). The two focus groups were transcribed by assigning each participant with a code (PS1, PS2: professional 1, professional 2, etc.), and each focus group was assigned a number (GF1, GF2, focus group 1, focus group 2). This was done to limit any informational elements. All the participants were given the option of not participating in the study at any time.

4. Results

4.1. 1st Phase. Training needs

The analysis of the qualitative poll given to experts provided the following data, which were classified into 16 categories and identified as different training needs. The subcategories were organized into 4 categories related with the area where the case was treated at more frequently: Major (Seizures, Stroke, Sepsis, Cardiology/Collapse), Minors (Plaster, Burns), Resus (Trauma, Airway & Anaphylaxis, ABCDE Adult & Paediatric, Cardiac Arrest, Ventilation & ABG) and General (cases observed in more than one area such as Mental health, Infectious diseases, Paediatric, etc.). The subcategories were utilized to choose the 16 cases to be offered to the participants during the first MAES© session. Among these, the three groups of participants selected one per group (Fig. 2). Along with the poll, the knowledge about simulation methods was assessed, where it was observed that the MAES© technique was almost unknown (only 3 people knew about it).

As for the results of the first MAES© session, the participants decided how to divide themselves into 3 groups. Then, each team decided on a name and provided a reason for it.

16 different themes were offered to the participants, inspired by the learning needs identified by the experts. For each of these, the researcher found specific materials to be presented to the participants. Each team could only select one theme to work on. The summary of the participant's choices and the theme proposed are shown in Fig. 2 (green = chosen, red = not selected).

For each theme, the participants made a decision about what they wanted to learn, using the brainstorming technique. The brainstorming results for each theme selected are shown in Table 1.

The assessment of the participants of their previous experiences with simulation-based learning was also examined. Most of them [6] had experience with simulation at university with the OSCE (Objective Structured Clinical Examination) exams. Only 2 of them had been part of a clinical simulation at the units where they had worked on before starting their experience at the Emergencies unit. Among the positive aspects, we found the possibility of training and learning in a non-threatening environment, whilst at the same time that teamwork improved.

"It is definitely a great way of delivering training in a non-threatening environment (…) (GF1-PS1)

As for the aspects that should be improved, from the individual

Table 1
Brainstorm results "What do we want to learn?"

GROUP NAME	Disney Puppy	The Beaches	Team E
CASE CHOICE	**Paediatric:** Young kid in poor health due to Flu at Exeter Hospital	**Airway/ Anaphylaxis:** Young college girl dies due to anaphylaxis	**Plaster:** Man with compartment syndrome due to tight plaster
SOURCE	Newspaper Devon Live	Newspaper (international)	Newspaper (international)
WHAT DO WE WANT TO LEARN?	Full Paediatric Assessment (ABCDE) Airway devices (OP, NP, IGEL, Tube) Devices (AIRVO, OPTIFLOW, BIPAP, CPAP, NEBS, INH) How to get ready for a "Triple Neb"	Anaphylaxis protocol + dose of adrenalin Airway management & difficult airway Can NEBS help patient?	When do we choose a full cast? How do we choose a below/above joint plaster? What are the red flags for a compromised limb? Ottawa knee and ankle rules

experiences with simulation, we observed that many comments pointed to the fear of evaluation of a practical exam or a lack of reality during the cases simulated.

"Most of the time you know what you are simulating, it loses reality (…)" (GF1-PS2).

"I was terrified when I had to do the exam with simulation. I liked it but my idea of simulation changed when I had to do the OSCE (…)" (GF1-PS3).

2nd Phase. Experience simulated with MAES©.

Each team designed a simulation scenario in accordance to the template standardized for MAES© (The scenarios designed are found in supplementary file). In this phase, the simulated experiences were conducted so that each team participated in a scenario that was designed by a different team. They were able to do so during the debriefing that, with MAES© method, follow the "GAS" (Gather, Analyze, Summarize) structure and it is guided by the facilitator [28,29]. After an initial emotional relief, allowed by letting the participant describe how they feel and what happened in the simulation, the debriefing continue with the analysis of strengths and weaknesses (plus/delta). The summarized phase facilitates the identification and the review of the lessons learnt. With MAES© this last part of the debriefing is done by the participants who design the simulation. They resolve the learning objectives about their case emerged in the first session, during the exposition phase of the debriefing.

3rd Phase. Perception of the participants about learning with MAES©.

The activity with the MAES© method was analysed in the third phase with a focus group, which allowed for the analysis of important aspects related to learning with MAES©.

After the literal transcription of the second focus group, 4 categories and 12 subcategories were identified (Table 2).

Category 1. Positive aspects of MAES©.

The participants identified many positive aspects. The self-learning method was one of the most mentioned. The members were satisfied because they were in charge of their own learning:

"It was good to choose the topics because we knew then what we wanted to learn (…)" (GF2-PS1).

"I really liked MAES© because it felt nice to have the lead and I could actually think about what I was doing, what was needed to be done (…)" (GF2-PS2).

Table 2
Results Phase 3: second focus group.

Theme: MAES© perceptions (3° phase)				
CATEGORIES	SUBCATEGORIES	N° CODES	% CODES	% CAT
MAES© +	Self-learning	12	17.91	64.18
	Updating knowledge & protocols	6	8.96	
	Motivation & confidence	11	16.42	
	Structure	6	8.96	
	Debriefing	8	11.93	
MAES© Δ	Structure VS time	2	2.99	2.99
LEARNING ENVIRONMENT & ORGANIZATION ASPECTS	Room	6	8.96	19.41
	Group	7	10.45	
PREVIOUS SIMULATION EXPERIENCES (NOT MAES©)	Positive	1	1.49	13.42
	To improve	8	11.93	
	TOTAL		100.00	100.00

Perception of the participants. Categories and subcategories*. *Data extracted from the analysis program MaxQda 2018®. Coded segments: The segments found in the transcriptions are counted. Each coded segment means that some participant referred to the category or subcategory in his/her discourse. Frequency: refers to the percentage represented by the theme in the total elements coded from the transcriptions (the data are shown according to category/subcategory).

The second positive aspect was the increase in motivation and the confidence perceived by the participants when they learned with MAES©:

"MAES© felt more real and it motivates more because we had the team already settled and if we need to ask for help, we had actual people coming (even if they were not real doctor or surgeon etc.). It can make you feel prepared (…)" (GF2-PS4)

"It is good that we had to look up for information, so you have to think about it a Little bit more (…)" (GF2-PS3).

The structure of the debriefing was something positive and new for the participants. They mostly appreciated that the fact that they could write what they were saying, and the idea of first analysing what was correctly done:

"I think it was good to run through what went well first and then what to improve after. I feel that make you feel a bit better as you could see you know something (…)" (GF2-PS2).

"(MAES©) debriefing is good because it makes you think why you do something, while sometimes in reality you do things just because "you have to" without thinking (…)" (GF2-PS5).

The last two positive aspects that emerged were related with the self-directed structure of MAES©. The participants highlighted the importance of their being the ones who had the possibility of periodically updating their knowledge and the protocols in the department (searching for information and planning scenarios). The collaborative work was also well evaluated:

"It is good for the department as well, the fact that we look up for information so we can match the guidelines (…)" (GF2-PS1-2–4).

"It was quite nice to be allowed to bounce ideas together as a group and then use those ideas to perform the scenario (GF2-PS2-1–4)"

"Homework and look up for things evidence-based, helped us to realise if the competences were up to date (…)" (GF2-PS4).

"Working as team worked very well, it helped us knowing each other (…)" (GF2-PS 1–2-3–4-5–6).

Category 2. MAES© aspects that could be improved:

There were only 2 comments about aspects that could be improved in the experience with MAES©, which were mainly related to its structure and the time needed to plan the sessions. The main fear was not having enough time to complete MAES© when the work schedule was intense:

"The structured debriefing was good. The problem is the time. If you want to do things well, you need time with MAES© (…)" (GF2-PS5).

Category 3. Aspects related with the learning environment and organization.

The participants named some organizational aspects that were mainly related with the creation of the group, considering the number of people and their background as "good", but suggesting that the presence of a doctor could have helped with the realness of the scenario (create interprofessional simulations). Some of the participants saw the absence of doctors as a good opportunity to understand their position:

"Having different backgrounds and knowledge it was good because we can join them together and share information (…)" (GF2-PS 5–1).

"The group of 3 was perfect. More people would have been a problem and be chaotic (…)" (GF2-PS4).

"Not having doctor helped us to make "doctor things" and understand their position (…)" (GF2-PS1).

"An improvement can be to have a doctor present in the simulation and do interdisciplinary simulation in clinical setting that will help as it can reproduce the daily settings (…)" (GF2-PS2).

The safe simulation environment was also mentioned. The participants said that it helped them feel less nervous, and saw the presence of other people in the room as supportive:

"Having colleagues watching in the room made me feel observed but supported (…)" (GF2-PS2).

Category 4. Previous experiences with other simulation methods.

During the focus group, we found a number of opinions regarding the previous experiences of the participants with simulation. Most of them (5 out of 7) had previously participated in at least one simulation. The

comments were mainly questions relative to the speed of the simulation, the lack of reality, and the feeling that it was centred on the doctor:

"Sometimes it feels simulations are not well planned and I cannot really see a learning outcome (…)" (GF2-PS1).

"I feel if I have to ask for help whilst doing simulation on the ward, the help is not coming because "it is just a simulation" (…)" (GF2-PS4).

"Simulation on a ward, with all the staff (nurses, doctor etc) makes it more doctor-centred (…)" (GF2-PS4)

5. Discussion

Our study is the first to evaluate this methodology in a hospital environment, thanks to the opportunity provided by the RD&E Emergency Department.

The study began with research on the training needs of these health professionals from the point of view to experts and having in mind the participants. The first finding of this study is a series of proposed situations which, from the point of view of experts, are fundamental for the training of emergency nurses. However, of the 16 situations, the participants selected 3 due to their importance to them (Paediatric, Plaster, and Anaphylaxis), which did not exactly correspond to the importance attributed by the experts (Cardiac arrest, Paediatric and Trauma/ABCDE evaluation). This could be due, for example, to the fact that cardiac arrest was a situation for which they had already been trained on and experienced previously at other hospital units. The ABCDE approach was considered common to all the simulations, so selecting only one case with the ABCDE approach was considered unnecessary, as it would be worked on in all of them. Trauma was not selected because within the emergency unit, there was a project with various courses centered on trauma which the participants had to take, so they decided to select other cases that were more attractive to them. Our interpretation can be justified within the constructivist framework of learning [30]. Learning will be truly meaningful when the students are able to associate new information with the structures of previous knowledge they already have stored [31,32]. This is why it is essential to know the baseline of the knowledge and competences of the participants before planning a training session. In MAES©, the case selection and competences phase belonged to the participants, and although a number of case suggestions were provided, they selected the most signficant ones to work on, which would promote meaningful learning.

In the British health training system in emergencies, the training of the health professionals is usually conducted, among other manners of training, through simulations in zone 3, with scenarios selected and designed by the consultants. This training allows for the acquisition of knowledge, the updating of skills, and the training in a safe environment to learn from mistakes [33]. Although the participants in this study confirmed these aspects, it was significant to discover that many of them found it to be too critical. They felt that the responsibiliy was mainly centered on the doctor, and made the nursing personnel feel evaluated, leaving them with a simulation experience that was not very positive. Some of them felt the same during the OSCE exams at Universtiy. It has been shown [34] that when the participants associated the simulation with an evaluation or exams, the experience was very stressful, and they thought it did not reflect reality. However, when one trains with the MAES© method, a great importance is given to the psycologically-safe environment so that this does not occur, with this aspect being well-evaluated by the participants.

Althoug this pilot study provides findings from a small number of participants, the main finding was the general acceptance of MAES© as a learning method in hospital environments. This could be due to its structure, which allowed the participants to reflect on the theme they chose to study. This self-directed process is one of the foundations of MAES© [14] and was also the main aspect mentioned by the participants. MAES© provides students and professionals with the opportunity to decide on the theme to work on, after which a reflection is made about it, which continues with the search of the latest scientific evidence for planning and executing the scenario.

The simulation is not the end of the process, as the participants are still the centres of activity during the debriefing phase (when they present answers based on scientific evidence to the group questions). The debriefing, and its structure, which was mainly directed by the participants themselves, was also a reason for the acceptance of MAES©. In the debriefing phase with MAES©, there is a presentation phase (as an addition of the typical phases described in the literature), in which the participants can defend their findings and answer the lack of knowledge that were initially proposed, using creative resources (not only with presentations), for example, videos, presentation of articles, testimonies from real patients, [35] etc.

Some studies [18,19,36] have verified the satisfaction of students who learned with the MAES© method, as well as the facilitators who utilized it. However, experiences in zone 3 (with native professional teams) were lacking until now. In our study, we verified the good acceptance of the MAES© method by the participants. We believe that this satisfaction was due to the influence of various aspects: the greater autonomy when selecting the learning objectives, as well as the motivation that participants could find being in charge of their learning (self-management learning). It is important to also have available an environment that is psychologically safe, where a mistake represents an opportunity for improvement, instead of a reason for criticism, as observed in the evaluation approaches in other simulations (OSCE).

Their involvement as individuals in a group granted them with responsibility and allowed them to feel the simulation experience in a more realistic manner when simulating the scenario. With MAES©, all of participants underlined that they had the possibility for training, acting, and speaking, and felt useful for their own learning and department. Also, training with MAES© could stimulate the health professionals to periodically verify the guides and protocols belonging to the unit, based on more up-to-date evidence when working with scenarios associated to their day-to-day work. We believe that this would help improve the quality of the health organisations, as this is demanded by the professionals themselves [37].

It has been demonstrated that learning with simulation can have some limitation mainly related to the fidelity of the scenario or the materials and the direction of the learning (self-directed or instructor-directed) [38,39]. In the first case high fidelity and standardised patient allowed to better deliver learning outcomes although is important to maintain a variety of educational intervention and resources. MAES©, being focused on the participants and their motivation, guarantees a variety of ideas, scenarios and resources. In the second case the learning outcomes were similar between self-directed and instructor-directed learning but participants in the self-directed group keep their level of learning and their motivation for a longer period than the ones in the instructor-directed learning. MAES©, using the self-directed learning method, can guarantee, accordingly with Bridges' study, to keep knowledge and motivation for longer.

MAES© left some doubts on its usefulness in a non-university clinical setting, especially with respect to the time invested in searching for information, designing scenarios, preparing the presentation for the debriefing (homework). MAES© is not centred on the expert, but it is instead centred on the participants, with their learning playing a vital role. We believe that its implementation in a hospital training context with health professionals should be accompanied by important planning of the time and resources (material and human). Perhaps this type of simulation method will be easier to manage when other training sessions are planned with other simulation models directed by other instructors. This could be explained because in this setting, the organization will not depend on the work by the participants, but the management will fall on the expert who plans the course.

The RD&E Emergency Department is continuously subjected to the presence of new personnel who have to be trained in specific competences in this area. We believe that a good opportunity for training could be the use of self-directed simulations (based on previous knowledge

and on the training needs that were self-identified), as observed in the results.

6. Limitations

The most evident limitation of the study came from the difficulty in organizing the space and the resources due to the start of the pandemic. The study, conducted at the end of March 2020, coincided with the start of the Covid-19 infections in the UK and the implementation of unprecedented measures at work.

Another limitation was the reduced number of participants, in that the external validity of the study was limited. Nevertheless, the results would be useful as a pilot study. Given the qualitative character of the study, the results are valuable, as they could be used as the basis for future studies.

Although the international nature of the investigation and the expertise involved guarantied no conflict of interests, is important to mention two of the authors of the study were directly involved with the creation of MAES© method.

7. Conclusion

The present study identified the training needs of nurses who were recently employed at an emergency department (in areas such a paediatrics, airway/anaphylaxis, and orthopaedic care/plaster). An experience with the simulation methodology MAES© was implemented, in which 3 scenarios were worked on in a self-directed manner. The scenarios were selected based on the needs and preferences of the participants. Lastly, the subjective impact of the experience was evaluated.

The results of the study indicated that the health professionals felt as if they were the protagonists of their own learning, more involved, as they were learning with simulation and freer to speak in a non-threatening setting. These aspects underlined the strict correlation between MAES© and what we think are the methods with more perspective of success in health training: situational and constructivist learning. Learning with MAES© could be conducted in hospital settings, and the health professionals evaluated it as a very positive experience, although they recognized that the MAES© structure takes time and resources. In the future, we suggest that its use could be investigated with multidisciplinary teams.

CRediT authorship contribution statement

Giulio Fenzi: Conceptualization, Methodology, Software, Investigation, Formal analysis, Supervision, Validation, Writing – original draft. **Adam D. Reuben:** Data curation, Methodology, Investigation, Writing – review & editing. **José Luis Díaz Agea:** Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Software, Supervision, Validation, Writing – original draft. **Tomás Hernández Ruipérez:** Investigation, Validation, Supervision, Writing – review & editing. **César Leal Costa:** Conceptualization, Methodology, Data curation, Investigation, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ienj.2021.101128.

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5.2.2. Article Nº2

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Article

An Undergraduate Interprofessional Experience with Self-Learning Methodology in Simulation Environment (MAES©): A Qualitative Study

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Abstract: This article describes the impact that a Self-learning Methodology in Simulated Environments can have on Interprofessional Education within a Crisis Resource Management simulated scenario. We used a qualitative approach. It is divided into three phases: study and design, plan of action, and analysis and evaluation. During the first phase of the study, there emerged a poor use of Interprofessional Education in the nursing and medical degrees, and it became apparent that there was a need for an implementation. Due to the possibility for better training for both technical and non-technical skills within Crisis Resource Management, a simulation scenario within this setting has been established as a learning baseline objective. The technique used to develop the scenario in the second phase of the study was the Self-learning Methodology in Simulated Environments. Its structure, comprising six items, was previously demonstrated in the literature as appropriate for healthcare degree students. The main result of the third phase shows an overall acceptance of an Interprofessional Education within Self-learning Methodology in Simulated Environments during the practice of a Crisis Resource Management scenario. The integrated application of a Self-learning Methodology in Simulated Environments, Interprofessional Education, and Crisis Resource Management result in a synergistic combination that allows students to share knowledge, technical, and non-technical skills using an innovative learning method.

Keywords: simulation; interprofessional education; nursing education; medical education; crisis resource management; MAES©

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1. Introduction

In healthcare, patients meet different professionals and specialists. Patients' safety and satisfaction throughout all of their health-processes are the basis for patients' care [1]. All healthcare professionals must link, train, and share their knowledge and competences to deliver a good standard of care that maintains patient safety [2]. The need for creating working links and sharing competences inside healthcare showcases the importance of training and improving knowledge, not only as a person or single professional, but also as an interprofessional team. When doctors and nurses train together, their learning is enriched and much more adjusted to reality than in traditional learning [3].

Interprofessional education (IPE) refers to "occasions when two or more professionals learn with, from and about each other to improve collaboration and the quality of care" [4,5]. IPE promotes interdisciplinary collaboration and teamwork [6], reduces the barriers and preconceptions prevailing among various healthcare groups, and promotes professional competencies [7,8]. IPE allows for the engagement of different health workers or students. These qualities evince IPE's potential to be applied to both pre-graduate and post-graduate

studies [9]. In 2016, the International Nursing Association for Clinical Simulation and Learning (INACSL)'s Standards of Best Practice: Simulation^{SM} published a standard of best practice specific to simulation enhanced interprofessional education (Sim-IPE) [10]. The standard is based on four criteria: (a) using a theoretical or conceptual framework, (b) using best practice in the design and development of Sim-IPE, (c) recognizing and addressing potential barriers, and (d) devising an appropriate evaluation plan. Despite a recently trending interest in interprofessional education, there remains a considerable gap in its study especially due to a lack of rigorous methods, design, implementation, and the difficulties of inserting a specific module of IPE inside the very stretched healthcare pre- and post-graduate programs [11].

One of the most effective methodologies that aids training for both technical and non-technical skills, which takes advantage of interprofessional education, is Crisis Resource Management (CRM). CRM is "*the ability to command and control all the resources at hand in order to execute care as planned and to respond to problems that arise*" and it includes a focus on communication, teamwork, decision making, the coordination of staff, leadership, and relations between team members [12]. Medical CRM is connected to Crew Resource Management, which was embraced by and formally created in aviation more than 20 years ago [13]. In a clinical practice, a small group of providers can work together, especially in stressful situations (e.g., cardiac arrest, difficult intubation, life-threatening situations inside theatres, etc.). We may meet different health professionals who join as a team to provide the best practice and care to a patient. In all these situations, medical and nursing staff are working not only alongside and between professionals, thus necessitating the implementation of IPE and CRM education, but also with pre-graduate medicine and nursing students. The potential application of IPE in pre-graduate settings can help future health professionals face more realistic situations during their training and become familiar with sharing and delegating the appropriate knowledge and skills, thereby creating a good team environment to safely care for patients [14–16].

To help health professionals in training, an experimental and reflective learning opportunity has been developed worldwide: the highly realistic clinical simulation [17]. A simulation can enable the training of both technical and non-technical skills (communication, leadership, coordination, prioritization, etc.), which makes it one of the best evaluated methods in the training of health professionals [10,18]. There exist various methodologies of clinical simulation. The main differences are found in the choice of the learning objectives. Simulation-based learning (SBL) is initially conducted by considering the objectives [19] which are set by the education center, by the course instructor, or by the training needs at an educational (university or course) or health (hospital) context. The simulation instructor is normally the one who manages and plans the session, sets the time, and ensures that the learning objectives are achieved [20].

An alternative to SBL is the Self-Learning Methodology in a Simulated Environment (Spanish acronym: MAES©) [21]. This innovative methodology, designed by Díaz, Leal, and García [22], and started in 2012 in the Catholic University of Murcia (Spain), is based on constructivist and situational learning [23]. MAES© is divided in six stages: pre-briefing, homework, briefing, simulation, debriefing, and exposition. It puts the student/learner at the center of their own learning throughout the whole process. During the pre-briefing, the learners are the ones who, guided by the facilitator, are in charge of choosing their learning needs, their learning objectives, and the competences that they want to learn or train. This can be done thanks to the group factor which helps to create a safety environment where learners can meet to share the strengths and weaknesses of their learning. Students are also in charge of designing the scenario (as homework). The group who designs the scenario will then give a quick handover (briefing) to a different group, following the SBAR method (Situation, Background, Assessment, and Recommendation) [24] The group that receives the handover enters the simulation room and performs a 10–12-min simulation. Once they are back in the debriefing room, the group who designed the scenario, with the help of the facilitator, guides the debriefing following the GAS method

(Gather, Analise, and Summarize) [25] or another style of structured debriefing. The MAES© experience ends with the exposition phase. This phase is still part of the MAES© structured debriefing. The learners that provided the knowledge need to close the gap or eliminate the deficiencies detected in the first session. They can do so with different methods: presentations, online tests, practical training, sharing their experiences, or inviting someone who personally experienced the simulated scenario in real life [26]. A MAES© facilitator assumes a secondary but essential role in the process, helping the group-factor, guiding the learners, and assuring that they keep focused on the learning objective they set themselves [21].

Researchers have agreed about the importance of using healthcare simulation as a vehicle for the multidisciplinary and even interprofessional training of healthcare providers, especially in CRM training [27–29]. SBL is the simulation method predominantly used during simulation training and courses although diverse studies have shown that the MAES© method is well accepted by the students and facilitators both in university and clinical settings [30–33]. No studies have been found applying MAES© in an interprofessional simulation yet.

The objectives of this study were to determine the need for interprofessional training in pre-graduate nursing and medicine students, to implement an IPE experience applied to CRM simulation training using MAES©, and to evaluate participants' perceptions of the MAES© method applied in IPE CRM training.

2. Materials and Methods

2.1. Settings

The Catholic University of Valencia (Spain, CUV) uses a building called Virtual Hospital (VH) for clinical simulation to train their students. At this location, students and professionals can use a very modern structure which mimics some hospital environments. VHs a have triage, a resus room, an emergency department observation area, general hospital wards, intensive care rooms, theatres, an obstetric room, and several other specialty rooms alongside laboratories and debriefing rooms. Although future nurses and doctors spend a lot of time in the same building, they do not share activities, classes, or simulations.

2.2. Design

We planned a qualitative study with formative action [34]. We were first interested in finding out what educational needs the simulation center had regarding interprofessional education, and then implementing a pilot joint training approach programmed with MAES© method as a tool and evaluating its impact. Qualitative study with a formative action is commonly utilized in education and social science contexts [35]. It consists of studying and analyzing a situation, with the intention of proposing a change to improve it, using a formative action. The researcher also becomes an agent of the change [36]. This study can be divided into three phases: detection of training needs (1º phase-Research), explication, preparation and application of the intervention with simulation MAES© (2º phase-Action), and evaluation and collection of evidence related to the results (3º phase-analysis and evaluation).

2.3. Participants

The study was conducted in the Catholic University of Valencia between January and March 2022.

To obtain information on the university objectives and learning needs, we considered the opinion of the expert in clinical simulation at CUV. He is a male nurse and professor, head of Clinical Simulation Module for nursing degrees, and is part of the organization of the Clinical Simulation Module for medicine degrees. His position made him our key informant. He was able to give us a general overview of the clinical simulation in his university. In addition, he served as the link between medicine and nursing by conducting a personal interview (1º phase). In this phase, we also created a group of students who

decided to apply to the study, investigate their learning needs regarding CRM using a brainstorming technique, and apply the MAES© method. Recruitment was done for convenience, not using probability criteria. We finally chose those students who met the inclusion/exclusion criteria (Table 1). The same group of students that were chosen in the first phase participated in phases two and three. The participants were a total of 13 students (6 nursing and 7 medical students). Of the 13 participants, there were 12 women and 1 man, with an average age of 24.5 (SD 5.09). The group was led throughout the study by a researcher with MAES©, IPE, and clinical simulation experience.

Table 1. Inclusion/Exclusion criteria.

Inclusion	Exclusion
Last year nursing students (4° year) Last year medical students (6° year) Previous clinical simulation experience	Previous experience with interprofessional training

2.4. Procedure

2.4.1. First Phase

The interview was designed by the research team before it was performed. The content of the questions was agreed upon by the team before the final draft was accepted. The research team validated the poll questions after several meetings (for content validity). The interview was completed online in January 2022. A male researcher (GF) who had experience in the management of simulations and IPE conducted the interview with open questions (Table A1) so that the interviewed expert could tell his opinion in a semi-structured way. The result of the interview was used to identify and analyze the need for interprofessional simulation in the university and to choose an appropriate scenario/situation which could help interprofessional education.

In phase 1, the researcher also performed a "brainstorming session" with the group of students according to the MAES© pre-briefing standards. The technique helped the group to set their learning needs and their learning objectives. The participants analyzed their existing knowledge about CRM and shared what they already knew and decided what they wanted to learn.

2.4.2. Second Phase

The first session of MAES© took place on 4 February 2022.The researcher (GF), an expert and facilitator of MAES© methodology, explained how it works and its characteristics to the students. The session lasted 240 min. MAES© standards were applied throughout the session; operational work groups were established, the psychological safety of the participants was worked on through group dynamics, and the simulation norms and the MAES© structure were explained. To establish the workgroups, the researcher divided the nursing students and the medical students. Asking questions about their interests (hobbies, pets, music, family members, birthday, travels, etc.) he managed to create 6 groups: 5 couples (1 nurse and 1 doctor) and 1 trio (1 nurse 2 doctors). Once the work teams were settled, the whole group proceeded to decide how to divide the work. This division left the 13 students divided in 3 definitive workgroups: one couple designed the scenario, the trio performed the simulation, and the remaining group were observers.

The facilitator explained how to design an MAES© case to the participants, providing them with resources for this (a template for the design and management of scientific evidence). The team who designed the scenario provided evidence about the learning objectives that were decided upon by the entire group. A month was given for this homework. During this time, the facilitator was available to resolve doubts or provide support for the design of the scenarios and the search for scientific evidence.

On 1 March, the second session of MAES© took place. This time, the team who designed the scenario helped to prepare the simulation room so that the team who had to

perform the simulation could do so, while the observers remained in the debriefing room. The debriefing and the exposition also took place on the same day.

Both sessions took place at the VH. The first session was performed in a debriefing room. The second took place in two different rooms (simulation room and debriefing room). The debriefing room allowed all the participants to watch what was happening while the simulation was performed in the ITU simulation room. For the simulation, the group used a manikin, resuscitation, and airway equipment. The simulation session lasted 1 h (5-min briefing, 10 min simulation, 30 min debriefing, and 15 min exposition phase).

2.4.3. Third Phase

After their participation in the learning program with the MAES© method, the participants were asked for their perceptions on the experience through a focus group technique. The focus group lasted one hour and consisted of the students and the university expert. Information was collected about how they had felt during the sessions, aspects about collaborative work, their opinion about the CRM scenario that they worked on, the simulation experience, the competences shown, the interprofessional education experience, and their overall idea of MAES©.

2.5. Data Analysis

The audio/video files (online interview and focus group were recorded) were transcribed into a single document which, after careful and independent reading by two different members of the research team with broad experience in qualitative research (GF, JLDA), served as the basis for categorization and content analysis [37]. The qualitative analysis software MaxQDA® v18 (VERBI computer software, Berlin, Germany) [38] was utilized for the coding of the results. The units of significance that emerged from the independent analysis of the text were identified and coded, and then these were grouped into categories and subcategories, as a function of their similarity. Likewise, for the interpretation of data, the contrasted method by Colaizzi was utilized, as it is recommended for social research [39,40].

At all times, the researchers sought to maintain a reflective attitude to minimize the impact of their subjectivity on the process of data collection and analysis. To present this research, the transparency and quality guidelines proposed by the COREQ (consolidated criteria for reporting qualitative research) standards [41] checklist were followed (Table A2).

3. Results

3.1. Study and Design: Investigate and Set Learning Needs

3.1.1. Expert Interview

The analysis of the interview with the university expert (his characteristics can be found in Section 2.3.) provided the following data that were organized into four categories: nursing and medical university training relationships, interprofessional education, MAES©, and CRM. In the interview, it emerged that nursing and medicine are two professions with many common objectives. Even with a visible and recognizable common ground during their working lives, the students' interactions during their university education are very limited in time and space.

> *"They are future professionals that will share many objectives and a great deal of knowledge: patients' care, patients' safety, health education, prevention etc. (. . .)." (I)*

> *"Thinking about how long nurses and doctors live together after their graduation, in their work sites, I cannot believe how poor their relationship is during university. They barely see each other (. . .)." (I)*

The interviewee analyzed the existing interprofessional education related to his personal and university experience. The focus was pointed towards the common educational objectives.

> *"Universities focus on developing nurses and doctor students' critical thinking, their ability to face difficult situations, and improving their patients' care (. . .)." (I)*

The IPE's existing training in the CUV was analyzed. It emerged that there were IPE experiences, but that they were punctual and focused on delivering specific training to one of the two groups of students. The experiences were based on solving clinical cases by mixed groups. This type of situation does not completely exploit the competences and learning abilities of both categories of students.

> *"If we clearly know what our common educational objective is, something is wrong when we use IPE only for some very punctual and specific training (. . .)." (I)*

> *"We use IPE training to develop and train only specific techniques in a more theoretical way. This does not allow us to develop and train non-technical skills. They work together in the same room, but they do not solve the case together (. . .)." (I)*

The university expert's desire to improve IPE was visible. During the interview, we could see that there was a will to assure that all the learning possibilities (planned and not planned) created by joining students from two different degrees were exploited. The interviewee determined that the best method towards this end was to repeat a clinical simulation. This method helps to deliver competences and train both technical and non-technical skills.

> *"We observed the medical students use nursing students only to realise that technique alone cannot solve the problem, while nursing students referred to doctors only to ask prescriptions. This does not allow us to develop and train non-technical skills, whereas clinical simulation is more appropriate and could help students to experience more realistic scenarios (. . .)." (I)*

> *"The students need to live experiences; they cannot base their training only on theory. Simulation can definitely help professors, tutors, and facilitators to deliver knowledge (. . .)." (I)*

The interviewee, who knew SBL and MAES© methods, focused his attention on the second, analysing its potential for IPE training. He mainly focused on the self-learning characteristic of the MAES© method and its collaborative learning nature.

> *"With SBL, students solve a case given by an expert and the relationships between nurses, and medical students may be limited to the simulation and the learning objectives decided by the facilitator. With MAES©, the experience could be amplified as the students not only solve the scenario, but also decide what they want to learn and then design it (. . .)." (I)*

> *"With MAES simulation, the medical students focus on their competences and the nurses on theirs, but for the first session, the homework and the structured debriefing could guarantee shared opportunities and the peer work could break barriers that students from different degrees usually have (. . .)." (I)*

During the interview, and in accordance with the university learning objective, the expert individuated a theme that was considered appropriate to performing IPE simulation training: CRM.

> *"How students can manage a crisis could be the best theme to work on (. . .)." (I)*

> *"In my opinion, CRM helps to share knowledge but it does not focus on how well you perform techniques or on who is the best in the team. It lets us focus on how students face a crisis together, as a team, something that we have less of an opportunity to train for in separate nursing and medical universities (. . .)." (I)*

3.1.2. Students' Learning Needs and Baseline Learning Objectives

As a consequence of the interview with the university expert, the group agreed to choose CRM (Crisis Resource Management) as the theme of the simulation. Using a

brainstorming technique, the group decided what they wanted to learn and shared what they already knew, as shown in Table 2.

Table 2. Baseline learning needs.

What Do We Know?	What Do We Want to Learn?
CRM was born in aviation. Teamwork and communication are two of the most important concepts in CRM. The qualities that define a team leader.	What is CRM? Is there any existing protocol we can follow to apply CRM? Who are the people and professionals involved in CRM? What are the techniques and concepts related to CRM applied in healthcare? Who is more appropriate to be a team leader in healthcare?

3.2. Action: IPE Planning and Simulating with MAES©

As for the results of the first MAES© session, the researcher helped the participants to divide themselves into six teams, who then decided to act as three groups:

- Group 1: design scenario, look for information to answer baseline learning needs during the exposition phase in the debriefing (one student nurse, one student doctor)
- Group 2: perform simulation and participate in debriefing (one student nurse, two student doctors)
- Group 3: observe and participate to the debriefing (four student nurses, four student doctors)

The group that designed the simulation did so in accordance with the template standardized for MAES© (the designed scenario is in Table A3). The case was set in a pre-Surgical area. The patient was a young female with acute abdominal pain that required emergency surgery. She needed airway management, and it was during her airway isolation that a crisis situation arose (CRM situation). To exacerbate the crisis, the group who prepared the simulation decided to give different roles and characteristics to each member of the group who was performing the simulation. The members of the simulating group did not know the role of their colleagues. In doing so, they aimed to create a stressful situation and reproduce a scenario where it was necessary to use CRM techniques. The roles were:

- Doctor 1: Emergency doctor who needed to manage the airway, even if she was not an expert. An authoritarian leader unopen to accepting others' ideas and possessing a short temper.
- Doctor 2: Anesthetic doctor, expert in managing (obstructed?) airways. She could not give suggestions because she wanted to be the center of the situation and she had to try to take over the airway management from the ED doctor.
- Nurse: She needed to react to what she saw as she would have done in a real situation.

At the end of the simulation, the standardized debriefing following the MAES© standards took place and was guided by a facilitator. The students analyzed their strengths and weaknesses and implemented their knowledge (exposition phase) [28,29]. During the exposition phase, the group who designed the scenario answered the questions and emerged during session 1 and listed in Table 3. They did so with a PowerPoint® presentation.

3.3. Evaluation: Perception of IPE with MAES© and CRM Experience Outcome

The activity that used the MAES© CRM simulation and IPE was analysed with a focus group (Table A4) at the end of the simulation learning session. After the literal transcription of the focus group, three categories and nine subcategories were found (Table 3).

Table 3. Categories and subcategories of Focus Group.

Category	Subcategory
MAES©	Self-learning & intrinsic motivation MAES© compared with previous experiences Debriefing Aspects to improve
IPE	Present situation Positive Aspects IPE & MAES©
CRM	Link with work situation Positive aspects to train CRM

3.3.1. Category 1: MAES

The participants identified many positive aspects. One of the most frequently mentioned was the self-learning method and its link with the intrinsic motivation.

> *"I liked the fact that I had to decide for myself about what I had to learn based on what I want, my interests, and how I wanted to spend my knowledge on my work. In other words, we were moved by our intrinsic motivation, and it made us more enthusiastic (. . .)." (GF3)*

> *"Knowing our student-colleagues were the ones who were performing the simulation motivated us even more to design a simulation case that had the best realistic elements possible (. . .)." (GF1)*

Students also noticed that MAES© allowed them to keep lessons more dynamic compared to normal classes. They noted that there was more dynamism compared with their previous experience with SBL.

> *"I think MAES is more practical and dynamic than a normal classroom. I found it even more dynamic than the clinical simulation I used to do (. . .)." (GF6)*

> *"This MAES experience induced us to work, investigate, share, and learn using a very dynamic approach that made our jobs less heavy than a normal class (. . .)." (GF2, GF3, GF11)*

Finally, the structured debriefing with the exposition phase was seen as a great opportunity to complete participants' learning and share their experiences.

> *"Analyse together, during the debriefing, what went well and what could have better helped us to focus and better understand the scenario and the subject. The exposition phase, at the end of the debriefing, also helped to better fix the ideas and answer our own questions. It was the best way to close the learning circle (. . .)." (GF1, GF12)*

The students agreed that the homework was something that could cause additional stress on an already busy University table, although they admitted that they overcame this problem thanks to the motivation that was generated by working in groups.

> *"I think the problem is homework and how at the beginning it is difficult to fit it into our already busy timetable. Although, I have to say, the group-work is motivating and the perception that we were really working for our own knowledge helped me to find an alternative solution for organisation (. . .)." (GF4)*

3.3.2. Category 2: IPE

Speaking of interprofessional education, participants firstly analysed the actual situation of IPE at their university. They agreed about the need to practice with IPE, but that its emergence in their experience was rare during their university careers, and they thought that the timetable could be used differently.

> *"In the future we will work together, and it is important to have experience together in university, but these experiences are rare. I can count three or maybe four times during my time in university. Many times, we (nursing students) have simulation on the same day as medical students and even with the same subject. Nevertheless, the university does not place us together. I think we are missing opportunities (. . .)." (GF7, GF9)*

Secondly, the participants analysed the potential positive and negative aspects of IPE training. Although they agreed on the possibility of an initial difficulty when adapting to students from a different degree and with different education and careers, they thought that IPE could enable an opportunity for implementing teamwork and communication, with a better understanding of all the situations.

> *"I think at the beginning, it is difficult, and we could be a bit shy or have preconceived notions towards our colleagues from a different career (. . .)." (GF1, GF2, GF4)*

> *"I do not think the problems with IPE are many, and even if they are, I think the positive aspects are more important. IPE allows us to see and touch a different view and a different way of working, even if it is with the same objective: patient care. It also improves teamwork and communication (. . .)." (GF2, GF5, GF10)*

Their opinions after the IPE simulation with MAES demonstrated the positive effect it had on their perception of the simulation, the teamwork, and the increased respect towards their student-colleagues from a different degree.

> *"Working alongside our future doctor colleagues helped us to put ourselves in their position and better understand their work and decisions. MAES and its self-learning method unified with its collaborative learning characteristic accentuated teamwork, helped communication, and raised our mutual respect (. . .)." (GF8)*

> *"Working with MAES during IPE made me meet someone with similar interests (patients' care and patients' safety) but at the same time made my group face the work from two different points of view. This enriched my experience (. . .)." (GF1, GF2)*

> *"MAES structured debriefing helped us to gain a better understanding of the situation from both points of view (nurse and doctor). It also helped to improve our empathy towards our colleagues (. . .)." (GF7)*

3.3.3. Category 3: CRM

The university expert and the students chose Crisis Resource Management as the simulation scenario during the first phase of the study. The preparation of the case, the simulation, and the structured debriefing with the exposition phase helped them to gain a better understanding of this subject. They thought that it was useful for two different reasons. Firstly, they thought that CRM was a great link to real situations and helped to minimize risks.

> *"With CRM we can see and train many non-technical skills that help us in the future to reduce risks for both the patients and the healthcare professionals (. . .)." (GF4)*

Secondly, the positive training opportunity that CRM gave them made them reflect on possible future job experiences, sharing competences between different health professionals.

> *"CRM helped us to better understand decision-making and how we should face a crisis in our team, and I think it is very useful when thinking of my professional future (. . .)." (GF3)*

> *"Communication, empathy, teamwork, leadership . . . they are all aspects that we can train and learn with CRM for our future jobs. It has been a great opportunity to do so with IPE since it was even more realistic (. . .)." (GF6)*

4. Discussion

Our study is the first to evaluate MAES© applied to Interprofessional Education with a simulation. The study investigated the IPE situation at CUV and examined good methods

to improve it. The results of this study are the basis for further research on the best way students from different health professions (doctors and nurses), who will eventually have interdependent jobs, can collaboratively learn together

The main findings account for the positive impact that interprofessional learning can have on undergraduates, provided that the learning model is adequate. In this sense, the MAES© method has been successfully used for this purpose.

The first finding of this study is the lack of IPE training during the nurses and doctors' university careers, although the literature marks the common ground of education between these two universities [42]. Both Students and university experts point out that IPE training at CUV is used to develop and train only specific techniques in a more theoretical way. During the investigation, we applied IPE and approached students' learning needs with a more practical method: simulation [43]. Students need new learning methods that are more dynamic, interactive, and based on intrinsic motivation. IPE allowed them to see and experience different ways and views of working towards the same objective: patient care. It also improved teamwork and communication. During IPE, the students could work in a group using a cooperative learning method which helped their motivation. It also helped to improve empathy, communication, and teamwork. All those aspects comprise the basis of the hospital teamwork that healthcare students will find once they finish university.

The available literature supports the idea that IPE is fundamental to training teams and aspects such as teamwork, coordination, communication, and good problem-solving abilities. Most of these skills are fundamental non-technical skills for health professionals and they are difficult to train and teach at universities [3]. Crisis Resource Management is a situation that professionals experience daily. It is very important for healthcare, as any error or rupture in teamwork may affect patients' safety and care [44]. It includes many aspects (teamwork, communication, and leadership) and allows for the development of both technical and non-technical skills. Students' awareness that nurses and doctors will share many hours and spaces during their work career motivates them to be ready to work together. The students nowadays need to feel ready to work when they finish their university education, especially for those who are requested in healthcare fields. This affects their willingness to learn and to be receptive to new methods [45].

Although this study provides results from a small pool of participants, the main finding is the overall acceptance of IPE with simulation especially when applying the MAES© method. Based on cooperative learning, peer education, constructivist, and situational learning, MAES© simulation is a great method for application to IPE with simulation for its structure, practicality, and dynamicity [23]. For the duration of their work using MAES©, students must work together and move towards answering the learning needs they have set themselves. The group factor and teamwork are two very important aspects shared by IPE and MAES©. The fact students with different preparations and backgrounds are sharing knowledge and different points of view can help them to reach their true potential. While the simulation itself is lived similar in MAES© and SBL, there are three different moments when IPE can further benefit from MAES©.

As shown in the results of the study, the setting of learning needs (first session), homework, and debriefing can guarantee more sharing opportunities. In the first session, the peer education and the constructivist learning method helped to break the barriers existing between the nursing and medical students. The role of the facilitator is very important as the elimination of friction and the creation of an atmosphere of respect are necessary. The previously broken barrier lets future nurses and doctors combine their knowledge and skills during homework. Collaborative learning, self-learning, and intrinsic motivation help to complete it. During the debriefing we can see the real result of the work. It is in this moment when the whole group benefits from sharing experiences, knowledge, and answers to the questions they completed in the first session [31].

The main limitation of this work is the local and reduced nature of the study. As it is a single experience, it is difficult to generalize the results to other contexts. The external validity of the study could be improved by conducting more experiences in other university

contexts (multicenter study), with more participants and using other methods in addition to qualitative research. However, we can consider this work as a pilot study that would lay the foundations for a broader interprofessional learning model based on the empowerment of students thanks to the self-directed and peer-to-peer learning provided by MAES©.

5. Conclusions

The present study identifies the necessity of Interprofessional training for nursing and medical students. It associates the MAES© method to IPE training with simulation and an overall acceptance. The application of CRM in a simulation scenario results in a great opportunity for students who can familiarize with stressful situations among different professionals. MAES©, IPE, and CRM appear to be a great combination that allows healthcare professionals to share knowledge, technical, and non-technical skills using a dynamic and new method. With this experience the students were moved towards the results by their intrinsic motivation. The participants recognized it as a very positive experience although they recognized that the MAES© structure required them to find more time and new resources. In the future, it may be interesting to develop similar studies with a larger pool and implement the number of experiences of MAES© with IPE.

5.1. Limitations

This study refers to a short experience with a small group of students (13 students). The size of the group and the lack of different universities participating in this experience may affect the results.

5.2. Implications for Educational Practice

The necessity of building good work relationships among healthcare professionals emerged from this research. This necessity is not only limited to the work environment (post-graduate), but also applies to pre-graduate settings. Considering these aspects, IPE training can become a resource inside the nursing and doctor students' university program. It helps to initiate an early-contact between two professions that have daily strong relationships during their working-life. It is necessary to involve future health professionals who will work interdependently in the learning process. Such a practice will allow health professionals to avoid miscommunication and to clearly understand and determine the skills of each team member.

The method used for training (MAES©) was suitable as it was a method that was wildly accepted by the participants. MAES© could be used in interprofessional educational contexts. It facilitates teamwork and a psychologically safe learning atmosphere. Peer education and self-directed learning methods, both used with the MAES© technique, can help participants to motivate themselves to improve their own learning. Creating a safe environment also helps to break the barriers between different degrees.

This pilot study has shown that joint training in non-technical skills (such as CRM) between medical and nursing students is highly satisfactory for the participants. The study used CRM as a good tool to work around interprofessional work relationships, focusing on communications, leadership, delegation, etc.

The implications of this preliminary study for educational practice are promising. Although this study has shown a general acceptance of the method (IPE with MAES©) and theme (CRM), further studies are needed for a more powerful and definitive recommendation.

Author Contributions: G.F.: conceptualization, investigation, data curation, writing, original draft preparation, introduction, discussion, and conclusion; J.L.D.-A.: conceptualization, introduction, methodology, project administration, writing, editing, and supervision; D.P.: conceptualization and editing; R.B.-D.: results and editing; N.H.-D.: results and editing; L.L.-C.: conceptualization, investigation, and results. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki. Prior to the study, the researchers obtained the permission from the universities involved and Ethics Committee from the (blinded for revision) (Reference number CE012107). During the first MAES© session, the researcher provided an informed consent form to all the participants for them to participate in the study. The decision was made to maintain the anonymity of the students and the university expert. During the transcription of the poll, the researcher assigned a letter and a number to each participant (I1 to the interviewed university expert and S1, S2 . . . to the student 1, student 2 . . .).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Interview.

Interview to the University expert		
What is your name? What is your role in the university Have you got any clinical simulation experience? Have you got any Interprofessional education experience? Do you interact with both nursing and medical degrees? What do you think about the relation that exist between nursing and medical students during their years in university, on a formation point of view? What is the main lack you have noticed during nursing and medical students simulation, thinking of no-interprofessional experiences? How can we help both students to think and learn in a more cooperative way? Do you know MAES©? Do you think MAES© can help interprofessional training? Can you motivate your answer? What do you think could be an appropriate case scenario to work with interprofessional MAES©?		
No. Item	**Guide Questions/Description**	**Reported on Page**
Domain 1: **Research team and reflexivity**		1
Personal Characteristics		1
1. Inter viewer/facilitator	Which author/s conducted the interview or focus group?	
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	1
3. Occupation	What was their occupation at the time of the study?	1, 5
4. Gender	Was the researcher male or female?	5
5. Experience and training	What experience or training did the researcher have?	5
Relationship with participants		5
6. Relationship established	Was a relationship established prior to study commencement?	4
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g., personal goals, reasons for doing the research	4, 5
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g., Bias, assumptions, reasons and interests in the research topic	4, 5

Table A1. *Cont.*

Domain 2: study design		3–6
Theoretical framework		1–3
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	1, 3
Participant selection		4
10. Sampling	How were participants selected? e.g., purposive, convenience, consecutive, snowball	4
11. Method of approach	How were participants approached? e.g., face-to-face, telephone, mail, email	3, 4
12. Sample size	How many participants were in the study?	4
13. Nonparticipation	How many people refused to participate or dropped out? Reasons?	N/A
Setting		
14. Setting of data collection	Where was the data collected? e.g., home, clinic, workplace	3
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	N/A
16. Description of sample	What are the important characteristics of the sample? e.g., demographic data, date	4
Data collection	17. Interview guide Were questions, prompts, guides provided by the authors? Was it pilot tested?	13, 18, 19
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	6
20. Field notes	Were field notes made during and/or after the interview or focus group?	6
21. Duration	What was the duration of the inter views or focus group?	4
22. Data saturation	Was data saturation discussed?	6
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	6
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	N/A
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	6
27. Software	What software, if applicable, was used to manage the data?	6
28. Participant checking	Did participants provide feedback on the findings?	N/A

Table A1. *Cont.*

Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g., participant number	6–11
30. Data and findings consistent	Was there consistency between the data presented and the findings?	6–11
31. Clarity of major themes	Were major themes clearly presented in the findings?	6–11
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	6–11

Table A2. COREQ.

MAES simulation	
MAES clinical simulation title: CRM **Team planning the simulation:** RN-TEAM	
Information provided to the simulator group prior to the simulation	
Debriefing	**Clinical history & situation**
Learning goals & discussion points	**Situation**
1. What is CRM? 2. Existing protocols 3. People involved? 4. Who is teamleader?	25 y.o. female patient who attended Emergency Department with 3 days history abdominal pain (RLQ), nausea and temperature. No vomit, no diarrhoea. In ED they performed XR, Bloods and CT scan before deciding she needed urgent appendicectomy.
Technical & non technical skills	**Background**
	Allergic to paracetamol. Smoker.
1. Technique to solve a CRM (check list)	**Assessment**
	FC 126, TA 87/52, FR 33, Sats 95%, Temp 39º. Patient with vomit, strong abdominal pain (8/10), GCS 13, pale, diaphoretic.
	Recommendation
	Assessment and secure airway to transfer her to theatre.

Table A3. MAES© Scenario.

Clinical happenings (Evolution of the clinical situation during the simulation)
1. Team enter the emergency room and the patient is semi-conscious. She knows about her situation, but she is starting to crash and vomiting. 2. Theatre call, they are ready to receive the patient 3. Doctor starts to induce hypnosis 4. Start first attempt of intubation: failed 5. If doctor tries a second attempt without changing technique, it will fail 6. If doctor changes the technique, it will succeed but IOT will be on their right lung and the patient will not manage sats >87% 7. During Third attempt of IOT, patient will have an airway oedema and they will need a difficult intubation kit 8. In every moment, actors have to react to stress and crisis following their characteristics.

Table A3. *Cont.*

Interventions
(Activities and interventions that the simulator team is expected to perform)

Intervention 1: Conflict resolution		
	YES	NO
Activity 1: Allow team members to express their feelings		
Activity 2: Use different communication technique (reflexion, active listening, open questions)		
Activity 3: Help members to identify problems and possible solutions		
Activity 4: Facilitate problems solution		
Activity 5: Help members to actively solve problems		
Intervention 2: Intubation and airway management		
	YES	NO
Activity 1: Wash hands		
Activity 2: Select correctly oropharyngeal/nasopharyngeal airway		
Activity 3: Correct patient's position and preoxygenation		
Activity 4: Aspiration of patient's airway		
Activity 5: Insert airway management tool and verify correct position		

Resources

Mannequin and Actors

Instruction for the actors:
Doctor 1: Emergency doctor who needed to manage airway, even if she was not an expert. Authoritarian leader, not opened to accept others' ideas. Easy to get angry
Doctor 2: Anesthetic doctor, expert in managing difficult airway. She could not give suggestions because she wanted to be the center of the situation and she had to try to take over the airway management from the ED doctor.
Nurse: She needed to react to what she saw as she would have done in a real situation

Materials

Resus trolley, airway trolley, difficult airway trolley, monitor, cannulation materials, medication for definitive airway management

SCIENTIFIC EVIDENCES	
Themes	**Reference**
1-2-3	https://www.google.com/search?client=safari&rls=en&q=Simulaci%C3%B3n+cl%C3%ADnica+y+segurdad+en+urgencia (accessed on 3 February 2022) https://litfl.com/crisis-resource-management-crm/s+y+emergencias%3A+Emergency+Crisis+Resource+Management+(E-CRM)&ie=UTF-8&oe=UTF-8 (accessed on 3 February 2022)
4	https://eds.p.ebscohost.com/eds/pdfviewer/pdfviewer?vid=0&sid=9ebca4d3-2d7c-479f-9903-716870e29339%40redis (accessed on 3 February 2022)
Check List	https://www.fcchi.org.ar/wp-content/uploads/2020/02/Checklist-IOT-UTIA-HIBAfeb2020.pdf?fbclid=IwAR1oR575sOaUzLnwgNCENF47niua6iQ1N7GFsmxa-uARd5qg4zEYM9wXU (accessed on 3 February 2022)

Table A4. Focus Group.

Focus Group
What is your name?
Have you got any clinical simulation experience?
Have you got any Interprofessional education experience?
What do you think about teamwork?
What do you think about the relation that exist between nursing and medical students on a formation point of view?
What do you think about the possibility to work with a doctor/nurse teammate?
Did you know MAES©?
Do you think MAES© can help interprofessional training? Can you motivate your answer?

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5.2.3. Article Nº3

Enhancing Cardiopulmonary Resuscitation Training: An Interprofessional Approach with Undergraduate Medicine and Nursing Students Using Self-Learning Methodology in Simulated Environments (MAES)—A Qualitative Study.

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Research Article

Enhancing Cardiopulmonary Resuscitation Training: An Interprofessional Approach With Undergraduate Medicine and Nursing Students Using Self-Learning Methodology in Simulated Environments (MAES)—A Qualitative Study

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Background: Training the knowledge and skills needed to recognize and respond quickly to cardiac arrest significantly increases patient survival rates. Recent advances in life support training focus on simulations. Interprofessional education, involving collaborative training between nursing and medical students, would enhance mutual understanding of roles and perspectives, resulting in comprehensive and real-world learning experiences. Self-learning methodology in simulated environments actively engages students by combining problem-based learning with clinical simulation.
Objectives: To analyze the perspective of a group of nursing and medical students in interprofessional training with self-learning methodology in simulated environments, clinical simulation in cardiopulmonary resuscitation, as well as to describe the main strengths and weaknesses detected and worked on during cardiopulmonary resuscitation training with the self-learning methodology in simulated environments.
Method: This multicenter qualitative study, based on focus group analysis, delves into the views of nursing and medical students who underwent interprofessional clinical simulation training in cardiopulmonary resuscitation.
Results: Benefits such as increased interest, motivation, and sense of responsibility are highlighted, along with improvements in teamwork, interprofessional education, and acquisition of both technical and nontechnical skills. Participants valued the structured debriefing sessions, which allowed them to learn from their mistakes. Suggestions for improvement revolved around the time constraints and responsibilities inherent in the methodology.
Conclusions: Interprofessional cardiopulmonary resuscitation training using the self-learning methodology in simulated environments offers an innovative and effective approach to improve traditional cardiopulmonary resuscitation training paradigms.

Keywords: cardiopulmonary resuscitation; clinical simulation; focus group analysis; interprofessional education; self-learning methodology

1. Introduction

Cardiac arrest continues to represent a public health problem with a high morbidity and mortality rate. It is necessary to emphasize the importance of correct care provided at an early stage, known as the "chain of survival." Specific training for healthcare personnel in charge of attending to these emergency situations is essential to improve patient survival [1].

There are numerous clinical practice guidelines that have been modified over the years, which contain the latest recommendations for cardiac arrest situations. Two of these

guidelines come from the American Heart Association (AHA) [2] standing out in the USA, and the European Resuscitation Council (ERC) in Europe [3]. These recommendations on cardiopulmonary resuscitation (CPR) highlight the importance of early identification of this situation, to begin early patient care, thus increasing the chances of recovery of spontaneous circulation. When the healthcare professional knows how to identify a cardiac arrest, and is trained in how to respond, the patient's chances of survival are clearly increased. In this regard, it is vital to know how to recognize this circumstance and this is achieved through prior training [4].

The latest developments in life support training are aimed at recreating a real-life situation so that students can improve their resuscitation skills and increase the survival rate of the population [5]. Simulation-based learning enables healthcare professionals to acquire not only knowledge and technical skills but also clinical reasoning-related abilities and nontechnical skills [6]. Keeping calm and knowing how to communicate with the rest of the team in a stressful simulated situation help both healthcare students and professionals when they witness a real situation. As a consequence, they are sufficiently trained and know how to respond effectively, ensuring maximum safety for the patient [7]. Regular updates on this type of situation are vital to prevent skills or knowledge from being lost over time. Thanks to clinical simulation and technological advances, the simulated experience can offer the maximum realism of the situation. With training in simulated CPR environments, skills can be practiced and improved at the same time as they are being performed.

Clinical simulation is a highly effective teaching method for healthcare practice that is being developed worldwide, with increasingly more realistic simulators and environments. These scenarios allow students to safely practice situations in which they develop skills that will help them in their professional performance [8, 9]. The continuous innovation to improve and create new educational methodologies takes down the boundaries of education. Health education moved its focus from theory in classrooms to practical and simulation methods. It helps to overcome traditional limitations and expand the possibilities for effective teaching and learning. In this scenario, the literature shows us some recent educational methods such as flipped classrooms [10] and in situ simulation [11, 12] developed as a consequence of COVID-19 limitations. In the first instance, students are required to procure adequate materials for their theoretical preparation at home or through preclass assignments. The acquired knowledge must then be applied to a new situation that could be a simulated scenario, as it happens in a flipped classroom simulation. In the second case, the focus shifts to conducting simulation scenarios in a real clinical environment with genuine interprofessional teams and performing a hot debriefing right at the end of the simulation [13]. Simulation with interprofessional teams in as realistic as possible scenarios also sits in the continuously evolving context of clinical simulation methodology. It answers to the need to train students and professionals in realistic teams, and it is called interprofessional education (IPE) with simulation. With this method, students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes [14]. IPE is a methodology that can combine simulation learning and collaborative learning. More specifically, when students from two health professions (nursing and medicine in this case) participate in mixed teams, in a simulated environment and in situations with similar characteristics to those they will experience in their professional future, it allows for mutual learning about the training of colleagues from the other discipline, understanding their functions and their points of view. When nurses and doctor students train together, their learning is more complete and much more in line with reality than traditional learning [15]. Moreover, these training experiences are very well received by the students, who find them very enriching as a team unites with a shared purpose, goal, and a profound mutual respect, all dedicated to delivering safe, high-quality healthcare [16, 17].

Within this panorama, there is the methodology of self-learning in simulated environments (MAES) which was developed in 2013 based on different training models such as problem-based learning, peer education, and clinical simulation in highly realistic environments [18]. The structure of MAES is developed with 6 phases in a minimum of 2 sessions and the completion of homework by the student between sessions 1 and 2. The work consists of the design of the scenario and the search for scientific evidence to support it (Table 1).

MAES consists of involving students with the guidance of a facilitator, an expert in this methodology. The students take on a more active role in their own training. In this methodology are the students themselves who, in small working groups, reflect on the aspects of their training that they need to develop and seek the necessary evidence. Following a structured scheme, they can develop a clinical case and respond to the different situations that may arise during the simulation. With proper guidance from the facilitator, simulation can have a positive impact on students' motivation, as they perceive this learning as more transferable to real practice [19, 20]. Finally, they can discuss with the rest of the group about the case, the knowledge acquired, and the experience lived [18]. The use of MAES as an educational tool provides the student with a feeling of greater motivation [21] learning and making the most of the sessions [20], which results in better academic results and the development of critical thinking [22, 23]. All these aspects ultimately lead to safer healthcare [18, 24].

MAES has been accepted in university and clinical training with nurses [18, 25], but it has not been sufficiently investigated with interprofessional simulation in CPR training. Based on the information described in the literature on the importance of CPR training and the need to implement MAES with CPR and IPE training, the objectives of the present study were to analyze the perspective of a group of nursing and medical students in interprofessional training with MAES clinical simulation in CPR, as well as to describe the main strengths and weaknesses detected and worked on during CPR training with the MAES method.

Table 1: MAES sessions and their phases.

Session	Phase	Objective
Session 1	(1) Group identity and group factor	Work groups are established, with a joint identity that is superior to the individual based on values (group essence)
	(2) Choose a scenario	The facilitator presents the students with a group of possible interesting cases. After a discussion session, each team voluntarily chooses the topic to be worked on
	(3) Baseline learning objective	Brainstorm session where all the teams' participants participate and discuss about what they want to learn
Work at home	(4) Design scenario	Each team designs a simulation scenario based on the previously chosen learning objectives
Session 2	(5) Simulation	Simulation experience
	(6) Debriefing	A structured, GAS (gather–analyze–summarize) debriefing. At the end of it, the students provide the information for the rest of the group

2. Materials and Methods

2.1. Study Location and Participants. The study was conducted at the Catholic University of Murcia (UCAM, Spain) and at the Catholic University of Valencia (CUV, Spain) in 2022. The choice of these two centers was due to the similarities between their nursing and medicine degree programs. Students from both the universities engage in simulation-based learning during their studies (a minimum of 20 h of clinical simulation per year). In addition, both nursing degree curricula at UCAM and CUV include MAES simulation (a minimum of 8 h in the third year and fourth year). The students' experience with simulations made them comfortable with procedures, scenarios, and debriefing. Finally, both nursing and medicine students from UCAM and CUV undergo training in basic life support (BLS) CPR following the ERC guidelines [3]. Despite their extensive use of simulation for student training, neither of the two universities has any experience with IPE during their programs.

Participants were chosen based on convenience sampling [26]. As inclusion criteria, the participants had to have previous experiences with simulation and previous training in BLS. They had to be in the last year of nursing (fourth) or medicine (sixth) university. The total number of eligible students between the two centers was 180 (110 nursing students and 70 medicine students). Finally, the participants recruited based on their willingness and availability to be a part of the IPE CPR training with MAES were $N = 23$. Their participation in the training was not compulsory. The reasons for nonparticipation among the remaining students included scheduling conflicts, lack of interest, and prior commitments. They were organized into two groups: 13 in CUV (7 medicine students and 6 nursing students) and 10 in UCAM (5 medicine students and 5 nursing students). The simulation experience with interprofessional CPR MAES training was performed between March (CUV) and July (UCAM) 2022.

2.2. Design and Data Analysis. This study employed a descriptive qualitative design [27] based on thematic analysis research [28]. The analysis followed a general inductive approach, allowing themes to emerge naturally from the data [29]. This approach was chosen to investigate students' experiences with a new educational programme. It provided an in-depth understanding of the participants' experiences and perceptions related to the topic of the research and its objectives. It aimed to highlight patterns within the data, rather than testing predefined hypotheses. By using thematic analysis, a rigorous and systematic reading and coding of the transcripts allowed major themes to emerge. The inductive approach facilitated the development of themes based on the raw data, ensuring that the findings were aligned with participants' perspectives.

Data were collected through structured debriefing of the simulated scenarios and focus groups. The use of both methods ensured flexibility to probe deeper into specific areas of interest while maintaining a consistent framework. All debriefings of interprofessional CPR training with MAES were performed at the end of each scenario. It followed the gather–analyze–summarize (GAS) debriefing method [30]. In the analytical phase of the debriefing, the facilitator used the plus/delta method ("plus" are the things that went well and "delta" are the ones that can be improved) [31]. In addition to plus/delta, the participants' mental models were investigated with a deep reflection technique [32]. At the end of each debriefing, the pluses/deltas' information and the mental models were transcribed and organized by consensus in a table visible to all the participants. Graphic recordings have been shown to improve concept fixation, motivation, and critical thinking compared to simply discussing topics without recordings [33]. This method allowed researchers to reduce biases and allowed participants to review and agree with the debriefing's final findings. The focus groups were performed at the end of each simulation session. In both cases (debriefing and focus groups), video and audio recordings were obtained as well as researcher's notes. Photos of the final debriefing tables were also obtained, which summarized the main learning points of the scenario.

The audio/video files, the notes, and the photos of the final tables of plus/delta were recorded, transcribed, and transferred to a single document for analysis. All data were accessible by the researchers. The data analysis process began with familiarization, where researchers read and reread the transcripts. After careful and independent reading by different members of the research team, the final document served as the basis for categorization and thematic analysis

[34]. Initial codes were generated to capture significant features of the data. The units of significance that emerged from the independent analysis of the text were identified and coded in different initial themes. After identifying the themes, different subthemes were recognized according to research objectives as a function of their similarity [35].

Throughout the analysis, reflexive practices were employed to acknowledge and address potential biases. The research team engaged in regular discussions to critically examine the emerging themes and ensure a transparent analytical process. The Standard for Reporting Qualitative Research (SRQR) checklist was used as a guide for the analysis of the qualitative data and the conduct of the focus groups [36] (Supporting file 4).

2.3. Procedure. The CPR interprofessional clinical simulation training with MAES was developed in two simulation sessions, carefully organized in accordance with MAES methodology [18]. The structure was the same in both universities (two sessions in UCAM and two sessions in CUV).

During the first session, participants were informed about the study's objectives, the simulation development process, and the MAES structure. The sessions were led by an expert MAES facilitator (G.F.) with over 5 years of experience with MAES and more than 7 years as a clinical simulation instructor. The facilitator helped to create small working groups by mixing students from both degree programs. He also ensured the creation of a safe environment to promote group identity and cohesion. The psychological safety of the participants was addressed through group dynamics following Lewin's theory and Tajfel's theory [37] (1: group identity and group factor). The division resulted in three definitive workgroups at each university. The workgroups were organized as follows: two people designed the scenario, two people performed the simulation, and the remaining were observers. In addition, in this session, students selected the main theme of their scenario based on the research of video, news, or newspaper articles about cardiac arrest patients which may directly move their interest (2: choose scenario). Finally, students selected their learning needs and learning objectives based on their intrinsic motivation (3: baseline learning objectives) [38]. Students from CUV wanted to learn the different CPR rhythms and the CPR sequence looking into special cases and focusing on team leadership. On the other hand, students from UCAM wished to better look at a special cardiac arrest case: CPR in drowning patients. They wanted to learn about protocols for drowning patients in cardiac arrest, focusing on managing the situation and possible hypothermia. All the learning objectives chosen by students were designed to complement the theoretical and clinical components of their respective programs by offering practical, hands-on training in CPR and clinical understanding of a cardiac arrest patient.

The participants had a period between sessions to design the scenarios (4: homework) based on the learning objectives set in the prebriefing. They stated them in their scenario tables as "learning goals and discussion points" or "technical & nontechnical skills." As a result of the learning objective chosen by students, the designed cases were "cardiac arrest secondary to myocardial infarct" (CUV) (see Supporting file 1) and "cardiac arrest secondary to drowning" (UCAM) (see Supporting file 2).

In the second session, students who designed the scenario proceeded by giving a short handover to the group who was performing the simulated experience (5: simulation). At the end of each simulation, the debriefings were conducted following the structured phases of the reflective learning: reaction, analytic, and summary phase (GAS) [30]. In the first phase, participants shared their feelings. In the second phase, they proceed to analyze what went well and what they could improve. Finally, they summarized the important points with the help of the simulation facilitator [39]. The debriefing sessions lasted approximately 45 min each. They were conducted by an experienced MAES facilitator (G.F.), who has over 7 years of experience in conducting debriefings. The facilitator, during his career in clinical simulation, received specialized training in debriefing techniques, including advanced simulation debriefing methods and reflective practice, ensuring a high level of proficiency in guiding participants through the debriefing process. The result of the debriefing was recorded and organized by the facilitator.

At the end of both experiences, participants were asked for their perceptions of the experience through focus group discussion. A total of two focus groups were conducted, one at each university, with all participants attending the focus group at their respective universities. Each focus group session lasted a minimum of 1 h and was led by the researcher G.F. The discussions were guided by 10 questions (Supporting file 3), covering topics such as students' feelings during the IPE MAES sessions, aspects of collaborative work, their opinion on the interprofessional CPR training, the simulation and scenarios they worked on, the IPE experience, and their overall impression of MAES.

The outcomes of MAES sessions were aligned with the ERC guidelines. The scenarios required students from both disciplines to work collaboratively, enhancing interprofessional training, mirroring real-world clinical settings.

2.4. Ethical Considerations. No rights were violated, and no data compromised the privacy and safety of any students. All the participants signed an informed consent form before the first MAES session with the possibility of opting out of the study at any time. The simulations were always conducted with respect and promoted the values of unity and teamwork.

To ensure trustworthiness, we employed credibility, transferability, dependability, and confirmability strategies. Researchers performed prolonged engagement, member checking, and triangulation of data sources (focus groups and observations). A detailed description of the research context, participants, and study settings was provided. A comprehensive audit of the research decision and

procedures, as well as reflexivity, was maintained. To ensure reflexivity, the research team comprises individuals from different backgrounds who incorporated diverse perspectives, maintained reflective practices, and critically examined assumptions and biases throughout the whole study.

The work was conducted in accordance with the Declaration of Helsinki (1964) and it was approved by the Ethics Committee from the UCAM, with reference number: CE052308. To safeguard the identity of the participants when presenting the verbatim text, the researcher assigned a code to the participants (S1: Student 1, S2: Student 2, etc.).

3. Results

In our study, we included a total of 23 participants. The participants' ages ranged from 21 to 26, with a mean age of 24.5 years. The sample consisted of 3 males (13%) and 20 females (87%). The educational backgrounds of the participants were similar: the medical students were all in their sixth year of medical school, and the nursing students were all in their fourth year of nursing school. In Spain, the fourth and sixth years correspond to the final years of nursing and medical degrees, respectively. Additionally, all the fourth-year nursing students had already completed their Critical Care or Emergency Care traineeship placements before participating in the study. Only four students had previously seen a real cardiac arrest patient, and only two of them had performed cardiac compressions in real life. This comprehensive demographic profile aids in understanding the representativeness of our sample and supports the interpretation of the study results.

The results of the inductive analysis of the study can be organized into 2 main themes and 7 different subthemes (Figure 1).

3.1. CPR Training With Interprofessional MAES. The first main theme resulting from our thematic analysis highlighted some of the characteristics that cardiac arrest training with MAES implements from the participant's point of view. The fact of performing interprofessional CPR training helped them to improve and train both technical and nontechnical skills (teamwork). It enhanced the awareness of other health professionals present in those emergencies before they could face a real situation. They also highlighted the effectiveness of the MAES in student engagement. They emphasized the benefits of realistic scenarios, shared responsibilities, and a structured debriefing process, which collectively contribute to improved nontechnical skills, personal growth, and knowledge retention. While the methodology is well-received, some students identified areas for improvement, such as the need for more time in scenario design and managing the responsibility of peer learning. Overall, the approach fosters a deeper connection to real-world medical scenarios and promotes collaborative learning.

3.1.1. Improvement of Teamwork. The MAES methodology significantly enhances teamwork in interprofessional settings, as students noted its positive impact on scenario design, simulation, and debriefing, fostering better collaboration and nontechnical skill development. Working with the MAES methodology in interprofessional teams was seen by most of the students as a support to improve teamwork. This was reflected in the whole process, both in the design of the scenarios and in the simulation debriefing.

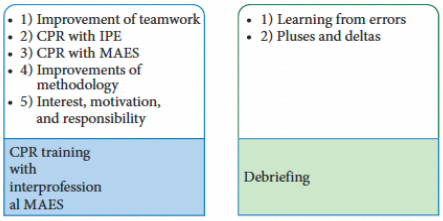

FIGURE 1: Conceptual map. Themes and subthemes of the study.

> *"The dynamics help us to get to know each other better and to work as a team. We can train nontechnical skills that with other methodologies may not get the same attention."* (S3)

> *"The methodology seems to humanise the teaching. The possibility of interprofessional MAES training makes the team stronger, which is reflected in the simulation team when acting on the patient."* (S5)

> *"The presence in the scenario of medicine and nursing allows us to give more reality to the scene and above all each participant takes more responsibility. We don't have to simulate decisions that we wouldn't make in our jobs. It improves teamwork and indirectly allows us to improve our specific skills."* (S11)

3.1.2. CPR With IPE. The students, by training with an interprofessional experience, got a more similar dynamic to the one they will face at work. The participants associated the possibility offered by the methodology with an enriching novelty. They commented that they saw cardiorespiratory arrest situations as possible critical situations in their future jobs. Training medical and nursing students together was perceived not only as a possibility of theoretical and practical preparation but also as an improvement on a personal and human level. Interprofessional training fosters collaboration between medical and nursing students, enriching their perspectives, enhancing real-world readiness, and improving skills crucial for their future work environments.

> *"I liked sharing the experience between medicine and nursing students, because in a few months we will be working together. We had never trained together before in our studies."* (S12)

> *"It changes the student's perspective which is different from what I am used to see and study. I can relate to a more work-like dynamic and share experiences. I think it is very enriching on a personal and human level."* (S13)

> *"Working with this methodology allows us to improve aspects of PCR that go beyond the techniques and that we will face in our work tomorrow."* (S8)

3.1.3. CPR Training With MAES. Most of the participants highlighted the importance of the CPR training. Their comments were mainly focused on the training experience with different methodologies comparing the possibility to learn both technical and nontechnical skills. It emerged that learning CPR with MAES gave them the possibility to feel in charge of their learning as well as the sensation of being able to retain more knowledge. The MAES methodology places students at the center of their CPR training, enhancing knowledge retention and providing a comprehensive understanding that goes beyond technical skills. They felt MAES was a useful methodology and made them feel more comfortable acting in an emergency compared to CPR lessons and SBL CPR training.

> *"Throughout the university we train technical skills on CPR. Sometimes we have the possibility to put these skills into practice with scenarios made by the teacher, but I always have the feeling that we don't manage to relate knowledge. With MAES this did not happen. We felt that we were at the center of our learning, and it allowed us to retain more knowledge about the topic we were dealing with."* (S19)

> *"With MAES I have the feeling of learning CPR, whereas when we do it without MAES it seems that we only focus on the technique. When we go to a patient in cardiac arrest, we cannot only know how to do compressions or ventilations, we also need to have theoretical knowledge and know how to relate it to our patient's situation. Simulating with MAES I have the feeling of receiving a broader knowledge and I feel more prepared."* (S21)

3.1.4. Improvements of the Methodology. The MAES methodology is valued for its engaging approach to CPR training, though students find the responsibility and additional workload between sessions challenging, especially during busy periods. The participants not only underlined positive aspects of CPR training with MAES IPE, but they also shared possible improvements of the interprofessional MAES methodology. A limit they saw was the short time for the scenario design in between sessions and with a busy calendar. Also, some of them agreed that they felt scared of the responsibility of leaving knowledge to their peers.

> *"I like the learning model, but the work at home between the two sessions can be a limit, especially if it is done in a busy period."* (S15)

> *"Learning CPR with MAES is very interesting because it gives you responsibility. Sometimes the responsibility of being the one who helps my classmates to learn such an important subject scare me."* (S5 and S17)

3.1.5. Interest, Motivation, and Responsibility. The possibility to choose the topic of their simulation scenario from interesting information founded in a newspaper or a video was seen as one of the positive aspects of the methodology [18]. This practice improved interest and increased motivation as students saw the connection between a real fact and their simulated scenarios. In addition, the participants felt more responsible for the deepening of CPR topics.

> *"The fact of deciding the scenario from a newspaper, a video or a title, generates more interest and curiosity in the person who chooses. It increases the motivation to face the chosen topic."* (S2)

> *"Being able to choose the topic or how we approach it when designing the scenario, allows us to address CPR issues. With the classic methodology we don't feel we are facing or analysing properly the scientific evidence. We feel more responsible towards the knowledge that would otherwise remain superficial."* (S6)

3.2. Debriefing. The debriefing process in the interprofessional MAES CPR simulation was positively received by participants. They valued the structured approach for its effectiveness in enhancing knowledge retention and error analysis. Debriefings helped students focus on their knowledge underlining and self-realizing what they know and what they must improve. Participants appreciated their teamwork, communication, and role assignment during the scenarios, which contributed to a well-organized workflow. However, they identified areas for improvement (deltas), including a lack of leadership and gaps in knowledge of advanced life support (ALS) protocols. The deltas impacted decision-making and task prioritization during critical moments. This feedback highlights the strengths of the structured debriefing used in MAES methodology as it allowed participants to learn safely from mistakes and live the simulation experience with more security. All these aspects are reflected in students' feelings of being better prepared for real-world scenarios.

3.2.1. Learning From Errors. The debriefing modality adopted in the CPR simulation with interprofessional MAES was widely accepted by the participants. The analysis phase of the debriefing, compared to other more direct or with feedback typologies, was recognized as positive. Students saw analytical debriefing as a possibility to retain more knowledge, with positive analysis of errors. All of this resulted in a better feeling at the end of the simulated experience. Structured debriefing in MAES provides a supportive environment for learning from mistakes, helping students feel more secure and promoting positive, constructive analysis rather than just critical feedback.

> *"Structured debriefing allows learning from mistakes. When debriefing is limited to feedback from the teacher, you end the scenario with a bad feeling, you think everything went wrong."* (S1, S7, and S10)

> *"With MAES you live the experience with more security because you know that in the debriefing the analysis of the mistakes is positive. It allows you to learn from them and you don't feel evaluated, although an evaluation of the skills is carried out."* (S16)

3.2.2. Pluses and Deltas. We have summarized the most frequently discussed aspects in both simulation groups of the 2 participating universities. The results of the two debriefings are shown in Figure 2.

Aspects highlighted in the analysis of the simulation scenarios showed several positive feedbacks. The participants demonstrated excellent teamwork and communication throughout the simulation. Each team member understood their role and contributed effectively to the overall effort, resulting in a cohesive and coordinated response using clear and effective communication. Role assignment in the scenario was also an extremely positive aspect, allowing a smooth workflow. Positive teamwork, communication, and role assignment positively affected the organization of the workflow and the scenario, ensuring that all necessary equipment was prepared and used efficiently. As technical feedback, students underlined the defibrillation technique (correct execution, good placement of the pads, and use of safety protocols as "clear the patient") and chest compression (high-quality chest compression was performed consistently).

On the other hand, the debriefings highlighted some aspects that could be improved (deltas). In contrast with good teamwork, communication, role assignment, and organization, a lack of leadership was noted. There were moments where ineffective direction and decision-making put patients' safety at risk. This directly affected the prioritization process of the team in critical moments. This caused delays in important tasks such as CPR medication administration following ALS protocols or performing the 12 leads ECG after ROSC. Participants found themselves unsure about the ALS protocols, recognizing their lack of knowledge about the advanced protocols which could have caused delays in their actions and decision-making.

4. Discussion

The discussion of our qualitative study focuses on the insights gathered from 23 participants, comprising predominantly female students in their final year of medical and nursing education. The inductive analysis revealed that the MAES methodology significantly enhances interprofessional CPR training by improving both technical (e.g., defibrillation and chest compressions) and nontechnical skills (teamwork, communication, and role assignment), thereby fostering collaboration and increasing student engagement. The IPE MAES methodology ensures learning from errors through deep reflection in its structured debriefing. While students valued the realistic scenarios and structured debriefing, some highlighted areas for improvement, such as the need for more time in scenario design and better leadership during simulations. These findings underscore the importance of refining educational methodologies to better prepare students for real-world medical scenarios.

Currently, the CPR courses of the different institutions (AHA, ERC, UKRC, etc.) respect the models imposed. They are based on the latest recommendations and comply with specific technical and nontechnical skills training [2, 3]. At the same time, as proposed by the latest recommendations of the ERC, there is the possibility for resuscitation courses to be more focused on the individual needs of the trainee. It is in this scenario that the MAES methodology is positioned. It is based on peer education, problem-based learning, and self-directed learning in highly realistic simulated environments [5]. The self-learning methodology has been widely accepted by students and professionals, with a proven improvement of the skills learned in previous studies [21, 25]. Our study is the first to evaluate MAES methodology applied to interprofessional CPR training.

4.1. CPR Training With Interprofessional MAES. Recent CPR guidelines recommend training of healthcare personnel in both technical and nontechnical skills [2, 3]. Communication, teamwork, critical situation awareness, and leadership are all crucial factors in achieving high-quality CPR and good clinical practice [5]. As emerges from the literature, training in these factors benefits from interprofessional simulated experiences [4, 40]. The participants in our study had undergone interprofessional simulation training experiences in CPR with MAES. A relevant aspect perceived by the participants in our study is the attention to teamwork. The structure and development of MAES are based on the group factor and the creation of small working groups. This allows participants to develop and train nontechnical skills and group/team relationship skills at every moment of the sessions, without the need for a specific case to work on them [18].

Interprofessional CPR simulation training is essential for enhancing the realism and effectiveness of the learning experience, bridging the gap between classroom theory and real-world practice. By engaging in simulations that involve both medical and nursing students, participants are exposed to a dynamic that reflects the complexities of an actual healthcare environment. This type of training allows students to deal not only with their technical skills (e.g., correct execution of chest compressions and the use of defibrillators) but also to develop crucial nontechnical skills, including teamwork, communication, and decision-making under pressure (improving interprofessional team simulation learning. one more step towards the humanization of health care in [33]). Furthermore, teaching these human and personal factors through realistic, interprofessional simulations not only increases the technical abilities of future healthcare providers but also boosts their confidence and willingness to engage in resuscitation efforts when faced with real emergencies [12].

One of the key outcomes of the methodology used in this study is the enhanced ability of participants to connect their knowledge directly to the patient or the simulated situation. MAES places students at the center of their own learning.

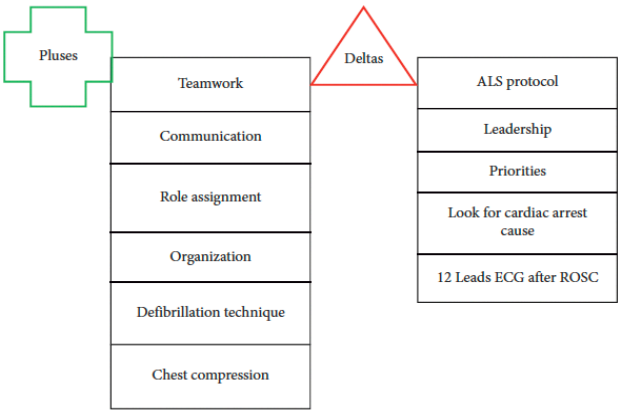

FIGURE 2: Pluses and deltas resulting from analytic phases of the debriefing.

This approach enabled them to develop a deeper understanding of their simulated patients and scenarios, allowing them to more effectively relate the information they gathered to the specific circumstances they were simulating [18], all this without leaving aside the objectives of improving technical skills (compressions, ventilations, etc.). With MAES, we also observed an increase in the motivation of the participants. The possibility of choosing the approach to the scenario and the associated learning objectives allowed for greater intrinsic motivation in accordance with previous studies [18]. In the same way, the methodology increased the learners' responsibility towards the search for more up-to-date scientific evidence, with the aim of leaving a higher level of knowledge to peers. Participants associated MAES with the feeling of receiving broader knowledge compared to other methodologies.

4.2. Debriefing. In simulation learning, regardless of the methodology involved, a fundamental factor is the debriefing [39]. Using debriefing allows participants to analyze the events of the simulated scenario. In the MAES methodology, an analytical debriefing is involved, which allows both positive aspects and things to be improved to be reflected upon. The analysis structure used allows participants to lose the fear of making mistakes, rather allows them to analyze and learn from them. Moreover, it is carried out with the participation of all the students, which reaches its maximum scope in the expository phase. In this phase, the group that designed the case transmits the knowledge about it, always with the presence of the facilitator as a guide [41]. In accordance with the above, it can be affirmed that with MAES, the students actively participate in the debriefing and they respect the error but lose the fear of declaring it. This makes it possible to become familiar with debriefing and to accustom the health professional to use it for the critical analysis of clinical situations, in accordance with the latest recommendations [1, 2, 13].

The methodology involved in conducting the courses or classes is as important as the content of the courses or classes [40, 42, 43]. In our study, we can observe analogies comparing the results of the "plus delta table" with the students' perceptions emerging from the focus group. The characteristic factors of the MAES methodology, positively perceived by the students (teamwork, communication etc.), were found to be reflected in the pluses of the simulated experiences. The fundamental technical skills in CPR (chest compressions and defibrillation) did not take second place and were also present in the simulation "pluses." At the same time, technical and nontechnical skills appeared among the aspects to be improved (ALS protocol, looking for cardiac arrest causes, and leadership). These aspects are independent of the MAES methodology. They are associated with more clinical experience and participation in advanced courses, which could be lacking in undergraduate students. In accordance with these findings, the need for continuous training in CPR is once again confirmed as the fundamental aspect for all health professionals [5, 40, 42].

4.3. Limitations. The internal validity of the study is assured as all recommended steps in conducting a qualitative study have been followed. Given that this is a qualitative study focused on the opinions of the participants, the results cannot be generalized to other contexts beyond the research itself, as the external validity of this type of study is limited. However, since it is a study performed in two different universities and it has not shown differences in opinion among participants, we can assert that this circumstance would enhance the study's validity.

To consolidate the preliminary results of this study, it would be necessary to increase the number of participants and experiences related to CPR with interprofessional MAES methodology.

5. Conclusions

The present study reaffirms the importance of the CPR training. It analyzes a new experience with MAES methodology made by undergraduate nursing and medicine students in CPR training. It demonstrates an overall acceptance of the experience with several positive aspects linked to the MAES methodology applied to IPE training in CPR. Students appreciated the possibility to be the center of their own learning, feeling that they could train both technical and nontechnical skills. They felt more motivation and responsibility towards their peers and their learnings. They also did not feel evaluated with the methodology applied. This fact allowed them to feel less pressure.

The study also shows the positive aspects of the simulation experiences and the things that could be improved. All the positive aspects aligned with MAES, its features, and the latest CPR training guideline standards. Likewise, the areas for enhancement in the clinical simulation experiences were anticipated, given their connection to a more advanced level of competencies. Learning and training CPR with MAES interprofessional could be a new and different approach to propose as an alternative training experience to the usual ones we could find in CPR training. All these aspects are in accordance with the international CPR guidelines, which suggest considering different ways to train, putting learners in the center of the process.

More research is needed to understand better and wider the potential of MAES applied in CPR training and courses.

Data Availability Statement

The data used to support the findings of the study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. *(Supporting Information)*

Supporting file 1: MAES case of MI with cardiac arrest. Supporting file 2: MAES case of drowning with cardiac arrest. Supporting file 3: Focus group. Supporting file 4: SRQR.

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5.2.4. Article Nº4

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The expository phase of debriefing in clinical simulation: a qualitative study

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Abstract

Background Clinical simulation fosters reflective, experiential learning in a safe environment, allowing participants to learn from mistakes without patient risk. Debriefing, essential for reflection, is typically facilitator driven. The MAES© methodology (Self-Learning Methodology in Simulated Environments) shifts the focus to students, guiding them through six sequential phases: group identity creation, topic selection, objective setting, competency establishment, scenario design, simulation, and debriefing. MAES© introduces an expository phase in debriefing, where students present theoretical and practical content. The facilitator assumes a significant, yet secondary role, fostering increased student-led learning opportunities and, at times, enabling even trained real patients to co-facilitate the debriefing.

Objective To explore participants' experiences and perceptions regarding the expository phase of debriefing within the MAES© methodology framework, with specific focus on the student-led debriefing component.

Method A descriptive qualitative inductive approach with thematic content analysis was used. Open-ended questionnaires from 151 undergraduate final year and post-graduate nursing students, captured their experiences with the MAES© expository phase. Open-ended questionnaires allow participants to freely and anonymously express their perspectives and experiences. Responses were transcribed, independently coded, and analyzed using MaxQDA® v18. Data were coded and analyzed based on absolute and relative frequencies of emerging categories. The study adhered to the SRQR (Standards for Reporting Qualitative Research) guidelines.

Results The analysis revealed several key themes in student evaluations. Satisfaction with the methodology emerged strongly, with over one-third of participants expressing no desired changes. The reflective nature of the approach was prominently valued, along with its effectiveness for concept clarification and fostering collaborative learning. Participants particularly noted developmental outcomes in communication competencies and technical skills, while appreciating the motivational learning environment and evidence-based focus. The suggested improvements focused on three main aspects: increased session dynamism, a greater use of visual and interactive elements, and reduced dependence on slide-based presentations.

Conclusion The study highlights the value of the expository phase in the MAES© methodology, emphasizing its effectiveness in clarifying concepts, fostering collaboration, and developing technical and communication skills. It also promotes student autonomy through active engagement. However, participants suggested improvements,

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such as greater dynamism, personalization, and varied presentation methods using videos, skill stations or patient's-oriented debriefing. Overall, the expository phase proves to be a valuable pedagogical tool with potential for broader application in simulation-based learning and other debriefing models.

Clinical trial number Not applicable.

Keywords Clinical simulation, debriefing, expository phase, MAES, Peer-led debriefing, Student-centered simulation, Self-directed learning

Introduction

Simulation Based Learning (SBL) is one of the most prominent learning methodologies in university teaching and clinical practice [1, 2]. Training and learning through simulation is considered a reflective and experiential method [3, 4]. Aligned with these principles can be found MAES© methodology (Self-Learning Methodology in Simulated Environments, Spanish acronym). The MAES© methodology (Self-Learning Methodology in Simulated Environments) shifts simulation-based learning from an instructor-led to a student-centered model, promoting autonomy and active engagement. Through six structured phases (group identity creation, study topic selection, initial objectives definition, competencies establishment, scenario design, simulation, and debriefing) students take control of their learning, design simulations, and engage in reflective analysis [5]. This approach fosters "learning by doing" in a safe environment, integrating theory with practice while encouraging collaboration and critical thinking. Participants can make mistakes and learn from them without posing risks to the patient [6]. The MAES© methodology is theoretically grounded in constructivist approaches [7], particularly Problem-Based Learning [8], which emphasizes active knowledge construction through problem-solving, and Collaborative Learning [9], where social interaction drives cognitive development. This framework aligns with Peer Learning principles [10], where knowledge co-creation occurs through symmetrical relationships among learners.

The reflective analysis of the simulated event and the strengths and weaknesses of the participants is carried out during the debriefing, which is considered essential for learning through simulation by most authors [11, 12]. Although its essential role in simulation, debriefing frameworks and techniques vary widely in their approach and effectiveness [13]. Debriefing began as a critical method initially focused on identifying errors, which limited effectiveness of feedback. To address this, the Debriefing with Good Judgment methodology was created, finding a balance between learning, reflection, motivation, and emotions [14]. Building on the need for structured feedback, the GAS model (Gather, Analize, Summarize) was introduced to organize debriefing into three logical, progressive stages, ensuring a systematic review of both strengths and areas for improvement [15]. Expanding this structure, the PEARLS (Promoting Excellence and Reflective Learning in Simulation) offers a detailed framework with defined phases: Setting the scene, Reaction, Description, Analysis, and Summary [16]. The main difference with GAS is that PEARLS link participants' emotions to the learning experience. In contrast to facilitator-led models, "self-debriefing" offers a more autonomous approach. Participants individually reflect on their performance without a facilitator's intervention fostering self-assessment and personal insight [17]. Expanding on this concept, "Videodebriefing" emerged during the COVID-19 pandemic, as a self-assessment remote alternative. Through simulation recordings, participants can objectively observe their performance, integrating visual feedback into the reflection process [18].

The debriefing models discussed provide structured and reflective analysis but are predominantly facilitator-driven [2, 19]. Studies suggest instructor-led debriefing is not always positive [19]. The unique feature of MAES© underscores the necessity for a tailored debriefing model that prioritizes a central role for students [5, 3]. With MAES© the facilitator retains their role in guiding and moderating the reflective process but transitions to a more supportive and concluding position [20]. This approach allows students to take on greater responsibility, fostering autonomy and critical thinking.

MAES© debriefing adheres to a well-defined five-phase structure aligned with the INACSL debriefing standards [21]. It distinguished from other models by its inclusion of an expository phase. In the initial phase, as in PEARLS debriefing [22], participants express their emotions immediately after the simulation scenario. The second phase, descriptive in nature, involves a narrative recounting of the events in the simulated scenario. The third phase, analytical, facilitates deeper reflective learning [23], utilizing analysis techniques such as "Plus/Delta" [24]. The analytical phase of MAES© emphasizes active student participation. Specifically, the students who prepared the case lead this phase by posing questions or offering reflections [5].

The expository phase, which follows the analytical phase, represents the primary structural innovation of MAES© debriefing. Collaborative learning (Barkley et

al., 2014) and peer-to-peer learning (Damon, 1984) are actively fostered in this phase. Students who designed the scenario take the lead, dynamically presenting scientific evidence related to the case while addressing the learning objectives established by the group. Participants are encouraged to creatively convey evidence through diverse methods (e.g., presentations, visual content, interactive activities, brief workshops and even inviting experts or patients with relevant experiences to share) [20, 3]. The expository phase is intentionally dynamic and designed to last no longer than 10 min to maintain engagement and effectiveness. The MAES© debriefing ends with a summary. The facilitator, guiding students in synthesizing key learning points, ensures that all learning objectives are addressed, including any emergent objectives that may not have been anticipated during the initial scenario design [25]. This distinctive approach not only enriches the reflective process but also enhances the autonomy and engagement of learners.

With its structure, MAES© emphasizes the active role of students throughout their learning process, including debriefing [26]. This process enhances intrinsic motivation, educational responsibility, and participant engagement [27, 28]. The facilitator takes a seemingly secondary role, allowing more student space and even enabling trained real patients to co-debrief [20]. The facilitator's role in MAES©, adhering to INACSL facilitation standards [29], is crucial in the expository debriefing. They guide students toward the initial objectives, focusing on students' baseline knowledge and motivations [3].

The MAES© debriefing retains the structured framework common to most debriefing models [30], adding a key structural innovation: the expository phase. Despite its conceptual grounding, prior research has not fully explored the perceptions and experiences of users who have applied this phase in practice, particularly in relation to student-led debriefing. Existing studies have largely focused on the theoretical aspects of the expository phase [5, 20], overlooking how it is perceived and experienced by participants in real-world settings. Consequently, the primary objective of this study is to explore participants' experiences and perceptions regarding the expository phase of debriefing within the MAES© methodology framework, with specific focus on the student-led debriefing component.

Method

Research design

This study employed a descriptive qualitative design with inductive approach, utilizing content analysis of an open-ended questionnaire to explore participants' experiences and opinions regarding the expository phase of MAES© debriefing. The methodology choice was taken with the aim to provide detailed, in depth understanding of MAES© expository phase. This method allows understanding of complex phenomena capturing lived experiences with great flexibility in data collection providing contextual insights [31]. Open-ended questionnaires provide a loosely structured approach that allows participants to freely and anonymously articulate their subjective perspectives and experiences in writing [32]. Although less commonly employed in qualitative research, this method offers valuable preliminary insights, particularly for exploring focused topics. Similar approaches have been applied in health sciences education research [33, 34, 35]. The study adhered to the SRQR (Standards for Reporting Qualitative Research) guidelines [36].

Participants

Participants were initially selected through non-probabilistic purposive sampling. Participants included were fourth-year nursing students (final year), enrolled in Practicum V and postgraduate students in emergency care in the Catholic University of Murcia (Spain). Students participating in exchange programs and not enrolled in simulation courses were excluded. The Practicum V cohort consisted of 304 students, divided across 20 simulation groups (16 students per group average). On the other hand, Postgraduate cohort consisted of 36 students, divided into two groups of 18 student. The total of the non-probabilistic purposive sampling was 340 students.

Practicum V incorporates 20 h of simulation-based learning using the MAES© method. These hours are structured into a 4-hour prebriefing session and four 4-hour simulation and debriefing sessions, each covering three scenarios with debriefings divided into five phases: reactions, descriptive, analytical, expository, and summary. The postgraduate students completed 24 h of simulation using the same methodology during their Masters' degree.

As a qualitative study examining learner experiences, we employed a systematic sampling approach within a convenience sampling framework, selecting eight undergraduate simulation groups and both postgraduate groups (totaling 10 groups with 164 eligible participants). This dual sampling strategy - systematic selection from convenience samples - is particularly suited for qualitative research where: (1) the population has natural groupings (simulation cohorts), (2) depth of experience with the intervention (MAES© methodology) is prioritized over probabilistic representation, and (3) logistical constraints require practical sampling solutions. The selection of 10 out of 22 available groups achieved three critical qualitative research objectives: experiential diversity (ensuring varied clinical backgrounds), data richness

(maintaining manageable but substantial narrative data), and methodological rigor (through systematic randomization within the convenience sample to minimize bias). Finally, 151 students completed the qualitative questionnaire, yielding a 92% response rate.

Procedure and data collection

All MAES© sessions adhered to the previously standardized self-directed learning structure, regardless of the specific competencies being addressed. Data were collected during the 2022–2023 academic year (September 2022–July 2023).

The data were gathered through an anonymous, self-administered questionnaire with no word limit or time constraints, allowing participants to respond flexibly from home. Students were aware the data collection was planned to end in July 2023. The questionnaire was distributed at the end of the simulation sessions for undergraduate and postgraduate nursing students participating in MAES©-based courses at UCAM. Students could complete the questionnaire online (via Google Forms®) or on paper. All participants decided to fill in the questionnaire online. Brief instructions were provided at the beginning of the questionnaire. Students were instructed to focus their comments on the expository phase of debriefing, and it was told that all questions requesting sociodemographic data (e.g., age, gender, academic level, previous MAES© experience, and educational resources used in the expository phase) were mandatory. Two open-ended questions guided the qualitative data collection: "Provide your honest opinion on the strengths of the expository phase of debriefing without a word limit." "Provide your opinion on the limitations and suggestions for improvement of the expository debriefing phase without a word limit." The research team carefully designed the questions to ensure they were open-ended, enabling participants to express diverse perspectives for a comprehensive thematic analysis. Participants can withdrawal from the study any time they want, simply not answering the questionnaire before the end of collection data period (July 2023). Anonymized raw data in Spanish are publicly available in the following repository: https://doi.org/10.6084/m9.figshare.27959604.

Data analysis

Responses from questionnaires were transcribed into a single document, with responses organized by participant and dimension (strengths and suggestions for improvement). This document was the foundation for an inductive thematic content analysis with a descriptive orientation [37] and a directed approach [38]. Two researchers independently GF (Masters' degree and 7 years simulation experience) and CAJ (PhD and 4 years simulation experience) coded the data with a qualitative analysis software (MaxQDA® v18). The software was used to create codes for key themes, organize subcategories, analyze patterns and visualize relationships between different themes. The process helped to categorize data into dimensions, categories, and subcategories. The results were discussed during two consensus meetings with a third researcher JLDA (PhD, expert qualitative researcher with more than 15 years of clinical simulation experience) who helped to resolve discrepancies. A final version of the coded data was obtained Quantitative measures of absolute and relative frequencies were calculated for each category. Although qualitative research primarily focuses on understanding meaning and experience, incorporating quantitative frequencies can enhance analytical rigor. Reporting how often specific themes or codes appears provides a systematic structure strengthening transparency and rigor, ensuring replicability demonstrating results are not only based on subjective interpretation. In our study, it also supports comparisons between groups (undergraduate and postgraduate) and it reenforce the validity of qualitative themes by showing their frequency and distribution. Absolute frequency refers to the number of occurrences of a category. In contrast, relative frequency expresses its percentage of the total dataset, calculated by dividing the absolute frequency by the total responses and multiplying by 100. All codes, including those representing less than 5% of the dataset, were described [39].

Study rigor

To ensure the rigor of the study, the following measures were applied [40, 36]:

To ensure the trustworthiness of our study, we took deliberate steps to strengthen each aspect of rigor. During participant selection, we carefully balanced both homogeneity and heterogeneity. All participants had been trained in the MAES© methodology, ensuring a shared foundation for comparison, while the inclusion of both undergraduate and postgraduate nursing students introduced a range of perspectives. This diversity enriched the analysis by capturing variations in experience and learning levels. For data collection, we used self-administered questionnaires, allowing participants to share their experiences freely without the presence or influence of researchers. This approach minimized social desirability bias, ensuring that responses genuinely reflected participants' perspectives rather than perceived expectations. To enhance transferability, we provided a detailed description of the study context and participant characteristics. By offering a rich account of the educational setting and demographic backgrounds, we enabled other researchers to assess the applicability of our findings to similar contexts. Transparency was ensured through open data practices. Anonymized raw

data was made available in a public repository, allowing future researchers to verify our findings and build upon our work. This openness reinforces the credibility of the study and fosters continued exploration of the topic.

Two researchers independently conducted the coding and thematic analysis. Through a structured consensus process, discrepancies were discussed and resolved, ensuring that findings were consistently interpreted and not solely dependent on individual perspectives. Given our familiarity with the MAES© methodology, we remained critically aware of potential biases. Regular discussions within the research team encouraged self-reflection and objective analysis, helping to mitigate any influence of prior knowledge on data interpretation. Both these actions made reliability and reflexivity an integral part of our research process.

Ethical considerations

All participants were informed of the study's objectives and provided written consent before participation, during the first MAES© simulation session of their group. The consent form was aligned with institutional research standards and approved by ethics committee from the Catholic University of Murcia (UCAM) prior to the study. To all participants it was explained that they withdrawal from the study any time they want. Anonymity was preserved as students can fill in the questionnaire using an anonymous single use code. Privacy and anonymity were also preserved by Spanish data protection legislation. The study was approved by the ethics committee from UCAM (reference number CE052308). Participant responses are presented with alphanumeric codes (e.g., A1, A2, A3), specifying if they are undergraduate or postgraduate to better represent the data obtained and reduce possible bias.

Table 1 Table of frequencies and percentages by subcategories in dimension 1

Category	Subcategory	Af	%
Clarification and Consolidation of Concepts	Clarification of Concepts and Doubts	12	8%
	Knowledge Consolidation	8	5.3%
Collaborative Learning and Teamwork	Interaction and Debate	10	6.6%
	Share and Learn from the Group	8	5.3%
Reflection on Errors and Improvements	Identifying Errors	15	10%
	Learning from Mistakes	10	6.6%
Development of Communication Skills	Improve Expressiveness	10	6.6%
	Using Creative Methods	5	3.4%
Development of Technical and Practical Skills	Specific Techniques	10	6.6%
	Application To Clinical Reality	9	6%
Motivation and Positive Learning Environment	Collaborative Environment	8	5.3%
	Personal Motivation	6	4%
Use and Search for Scientific Evidence	Preliminary Research	7	4.7%
	Use of Evidence	5	3.4%
Autonomous and Meaningful Learning	Active Preparation	7	4.7%
	Easy to Remember	4	2.7%
Educational Innovation	Dynamic Learning	6	4%
	Diversity of Resources	3	2%
Total		151	100.00%

Results

The study included 151 participants with a mean age of 22.75 years (SD = 2.57). Most were women ($n = 115$), while 36 were men. All participants were students at the Catholic University of Murcia (Spain). Regarding prior experience with MAES©, 109 students had previous exposure, whereas 42 did not. Academically, 126 participants were undergraduate students, and 25 were enrolled in postgraduate nursing programs.

A thematic content analysis of the qualitative responses identified two primary dimensions: strengths and areas for improvement in the expository phase of MAES© debriefing. Data were categorized into thematic groups, and absolute frequency (AF) and percentage (%) were calculated for each subcategory.

Dimension 1: Strengths of the expository phase in MAES© debriefing

The first dimension individuated in our study focuses on the strengths of the expository phase in MAES©. In this phase, students take an active role presenting theoretical and practical competencies related to the simulation scenario experienced by another group, while the facilitator provides guidance and supervision. Findings suggest that peer-led information exchange significantly enhances learning. This phase fosters concept consolidation, reflection on errors and improvements, and collaborative learning by encouraging exchanging ideas and experiences. Additionally, it strengthens communication skills, autonomy, and scientific literacy, creating a motivating and interactive learning environment. The absolute frequency (AF) and percentage of each category within Dimension 1 are summarized in Table 1.

The expository phase of MAES© debriefing enhances clarification and consolidation of concepts (category 1). It facilitates conceptual clarity resolving doubts (8%) with the opportunity to ask questions at any time and reinforces theoretical and practical knowledge (5,3%) linked with the learning baseline previously set by students. One participant said, "You can ask anything you don't know or

anything that wasn't clear" (A4-undergraduate). Another stated, "It helps you understand the case better, providing you with the necessary information based on what we want to learn" (A82-postgraduate).

Beyond individual comprehension, the collaborative nature of this phase fosters teamwork and shared learning (category 2). Students emphasized the value of exchanging perspectives and discussing different approaches with their peers. The exchange of perspectives and collective discussion were highlighted as enriching aspects of the learning experience. One participant noted, "Discuss different points of view with classmates, see the mistakes and how to improve" (A2-undergraduate), while another emphasized, "Share practical knowledge with classmates" (A101-undergraduate). This collective reflection further supports reflection on errors and improvements (category 3).

The expository phase promotes reflective learning by encouraging the identification of mistakes (10%) and analysis of errors, allowing students to improve future performance learning from them (6,6%). One student stated, "Analyze the mistakes to learn from them" (A50-postgraduate), and another added, "You learn from mistakes" (A94-postgraduate).

In addition to deepening knowledge, the expository phase also strengthens development of communication skills (category 4). Structured presentations and public speaking opportunities boost students' confidence and expressiveness (6,6%). The use of interactive methods made presentations more engaging (3,4%). As one participant described, "It helps to present in public and gives us confidence for other presentations like the Final Degree Project" (A12-undergraduate). Another remarked, "It's interactive, so the class is invited to join the activity" (A90-postgraduate). At the same time the expository phase helps Technical and Practical Skills development (category 5).

The expository phase enhances technical competencies (6,6%) and their application in clinical practice (6%). One student commented, "Refresh nursing techniques, share experiences with classmates" (A70-undergraduate). At the same time, another highlighted, "Know the small details of the case that we overlooked in the simulation and that can be relevant to the patient's well-being" (A86-postgraduate).

Academic and technical aspects are not the only ones remarked as positive. As matter of fact, the expository phase of MAES© debriefing is seen as a chance to improve motivation and give a positive learning environment (category 6). The expository phase creates a supportive and engaging atmosphere where peer recognition and participation contribute to a positive learning experience. A participant noted, "The camaraderie and respect during the nervous moments we have when presenting" (A112-undergraduate), and another stated, "It's good that the class takes an interest and listens to you; it motivates you to keep explaining" (A33-undergraduate).

The expository phase also promotes the use and search for scientific evidence (category 7), reinforcing an evidence-based approach to learning (3,4%) especially applied in the preliminary preparation of this phase (4,7%) One participant reported, "Searching for information helps you learn" (A7-undergraduate), while another added, "With the expository phase of debriefing, you update and reinforce information and knowledge" (A92-postgraduate). Moreover, active student involvement (4,7%) in preparing and presenting material contributes to deeper understanding and better knowledge retention (2,7%) helping autonomous and meaningful learning (category 8). One participant described, "Preparing material involves greater dedication and learning by the person doing it" (A5-postgraduate). Another noted, "The clarity with which the content stays and the ease of acquiring knowledge" (A91-postgraduate).

Finally, students recognized the educational innovation (category 9) of the expository phase. Participants recognized the expository phase as an effective alternative to traditional learning due to its dynamic methodology (4%) and the diversity of the resources that students can use to learn (2%). One student observed, "A different way of learning and, in my opinion, more effective and dynamic than conventional" (A35-postgraduate). Another highlighted the creative approaches used in presentations: "I find it fun that classmates try other things, like a quiz game or doing theater" (A47-graduate).

Dimension 2: Areas for improvement in the expository phase of MAES© debriefing

The analysis of participants' feedback on the expository phase of the MAES© debriefing reveals several key areas for improvement, as well as a significant number of students who expressed satisfaction with the current methodology. The primary focus of most suggestions revolved around enhancing student engagement and participation, either through reducing reliance on traditional methods like PowerPoint or incorporating more interactive, hands-on learning activities. Additionally, there was a call for more personalized support for students, particularly those who experience anxiety or discomfort in public speaking. Several participants also highlighted the need for clearer organization and better pacing of activities to optimize learning outcomes. The absolute frequency (AF) and percentage of each category within Dimension 2 are summarized in Table 2.

The most frequently identified category in this dimension was full satisfaction (category 1), with 37.1% of participants stating they would not change anything. While this does not represent a suggestion for improvement, it

Table 2 Absolute frequency (AF) and percentage of each category in dimension 2

Category	Absolute frequency (Af)	Percentage (%)
Full Satisfaction: "Nothing" or "I Wouldn't Change Anything"	56	37.1%
Duration and Length of Activities	15	10%
Greater Dynamism and Interactivity	18	12%
Inclusion of Practical Workshops and Visual Activities	16	10.6%
Improved Structuring and Clarity	11	7.3%
Criticisms of the Frequent Use of Powerpoint	11	7.3%
Emotional Support and Personalization	7	4.7%
Additional Suggestions	17	11.3%
Responses Without Substantive Content	10	6.6%
Total	151	100.00%

provides valuable insight into students' positive perceptions of the current methodology. Common responses from both undergraduate and postgraduate students included: "Nothing" (A4, A6, A24, A27, A29) and "Wouldn't change anything, honestly" (A7). Others expressed general contentment with statements such as: "Everything is perfect" (A150). These responses reinforce the positive reception of the expository phase among a considerable number of students.

Some participants (10%) found certain presentations excessively long (category 2), which they perceived as detrimental to engagement and learning. Comments included: "They should be shorter" (A12-postgraduate) and "Maybe the time, make it quicker and more manageable, but overall very good" (A72-graduate). These observations suggest the need to optimize the duration of activities to sustain attention and maximize learning outcomes. In line with this, a substantial number of participants (12%) advocated for grater dynamism and interactivity (category 3) One student proposed: "Improve by not using PowerPoint for all presentations; I think it's more enriching to do practical workshops, using questions and answers" (A5-undergraduate). Another emphasized: "Make it more interactive" (A117-undergraduate). These suggestions underscore the importance of pedagogical strategies that foster active student participation in the learning process.

Many participants (10,6%) recommended incorporating more hands-on workshops and visual materials (category 4) to enhance learning effectiveness. Illustrative comments include: "Use more practical workshops" (A8-undergraduate) and "In conclusion, implement more workshops and not so many presentations" (A120-postgraduate). These perspectives highlight the value of experiential learning as a complement to theoretical instruction. In addition to this, some participants (7,3%) suggested that the organization and clarity of activities could be improved (category 5). For instance, one student remarked: "I think I would structure the plus and delta parts more" (A17-postgraduate). Additionally, the need for final summaries to consolidate learning was emphasized: "Make a summary at the end of the debriefing of everything learned. Sometimes it's a bit scattered" (A94-undergraduate). These insights indicate a demand for clearer and more structured debriefing sessions. In line with the suggestions to have a more hands-on session and the need of an improved organization and clarity expository phase of MAES©, several participants (7,3%) expressed concerns about the excessive reliance on PowerPoint® presentations (category 6). They argued that this format can become monotonous. One participant noted: "The presentation mode we students use (generally PowerPoint) sometimes gets a bit tedious and you don't pay the attention it deserves" (A105-undergraduate). A more extreme suggestion was: "Ban the use of PowerPoint presentations because they tend to be very boring" (A137-postgraduate). These critiques point to the need for diversifying presentation tools to maintain student engagement.

Although a smaller group of participants (4,7%) highlighted the need for emotional support and personalization (category 7), this feedback is still significant. A few participants highlighted the importance of adapting activities to accommodate individual emotional and psychological differences. One student commented: "The only drawback I find is that for people who are shy or get nervous speaking in public, it can penalize them" (A40-undergraduate). This suggests that some students would benefit from more individualized support, particularly in addressing the emotional and psychological challenges of public speaking and group presentations.

Lastly, few participants (11,3%) provided specific additional suggestions (category 8) that did not fully align with the previously identified categories. These included: "Have classmates make a summary-outline of the information gathered and share it with others in a Drive after each presentation" (A48-undergraduate). Another proposal was: "Require something practical with classmates in each case" (A126-postgraduate). These ideas contribute to a broader discussion on how the expository phase can be further refined. In contrast to those who propose additional suggestions, a residual category was identified, comprising responses that did not provide relevant content or were otherwise uninformative (category 9). These responses were minimal (6,6%) but included for completeness in the analysis.

Discussion

This study aimed to explore students' perceptions of the expository phase of debriefing within the MAES© methodology, an innovative approach that places students at the center of the learning process. By introducing a structured phase for student-led content presentation, MAES© modifies the traditional debriefing flow. While this alteration may initially seem disruptive, participants identified multiple strengths of the expository phase. The results indicate that students perceive it as an opportunity to consolidate knowledge, clarify concepts, improve communication skills, enhance autonomy, and foster creativity by cultivating a collaborative and motivating learning environment. These aspects contribute to a richer educational experience while also developing transversal skills critical for professional practice.

In MAES© debriefing, facilitators can integrate any established debriefing structure, provided they allocate space for the expository phase to address knowledge gaps identified by participants. Unlike traditional debriefing models, where facilitators assume a predominant role in guiding reflection [22, 13], expository phase shifts the focus toward student-led learning. In our study it has been demonstrated that this transition, while potentially perceived as interrupting the linear flow of debriefing, promotes deeper theory-practice integration and increases student engagement. These findings align with active and collaborative learning theories [41], which emphasize that students construct knowledge more effectively through engagement in discussions, problem-solving, and experiential activities. Additionally, collaborative learning highlights how pooling skills and reflections among learners working toward shared goals enhances critical thinking and knowledge application [42].

A key outcome of this study is the recognition that the expository phase contributes to the development of multiple competences and skills, enhancing collaborative learning. Through peer interaction and knowledge exchange, students reinforce both theoretical concepts and practical skills through active participation increasing their motivation to learn [28]. The necessity of explaining and debating concepts improves communication abilities, as students must articulate their understanding clearly, adapt their explanation to different audiences and engage in constructive dialogue. Explaining and discussing concepts requires students to articulate ideas, adapt discourse and engage in dialogic learning [43, 44],which strengthens cognitive processing. These aspects add to the variety of different possibilities to expose their knowledge during the debriefing, make the expository phase of MAES© a fundamental opportunity to train effective teamwork which is fundamental in clinical settings [45, 46].

Additionally, preparing and presenting content fosters autonomy and creativity, requiring students to critically structure and convey their ideas. This autonomy in content delivery helps deeper cognitive engagement, as students take ownership of their learning process aligning with self-regulated learning and MAES© objective [47, 5]. In this sense, the results of the study regarding the promotion of autonomy in learning could be explained based on self-regulated learning theories [48] which explain that preparing and presenting content promotes independent organization, critical evaluation and active construction of knowledge. These findings support the role of the expository phase in promoting reflective and peer learning, both fundamental pillars of the MAES© model. Guided reflection enables students to internalize key concepts from simulation, identify learning gaps, and actively seek solutions. Furthermore, the process reinforces essential competencies such as the ability to search for, analyze, and apply scientific evidence, aligning with the principles of Evidence-Based Nursing [49, 50].

In response to the question about aspects to improve, a significant proportion of participants perceived the expository phase as effective and well-structured, requiring no modifications. This suggests that, for many students, the current methodology effectively facilitates learning. Despite this strong satisfaction rate, it coexists with several calls for improvement. This contrast underlines the importance of balancing established strengths with continuous refinement, ensuring that the methodology remains responsive to diverse student needs and learning preference.

Many participants emphasized the importance of diversifying presentation methodologies to reduce reliance on PowerPoint® and incorporating more dynamic and interactive elements. Based on our findings, many students stated to have tried different methods of exposition rather than Power Point presentations, finding them more positive to enhance students' interaction and knowledge retention. Active learning strategies like group discussion, case-based problem-solving and patient-oriented debriefing can deepen reflection and help critical thinking. Diversifying presentation styles with videos, infographics, and role playing can cater to various learning preferences. Integrating gamification through quizzes and challenges can help maintain engagement. Additionally, allowing students to create multimedia content, like podcasts, videos or social media content can enhance motivation and continuous improvement. This feedback reflects a broader pedagogical trend toward integrating innovative educational approaches, such as gamification and interactive technologies, to transform learning environments into more participatory and engaging spaces [51, 52].

These findings further underscore the need to reconsider the facilitator's role in MAES© debriefing. Rather than directing the session, facilitators should adopt a more flexible, supportive role, intervening primarily when students deviate from the prebriefing objectives. This adjustment enhances student agency, fostering a more collaborative and student-driven learning environment that aligns with contemporary trends in health education [53, 31]. These findings further underscore the need to reconsider the facilitator's role in MAES© debriefing. Rather than directing the session, facilitators should adopt a more flexible, supportive role, intervening primarily when students deviate from the prebriefing objectives. This adjustment enhances student agency, fostering a more collaborative and student-driven learning environment that aligns with contemporary trends in health education [53, 31].

This student-centered approach to debriefing aligns with broader research on peer-led learning, such as the study by He et al. [19], which highlights the effectiveness of structured peer debriefing in enhancing simulation performance and knowledge acquisition [26]. Similarly, Christiansen et al. [54] found that student-led debriefings resulted in reflection levels comparable to those in facilitator-led debriefings, reinforcing the idea that students can effectively lead their own reflective learning processes. However, their findings also suggest that the complexity of the simulated scenario plays a crucial role in the depth of reflection achieved. In contrast, MAES© emphasizes structured, student-led knowledge consolidation through the expository phase, ensuring that reflection is complemented by a deeper integration of evidence-based content. While Christiansen et al. focus on the equivalency of student-led and facilitator-led reflection [54], our study highlights how structured student presentations enhance engagement, autonomy, and the practical application of theoretical concepts.

Integrating the expository phase within MAES© debriefing presents a valuable opportunity for refining simulation-based education by fostering more dynamic, personalized, and student-centered learning experiences. However, several limitations must be considered. Achieving a seamless flow in debriefing depends on the ability of facilitators to create a dynamic and engaging learning environment, particularly during the prebriefing phase. Without skilled facilitators and motivated students, the effectiveness of the expository phase may be compromised. Additionally, variability in students' ability to search for and present learning objectives may impact the expected learning outcomes. Another critical aspect is the degree of creative freedom afforded to participants in choosing their presentation methods, as some students may engage more innovatively than others, influencing group perceptions and expectations.

Future research should investigate the adaptability of the expository phase across diverse educational contexts and assess when combined with different simulation methodologies. For example, studies could explore the implementation of the expository phase in interprofessional simulation to determine whether it enhances teamwork across disciplines. Additionally, emerging technologies, such as mixed reality [55], could further optimize this phase, enhancing both student participation and knowledge retention. Investigating the integration of mixed reality into the expository phase could also be a valuable research direction, exploring its impact on participants' perceptions and retention of knowledge. Finally, the expository phase could be analyzed in in-situ simulations, where researchers could investigate whether it improves the work dynamics, clinical teamwork, and non-clinical group cohesion among healthcare professionals participating in a simulation experience with a debriefing that includes this methodology.

Conclusions

This study indicates that participants highly value the expository phase of debriefing in the MAES© methodology. Students particularly emphasize its effectiveness in clarifying and consolidating concepts, integrate theory with practice, foster collaborative learning, and developing both technical and communication skills. Students appreciate the active role this phase plays in promoting autonomy and encouraging collaborative learning. By providing structured reflection and evidence-based presentations, the expository phase supports deeper understanding and enhances students' engagement with material.

Despite these strengths and the well-regarded expository phase, participants also identified areas for improvement, including the need for greater dynamism, interactivity, and personalization. There is a clear call for diversifying presentation methods to better offer various learning preferences and maintain engagement throughout the process. These suggestions point to the potential for evolving the MAES© methodology to further enhance its effectiveness and responsiveness to diverse students' needs.

In conclusion, these results suggest that the expository phase within MAES© debriefing is a valuable pedagogical tool in simulation-based learning. It enables students to integrate theoretical and practical knowledge effectively. Its structured yet flexible design may allow for broader application in other simulation based reflective analysis contexts or debriefing models, particularly in the health science field. It can happen especially in context where students assume a central role in presenting theoretical and practical insights related to a simulated scenario. By integrating structured reflection with evidence-based

presentations, it enables deeper concept consolidation and enhances student ownership of the learning process, making it a valuable and novel addition to debriefing literature. Addressing the identified areas for improvement can further strengthen its role in simulation, providing a more dynamic and inclusive learning environment. To achieve this, simulation educators and curriculum designers should consider training facilitators in student-led methods, such as encouraging active participation through peer teaching, adapting the pace and structure of the expository phase, incorporating brief reflection intervals and interactive elements to maintain energy and focus. These adjustments would not only address the call for greater dynamism but also create a more responsive and inclusive learning experience that better meets the needs of all students.

The expository phase in the MAES© debriefing model offers significant potential for enhancing student engagement and autonomy in simulation-based education. As technology, such as mixed reality, continues to evolve, this phase can be further refined to create more interactive and personalized learning experiences. Its adaptability positions it to play a key role in the future of simulation education, empowering students to take ownership of their learning.

Limitations

This study has several limitations. As with all qualitative research, external validity is inherently constrained, and the exclusive focus on students from a single institution may limit the generalizability of the findings. Future research should include broader, multicenter studies to compare and extend these results across diverse educational settings.

Additionally, the use of written questionnaires for data collection, while beneficial for obtaining a wide range of responses, may have restricted the depth and richness of the data compared to other qualitative techniques such as interviews or focus groups. Employing a combination of qualitative methods in future research could provide deeper insights into students' experiences and perceptions of the expository phase in simulation-based learning.

Supplementary Information

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Supplementary Material 1

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Author contributions
GF performed conceptualization, methodology, investigation, data curation, software, resources, and validation, writing-original draft, and visualization. CAJ performed conceptualization, methodology, investigation, data curation, writing review and editing, and visualization. PSCF performed methodology, investigation, data curation, writing review and editing, and visualization. GSL performed methodology, investigation, data curation, writing review and editing, and visualization. CLC performed methodology, formal analysis, data curation, writing review and editing, visualization and supervision. JLDA performed conceptualization, methodology, validation, formal analysis, writing-original draft, visualization and supervision. All authors approved the final version.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was performed in accordance with the Helsinki standard and was approved by the Ethics Committee from the Catholic University of Murcia (reference number CE052308). All participants were informed of the study's objectives and provided written consent before participation. Anonymity was preserved by Spanish data protection legislation. Participant responses are presented with alphanumeric codes (e.g., A1, A2, A3).

Consent for publication
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Competing interests
The authors declare no competing interests.

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VI – DISCUSIÓN

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El objetivo de este compendio de estudios fue valorar las nuevas aplicaciones de la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en contextos clínico-formativos. Asimismo, se investigó el debriefing con fase expositiva, realizando un análisis comparativo de este modelo con el convencional, evaluando su aceptación en Ciencias de la Salud.

En la actualidad, el aprendizaje basado en simulación se ha consolidado como una estrategia formativa clave en Ciencias de la Salud (Le, 2023). El carácter práctico de SBL permite transmitir contenidos de forma más activa, experiencial y reflexiva (Ageel, 2024). En este contexto, la fase de debriefing asume un rol fundamental en el proceso formativo. El debriefing es un espacio esencial para la reflexión crítica, la integración de experiencias y la consolidación del aprendizaje. Su correcta implementación permite identificar fortalezas y áreas de mejora. La simulación clínica, con un debriefing efectivo, contribuye a preparar profesionales capaces de afrontar escenarios clínicos complejos donde se requieren conocimientos técnicos y no técnicos, alineando la formación en Ciencias de la Salud con la práctica profesional real(Lee et al., 2020).

En este contexto, se desarrolla MAES©. Esta metodología de aprendizaje con simulación se apoya en múltiples enfoques formativos y está aceptada y validada según los estándares INACLS (Díaz et al., 2016). Como SBL, esta metodología permite un aprendizaje basado en problemas, reflexivo y experiencial. Al mismo tiempo, MAES© amplía sus fundamentos pedagógicos incluyendo el aprendizaje entre pares, el aprendizaje colaborativo y el aprendizaje autónomo (Diaz Agea et al., 2014). Esta integración, no solo enriquece las experiencias de aprendizaje con respecto al *Simulation Based Learning*, sino que también responde de forma más coherente a las demandas actuales de la educación en Ciencias de la Salud, concediendo al estudiante un papel activo dentro del proceso formativo (Cangás et al., 2024).

Con la estructura metodológica de MAES© se promueve un rol de protagonista de los estudiantes que participan activamente en todas las fases. Son ellos quienes identifican las necesidades formativas, construyen y diseñan el caso

clínico y realizan la reflexión estructurada en el debriefing (Díaz Agea, Megías Nicolás, et al., 2019). Este enfoque permite a los estudiantes ser generadores de conocimientos, lo cual fortalece el desarrollo de la autonomía y de la responsabilidad individual. A su vez, el aprendizaje entre pares y el factor grupal garantizado por el trabajo en equipo, estimula la construcción conjunta del conocimiento (García-Méndez et al., 2022). El cambio metodológico aportado por MAES© también repercute en la motivación del estudiante. Al ofrecer una participación activa en la toma de decisiones y en la reflexión, MAES© favorece una transición de la motivación extrínseca (basada en la aprobación del docente o en la evaluación) hacia una intrínseca. Esta transformación permite un mayor interés personal, curiosidad y autorrealización. Con MAES© se ven afectados positivamente el pensamiento crítico y la comunicación efectiva, elementos fundamentales para el ejercicio del profesional sanitario (Díaz-Agea et al., 2021). Considerando el aporte metodológico de MAES©, los resultados de nuestro estudio confirman que supera las limitaciones del modelo más tradicional SBL. MAES© ofrece un enfoque más holístico, participativo y centrado en el estudiante. La metodología de Autoaprendizaje en Entornos Simulados se propone como una herramienta clave y alternativa válida en el cambio formativo actual en Ciencias de la Salud.

Al igual que en SBL, la metodología MAES© se caracteriza por su polivalencia. MAES© permite adaptarse a diferentes contextos formativos y niveles de complejidad. Esta flexibilidad se ha demostrado en varios estudios anteriores que han implementado la metodología en entornos académicos y con estudiantes de diferentes niveles (posgrado y grado) (Arizo-Luque et al., 2022; Díaz-Agea, Ayensa-Arano, et al., 2022; Díaz-Agea et al., 2021). No obstante, MAES© tiene algunas limitaciones todavía inexploradas con respecto a SBL. Una de estas limitaciones es el análisis de su aplicabilidad en entornos clínicos con profesionales. Estudios han demostrado que la formación con simulación es fundamental tanto en contextos universitarios como clínicos (E. Kim et al., 2023; Le, 2023). En este último caso la metodología que más resulta beneficiosa es el aprendizaje con simulación *In-Situ*. Realizar escenarios simulados *In-Situ* permite entrenar en el entorno real de trabajo identificando riesgos latentes, mejorando la familiarización con recursos y fortaleciendo el trabajo en equipo (Bai et al., 2023). Quien más se beneficia de esta metodología es el personal recién contratado debido a que no solo

mejora su conocimiento, sino que también aprovecha de los escenarios para la primera toma de contacto con un escenario nuevo. También es posible el entrenamiento de habilidades específicas del nuevo servicio (Schram et al., 2022). Nuestro estudio se encarga de ampliar la investigación sobre MAES© a estos ámbitos todavía inexplorados. Los resultados que se han obtenido reafirman la polivalencia de MAES© que, acorde con la literatura, ofrece su enfoque para la formación continuada en entornos clínicos con particular atención para el personal recién contratado. Además, gracias a sus fundamentos pedagógicos de aprendizaje colaborativo, permite investigar previamente las necesidades de aprendizaje de las nuevas incorporaciones para delinear una formación más productiva y centrada en el estudiante. Finalmente, la libertad en la elección de los escenarios aumenta la motivación y la implicación del personal sanitario que se forma con MAES©. Este aspecto garantiza una mayor entrega en el trabajo y una mejor preparación, favoreciendo la seguridad del paciente y la calidad asistencial.

Hasta el momento, la metodología MAES© ha sido investigada principalmente en el ámbito de simulación interprofesional con profesionales o estudiantes de posgrado. Sin embargo, existe aún una insuficiente evidencia sobre MAES© interprofesional aplicada en el área de grados universitarios de Ciencias de la Salud. En la literatura existente se encuentran diferentes estudios que confirman la eficacia de la educación interprofesional con simulación (EIP-S) en el grado, demostrando múltiples beneficios. Este enfoque permite comprender mejor los roles y responsabilidades de otras profesiones, mejorar la comunicación, el respeto mutuo y la toma de decisiones. Además, prepara a los futuros profesionales para enfrentarse a un entorno clínico real de manera colaborativa (Krielen et al., 2023; Parnell et al., 2024). En la aplicación de la EIP-S los escenarios complejos han sido reconocidos como lo más adecuados para fomentar el desarrollo de competencias interprofesionales. La necesidad de coordinación, liderazgo, priorización y respuesta efectiva que se puede encontrar en escenarios de RCP y CRM, ha permitido destacar estos temas como oportunos para el desarrollo de competencias interprofesionales (Alegret et al., 2023; Friedlaender et al., 2025).

En esta Tesis se ha abordado la carencia de aplicación de MAES© en contexto de formación interprofesional en grado (medicina y enfermería). Además, se ha ofrecido a los estudiantes la elección de temas centrados en escenarios de alta complejidad (RCP y CRM) de acuerdo con la literatura. Los resultados de nuestro

estudio han evidenciado que el método MAES©, al fomentar el aprendizaje colaborativo y la construcción de conocimiento grupal, favorece una relación más cercana entre compañeros. Si se aplica a escenarios interprofesionales, se contribuye a una mejor comprensión del rol y trabajo del compañero. Esto permite promover un aprendizaje más significativo, contribuyendo, además, a la humanización del rol sanitario y del cuidado. Todos estos aspectos hacen de este modelo una propuesta aún más enriquecedora que el modelo tradicional de SBL. Validando MAES© también en un contexto interprofesional de grado, la polivalencia de esta metodología aumenta.

La investigación sobre MAES© interprofesional con escenarios clínicos complejos, no solo permite avanzar en la validación de la metodología y sus aplicaciones prácticas, ofrece también la posibilidad de analizar las habilidades trabajadas durante casos de RCP y CRM y verificar la adaptación de esta metodología para el entrenamiento de competencias específicas en profesionales. Los escenarios de RCP y CRM son ampliamente reconocidos por su valor en el desarrollo de habilidades técnicas (maniobras de soporte vital básico y avanzado, manejo de dispositivos, administración de fármacos etc.) y no técnicas (liderazgo, comunicación, toma de decisiones, trabajo en equipo etc.) (Ougli et al., 2024). Estas competencias requieren conocimientos específicos de protocolos, rapidez y precisión. Por ejemplo, en un caso de RCP, el liderazgo y la asignación de roles son determinantes como la calidad de las compresiones torácicas o la administración de adrenalina (Wittig et al., 2024). De la misma forma, en casos de CRM, la capacidad de priorizar acciones, coordinar el equipo y mantener una comunicación efectiva puede marcar la diferencia entre una respuesta efectiva o mejorable (Saeed et al., 2024).

En los últimos años, sociedades científicas internacionales demandan nuevas metodologías educativas para el entrenamiento con RCP. La *European Resuscitation Council* (ERC), *American Heart Association* (AHA) e *International Liaison Committee on Resuscitation* (ILCOR), han subrayado la necesidad de transformar los modelos pedagógicos de la formación en RCP (Greif et al., 2021; Panchal et al., 2020; Wyckoff et al., 2022). Los últimos estándares de estas sociedades recomiendan la búsqueda de métodos alternativos a los enfoques que han tenidos los cursos de capacitación hasta el momento. Se recomienda buscar una alternativa a los talleres teórico-prácticos y al método tradicional de enseñanza con simulación (SBL)

exclusivamente dirigida por instructores (Maestre et al., 2024). En esta línea, los resultados de nuestro trabajo aportan evidencia de como MAES© es altamente válida para su aplicación en escenarios complejos como RCP y CRM. En este sentido, se confirma que MAES© podría ser una alternativa válida al método tradicional de entrenamiento en los cursos de capacitación de RCP, de acuerdo con los estándares de las sociedades científicas.

Como se ha mencionado en el anterior párrafo, los escenarios de RCP y CRM representan una óptima posibilidad de entrenamiento tanto de las habilidades técnicas como de las no técnicas. Además, han sido fundamentales para validar MAES© en contextos interprofesionales. Sin embargo, es importante destacar que estas competencias no son exclusivas de estos escenarios. La práctica clínica exige en todo momento la integración de competencias técnicas (procedimientos invasivos, administración de medicamentos etc.) junto con habilidades no técnicas. Las primeras son indispensables para garantizar la calidad del acto asistencial, mientras que las segundas influyen directamente en la seguridad del paciente y eficacia del trabajo (Leal-Costa et al., 2023). La literatura ha demostrado que los errores en el ámbito sanitario, muchas veces no se deben a fallos técnicos, sino que están ocasionados por deficiencias en el manejo de aspectos no técnicos (Sánchez-Marco et al., 2023). Comprobar que MAES© permite entrenar eficazmente ambas dimensiones resulta clave para la consolidación de esta metodología.

La simulación clínica permite replicar escenarios realistas en un entorno seguro, donde los estudiantes pueden poner a prueba sus competencias, reflexionar y prepararse para la práctica clínica sin poner en riesgo al paciente. En este sentido, existen estudios que certifican cómo MAES© aporta valor añadido, integrando aprendizaje autónomo, colaborativo y entre pares, fomentando así la participación. Todo ello facilita una continua retroalimentación de habilidades técnicas y no técnicas entre pares, tanto en el escenario simulado, como también en todo su proceso y desarrollo (desde el prebriefing hasta el debriefing) con la ayuda del facilitador (Rodríguez-Herrera et al., 2023). Gracias a la presente Tesis, se ha podido ampliar esta evidencia aplicando la metodología en áreas poco exploradas. En primer lugar, el entorno clínico real con profesionales sanitarios recién incorporados, y en segundo lugar en el grado con formación interprofesional entre estudiantes de medicina y enfermería. Este aporte refuerza MAES© como metodología robusta para el entrenamiento integral en Ciencias de la Salud.

Además, a diferencia de SBL, garantiza un aprendizaje continuo en todo su proceso, sin limitarlo al escenario y debriefing.

Uno de los aportes más novedosos y diferenciadores de la metodología MAES© es la inclusión de la fase expositiva dentro del debriefing estructurado (Díaz et al., 2016). Esta fase, ubicada después del análisis del escenario (fase analítica) y antes del cierre, permite a los estudiantes presentar la evidencia científica que respalda su caso diseñado. Además, también se les permite responder a los objetivos de aprendizaje planteados previamente en el prebriefing (Díaz Agea, Megías Nicolás, et al., 2019). A pesar de su valor pedagógico, esta fase sigue siendo escasamente investigada, con pocas referencias en literatura que describan detenidamente los fundamentos teóricos y su estructura. Esta deficiencia limita su comprensión y correcta implementación.

Los modelos de debriefing estructurados más conocidos (GAS y PEARLS) han demostrado ser herramientas eficaces para guiar la reflexión (Eppich & Cheng, 2015; Phrampus & O'Donnell, 2013). Sin embargo, ambos modelos tienen una estructura centrada en el instructor, que no se adapta completamente a los fundamentos pedagógicos de MAES© (Lee et al., 2020). En contraste, la fase expositiva de MAES© ofrece posicionar el estudiante como protagonista activo, aumentando la consolidación de sus conocimientos. En la fase expositiva se reflexiona sobre los objetivos de aprendizaje del caso clínico y además, también se expone el fundamento científico y se motivan las decisiones tomadas en el diseño del caso clínico (Díaz-Agea et al., 2017).

Los resultados de nuestra Tesis han permitido describir con mayor profundidad esta fase expositiva, dotándola de un marco teórico y pedagógico que respalda su implementación. Entre las características, destacan la integración explícita del conocimiento científico, la capacidad de argumentar decisiones clínicas y la conexión directa de práctica y teoría. Asimismo, hemos explorado la percepción de los estudiantes contando con aspectos positivos y posibles mejorías. La autonomía, el desarrollo del pensamiento crítico, la mejora de la motivación intrínseca y la libertad de elección de los recursos, son todos aspectos evidenciados por los participantes y que se alinean con los fundamentos pedagógicos de la metodología MAES©, confirmando los fuertes fundamentos de la nueva fase expositiva. Estos hallazgos no solo consolidan la fase expositiva como una contribución original y valiosa de MAES©, ampliando y enriqueciendo los modelos

tradicionales de debriefing, sino que también certifican una amplia aceptación por parte de quién la utiliza.

Los hallazgos obtenidos durante nuestra investigación confirman la polivalencia de la metodología MAES© como herramienta formativa innovadora en Ciencias de la Salud. Su aplicación y validez científica y pedagógica se ha demostrado en contextos interprofesionales en el grado de medicina y enfermería, además de en entornos clínicos reales internacionales, ampliando las posibilidades de su implicación. MAES© se ha demostrado en todos los estudios como una válida herramienta para entrenar tanto habilidades técnicas como no técnicas, promoviendo un aprendizaje autónomo, colaborativo y centrado en el estudiante. Finalmente, la inclusión de la fase expositiva en el debriefing amplía las posibilidades pedagógicas de la simulación clínica. Todos los resultados refuerzan el potencial de MAES© en educación sanitaria, confirmando esta metodología como una válida alternativa a SBL, más alineada con las demandas actuales formativas.

VII – CONCLUSIONES

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1. The comparison between MAES© and SBL reveals significant differences in terms of student protagonism, learning autonomy and motivation. While SBL mainly focuses on problem-based and reflective learning, MAES© incorporates collaborative, peer-to-peer and autonomous learning. The coexistence of different learning methods in MAES© make this methodology a more active and participatory way of learning. It is also important to notice that SBL follows a traditional approach with the instructor assuming a directive role, whereas MAES© gives protagonism to the students incorporating the figure of the facilitator. The implementation of MAES© in clinical settings with newly hired professionals proves to be useful and well accepted, confirming the versatility of the methodology.
2. The application of MAES© in undergraduate interprofessional settings shows a remarkable capacity to promote co-learning and mutual respect. The design f scenarios not only support clinical competences but also help the humanization of care and deep understanding of the role and value of the other professional. IPE with MAES© strengthens interprofessional relationships, improves communication and help to have a more comprehensive understanding of teamwork
3. The implementation of MAES© in complex scenarios such as Cardiopulmonary Resuscitation (CPR) and Crisis Resource Management (CRM) validates its effectiveness for the simultaneous training of both technical and non-technical skills. This also position MAES© as a valid alternative to the traditional CRP training methodologies, answering to the current demands for more active and student-centred methods. Furthermore, these aspects support the use of MAES© in complex scenarios.

4. Undergraduate and Postgraduate students have accepted and welcomed the expository phase of the structured debriefing introduced in the MAES© methodology. Students positively value this phase because it allows the integration of scientific evidence and reflective learning of the objectives set at the beginning of their sessions. Expository phase promotes critical thinking, knowledge ownership and active participation in a safe environment. The Doctoral Thesis offers a clear theoretical and pedagogical description of the expository phase, consolidating the innovative value of MAES© in simulation and debriefing process.

VIII - LIMITACIONES Y FUTURAS LÍNEAS DE INVESTIGACIÓN

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8.1. LIMITACIONES

8.1.1. Limitaciones comunes

Aunque la naturaleza internacional de la investigación y la experiencia del equipo garantizaron la ausencia de conflictos de interés, es importante mencionar que dos de los autores de los estudios estuvieron directamente involucrados en la creación del método MAES©.

La metodología cualitativa se centra en las opiniones y percepciones de los participantes, por lo tanto, es más difícil generalizar los resultados a otros contextos diferentes de los estudiados. Sin embargo, al haber realizado distintos estudios en más de un entorno (varias universidades y entornos clínicos) sin observar diferencias de opiniones entre participantes, se puede afirmar que esta circunstancia refuerza la validez del estudio.

8.1.2. Limitaciones especificas estudio Nº1

La limitación más evidente del estudio fue la dificultad para organizar el espacio y los recursos debido al inicio de la Pandemia. El estudio coincidió con el comienzo de los contagios por COVID-19 en el Reino Unido y la implementación de medidas laborales sin precedentes.

Otra limitación fue el reducido número de participantes, lo que limitó la validez externa del estudio. No obstante, los resultados pueden ser útiles como estudio piloto. El carácter cualitativo del estudio puede servir de base para investigaciones futuras.

8.1.3. Limitaciones especificas estudio Nº2

Este estudio hace referencia a una experiencia breve con un grupo pequeño de estudiantes (13). El tamaño del grupo y la ausencia de participación de diferentes universidades en esta experiencia pueden afectar a los resultados. No

obstante, el carácter interprofesional del estudio permite garantizar la variedad de opiniones y percepciones, reforzando la metodología.

8.1.4. Limitaciones especificas estudio Nº3

La validez interna del estudio está asegurada, ya que se han seguido todos los pasos recomendados para la realización de un estudio cualitativo. Sin embargo, los resultados no pueden generalizarse a otros contextos más allá de la propria investigación. Al haberse realizado el estudio en más de una universidad y no haberse observado diferencias de opinión entre los participantes, esta circunstancia refuerza la validez del mismo estudio. Para consolidar los resultados preliminares de este estudio, sería necesario aumentar el número de participantes y experiencias relacionadas con la RCP mediante la metodología interprofesional MAES ©.

8.1.5. Limitaciones especificas estudio Nº4

Investigaciones futuras deberían incluir estudios más amplios y multicéntricos para comparar y ampliar estos resultados en campos educativos diversos. Además, el uso d cuestionarios escritos para la recolección de datos, si bien resulta útil para obtener una amplia gama de respuestas, puede haber limitado la profundidad y riqueza de los datos en comparación con otras técnicas cualitativas. La utilización de una combinación de métodos cualitativos en futuras investigaciones podría ofrecer una comprensión más profunda de las experiencias y percepciones de los estudiantes sobre la fase expositiva en el aprendizaje basado en la simulación.

8.2. FUTURAS LÍNEAS DE INVESTIGACIÓN

Es importante, antes de proponer nuevas líneas de investigación con la metodología MAES© y el debriefing expositivo, recordar cómo se podrían ampliar y fortalecer los estudios realizados en esta Tesis. Ampliar el número de participantes y realizar estudios multicéntricos son dos propuestas que se tienen que considerar en un futuro para mejorar la validez externa y la generalización de los resultados.

En cuanto a las futuras líneas de investigación directamente conexas con nuestro estudio de Tesis, resulta imprescindible realizar más estudios sobre la validez de la fase expositiva del debriefing MAES©, un aspecto poco explorado hasta la fecha. Se puede profundizar la percepción de esta fase no solo en estudiantes, también en los profesionales y facilitadores. Además, es necesario analizar más detenidamente el rol de los pacientes o expertos que participan en esta fase, para garantizar una estructura a su participación y validar su aporte a nivel metodológico, maximizando la dinámica educativa.

Otra posible línea de investigación directamente relacionada con nuestro estudio es la aplicación de MAES© en contextos clínicos reales. Es necesario explorar su utilidad no solo con personal recién contratado, sino también en profesionales con experiencia, aprovechando la posibilidad de entrenar en equipos interprofesionales y con simulación *In-Situ*. Este enfoque permitiría evaluar su impacto en entornos laborales reales y en situación de alta fidelidad, donde la coordinación y la comunicación son fundamentales.

Siguiendo la evolución tecnológica de los últimos años, resulta de mayor importancia seguir adaptando la metodología MAES© a las nuevas tecnologías, explorando su integración con herramientas emergentes como la realidad mixta. Su aplicación durante la simulación o en la fase expositiva, podría enriquecer la experiencia inmersiva del aprendizaje y sería fundamental su estudio. Asimismo, la inteligencia artificial representa una oportunidad para innovar tanto el diseño de escenarios personalizados como el desarrollo de contenido expositivo, lo cual podría optimizar el tiempo y la precisión del proceso formativo. De acuerdo con la metodología MAES©, resulta importante que los alumnos se queden al centro de su aprendizaje, por lo tanto, es importante estudiar la posible aplicación de estas nuevas tecnologías de manera reglada, funcional y sin abuso.

Por último, se requiere mayor investigación sobre el valor del factor grupal y dinámicas de grupo. En una sociedad cada día más dependiente de la tecnología, es fundamental analizar cómo el grupo y sus dinámicas pueden afectar la educación y las prácticas clínicas. En Ciencias de la Salud y, más concretamente, los profesionales sanitarios, tienen como centro de su labor al paciente. La relación entre sanitarios y pacientes debe tener una base en la empatía y colaboración, ambos aspectos son claves de la metodología MAES©. Por esta razón, la

metodología MAES© puede ser un vector importante en generar evidencia sobre cómo el grupo influye en el trabajo sanitario.

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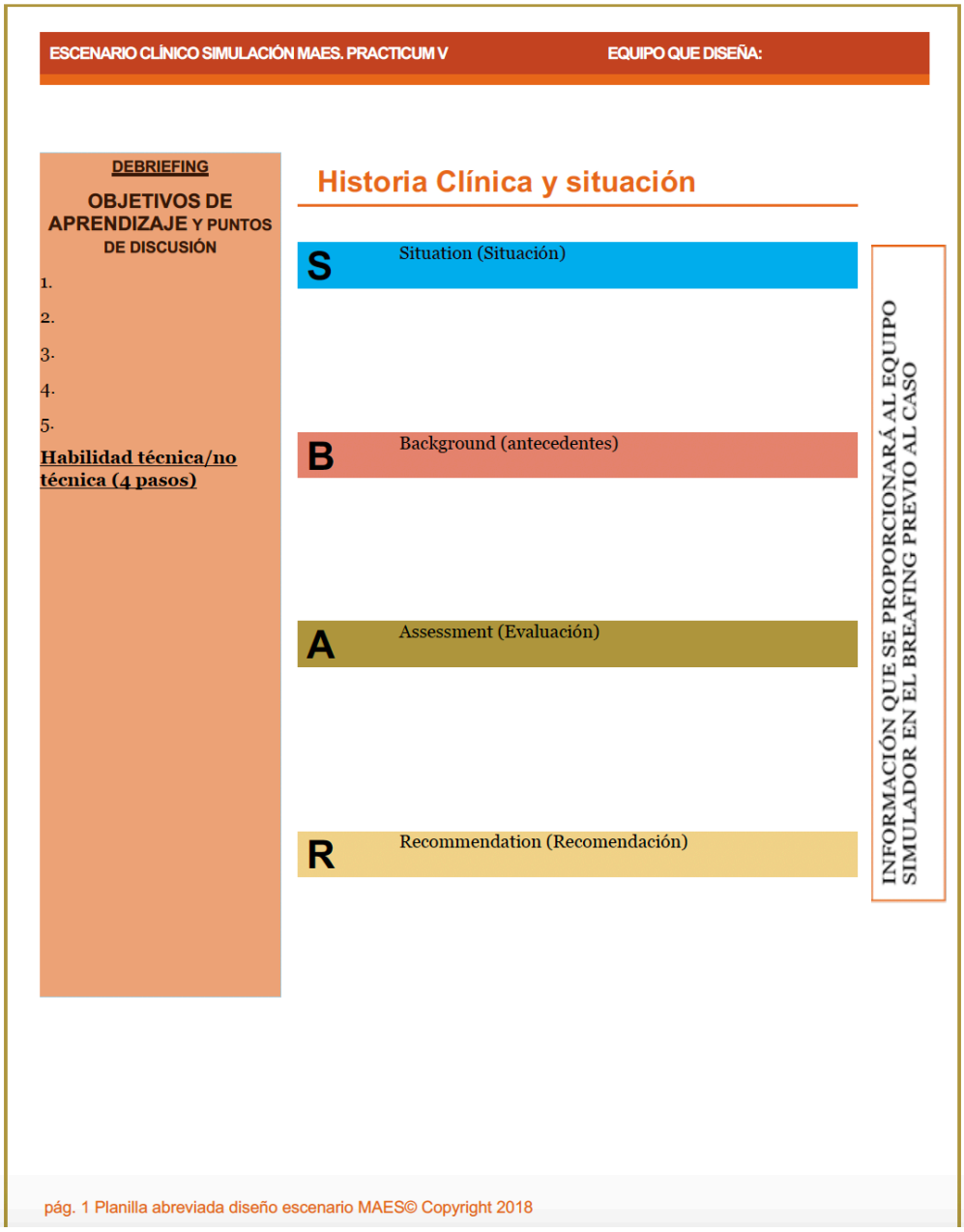
X – ANEXOS

X - ANEXOS

Anexo 1 Diseño de caso MAES©



ESCENARIO CLÍNICO SIMULACIÓN MAES. PRACTICUM V EQUIPO QUE DISEÑA:

Curso Clínico

Evolución secuencial de los eventos del escenario clínico (Guión pormenorizado)

1) …

Recursos*

*enviar correo con esta información a vmruiz@ucam.edu (técnico)

Tipo de simulador: Maniquí/Actores.
Instrucciones para el actor/es
Necesidades de caracterización

Material necesario

ESCENARIO CLÍNICO SIMULACIÓN MAES. PRACTICUM V **EQUIPO QUE DISEÑA:**

Intervenciones

Descripción de las intervenciones y actividades que se espera que el alumno/s realicen en el escenario clínico simulado.

INTERVENCIÓN 1		
	Si	No
Actividad 1		
Actividad 2		
Actividad 3		
Actividad 4		
Actividad 5		
INTERVENCIÓN 2		
	Si	No
Actividad 1		
Actividad 2		
Actividad 3		
Actividad 4		
Actividad 5		

Evidencia científica

Temática	Fuente documental: Artículo científico/Guía clínica/manual

ESCENARIO CLÍNICO SIMULACIÓN MAES. PRACTICUM V **EQUIPO QUE DISEÑA:**

BREVE INFORMACIÓN TEÓRICA SOBRE OBJETIVOS DE APRENDIZAJE

Pegar aquí la información teórica sobre las cuestiones escogidas como objetivos de aprendizaje, (patología, el tratamiento, los cuidados y las técnicas puestas en práctica sobre nuestro paciente).
La extensión debe ser breve y se permite la inclusión de texto y fotografías de revistas, libros, apuntes, internet, etc. de manera estructurada y de fuentes fiables.

OBJETIVO 1:

OBJETIVO 2:

....

Anexo 2 Permiso RD&E Hospital

Royal Devon and Exeter NHS
NHS Foundation Trust

Royal Devon and Exeter
Hospital (Wonford)
Barrack Road
Exeter
EX2 5DW
Tel: 01392 411611
Emergency Department

17 March 2020

Dear Giulio

I am writing to acknowledge the department is aware and allow you to perform a scientific investigation in the period from 23/03/2020 to 31/03/2020.

The investigation is done for your Masters Degree at the Catholic University of Murcia (UCAM) and it will be incorporated in the Induction period of the newly employed nurses with the following themes and dates:

Course Name	Venue	Date	Hours
Induction Period – MAES© (Self Learning Methodology in Simulated Enviroment): Session 1 (group identification and scenarios choice)	RD&E NHS Trust ED	23/03/2020	4
Induction Period – MAES© (Self Learning Methodology in Simulated Enviroment): Session 2 (simulation)	RD&E NHS Trust ED	31/03/2020	4

On the day, you must notify your presence to the Matron or Nurse in Charge and complete the attendance list of the participants for our training records to be updated. Please also bring your Trust ID badge with you, or if you are not employed by the NHS, another form of photograph identification. Please bring a proof your University is also aware of the investigation.

Please note that we cannot accept any responsibility for valuables brought with you to training events.

Yours sincerely

Emergency Department

Anexo 3 Comité de Ética CE: 012107

UCAM
UNIVERSIDAD CATÓLICA SAN ANTONIO

COMITÉ DE ÉTICA DE LA UCAM

Universidad Católica San Antonio. Vicerrectorado de Investigación. Salida nº 7781 01/02/2021 17:56:51

DATOS DEL PROYECTO

Título:	"Análisis de la percepción, adquisición de competencias y aspectos cognitivos y educativos relacionados con diferentes metodologías activas de simulación clínica en profesionales y alumnos de grado en ciencias de la salud"	
Investigador Principal	**Nombre**	**Correo-e**
Dr.	José Luis Díaz Agea	jluis@ucam.edu

INFORME DEL COMITÉ

Fecha	**29/01/2021**	**Código**	**CE012107**

Tipo de Experimentación

Investigación experimental clínica con seres humanos	
Investigación experimental no clínica con seres humanos	
Utilización de tejidos humanos procedentes de pacientes, personas sanas, tejidos embrionarios o fetales	
Utilización de tejidos humanos, tejidos embrionarios o fetales procedentes de bancos de muestras o tejidos	
Investigación observacional, psicológica o comportamental en humanos	**X**
Uso de datos personales	**X**
Experimentación animal	
Utilización de agentes biológicos de riesgo para la salud humana, animal o las plantas	
Uso de organismos modificados genéticamente (OMGs)	

Comentarios Respecto al Tipo de Experimentación
Nada Obsta

Comentarios Respecto a la Metodología de Experimentación
Nada Obsta

UNIVERSIDAD CATÓLICA SAN ANTONIO • COMITÉ DE ÉTICA •

UCAM
UNIVERSIDAD CATÓLICA SAN ANTONIO

COMITÉ DE ÉTICA DE LA UCAM

Sugerencias al Investigador

A la vista de la solicitud de informe adjunto por el Investigador y de las recomendaciones anteriormente expuestas el dictamen del Comité es:

Emitir Informe Favorable	**X**
Emitir Informe Desfavorable	
Emitir Informe Favorable condicionado a Subsanación	

MOTIVACIÓN
Incrementará conocimientos en su área

Vº Bº El Presidente,

Fdo.: José Alberto Cánovas Sánchez

El Secretario,

UNIVERSIDAD CATÓLICA SAN ANTONIO · COMITÉ DE ÉTICA ·

Fdo.: José Alarcón Teruel

Anexo 4 Consentimiento Informado RD&E

Universidad Católica S. Antonio de Murcia (UCAM)
Master in Emergency Medicine
Campus de los Jerónimos, Guadalupe
Murcia - España - 30107
Tel: +34968278800
info@ucam.edu

Date: _____

Dear RD&E ED colleague _____

My name is Giulio Fenzi, a nurse since 2014 and an Emergency Medicine Masters Degree student at the Catholic University of Murcia (UCAM). I am carrying out a scientific investigation about a method of simulation called Self Learning Methodology in Simulated Environment (MAES©) and its use within a clinical area. During this investigation I am representing my University institution.

To achieve the best from this project, I need your help. Your participation in the investigation has been agreed with your manager and is part of your induction period, however, not mandatory. Please feel free to opt out if you do not want to take part in it.

During the study you will be asked to attend two sessions, taking place at the RD&E Emergency Department during the period of the 23rd and 31st March 2020 with the following themes and dates:

Course Name	Venue	Date	Hours
Induction Period – MAES© (Self Learning Methodology in Simulated Environment): Session 1 (group identification and scenarios choice)	RD&E NHS Trust ED	23/03/2020	4
Induction Period – MAES© (Self Learning Methodology in Simulated Environment): Session 2 (simulation)	RD&E NHS Trust ED	31/03/2020	4

During these two sessions we will work as a team. I will briefly explain what MAES© is and the whole group will be divided in smaller working-groups. You will choose some themes to work on and some scenarios will be planned. During the second session there will be clinical simulations (which will be video-recorded) and a debriefing will follow. It will be requesting some work at home.

The session will end with a focal-group to analyse strengths and weaknesses of the study (this will be audio-recorded). The audio and video records will be done for the analysis of the results of the study. They will be completely confidential and not published.

There will not be an evaluation of your practice during the whole study; you will always be in a protected environment where mistakes are good for learning.

If you agree with the plan of the study and all the conditions, please sign this paper below.

Signature: _____

Anexo 5 Consentimiento Informado CRM

Universidad Católica S. Antonio de Murcia (UCAM)
Campus de los Jerónimos, Guadalupe
Murcia - España - 30107
Tel: +34968278800
info@ucam.edu

Mi nombre es Giulio Fenzi y soy profesor de enfermería en la Universidad Católica de Murcia. Estoy realizando una investigación sobre la utilización de la metodología MAES© (Metodología de Autoaprendizaje en Entornos Simulados) en las simulaciones interprofesionales con estudiantes de grado de Enfermería y Medicina.

La investigación se realizará en 3 sesiones por un total de 12 horas presenciales en la Universidad Católica de Valencia.

En estas sesiones se realizarán grabaciones audio-video para realizar análisis de los resultados del estudio. Todos los materiales audio y video serán confidenciales y no serán publicados. En el estudio no se evaluará tu preparación académica y se garantizará en todos momentos un entorno seguro para el aprendizaje.

Si estas de acuerdo con la investigación, con la grabación de material audiovisual y con tu participación en ella, te ruego que firme este consentimiento.

D/Dª_____, Mayor de edad, con DNI nº_____ y mail_____ por medio de la presente, y conforme a lo previsto en el articulo 2.2 de la ley organica 1/1982, de 5 de mayo, reguladora del derecho al honor, la intimidad personal, familiar y la propia imagen.

AUTORIZA

Giulio Fenzi y a la Fundación Universitaria San Antonio, con C.I.F. G-30.626.303, para la captación de la imagines videograficas que reproducen su propia imagen en cualquier suporte de forma gratuita, con motivo de su participación en la investigación de la metodología MAES en simulaciones interprofesionales en las ubicaciones de la Universidad Católica de Valencia, con fines exclusivamente docentes e investigadoras. La fundación se compromete a no ceder imagen a terceros usándola en contextos que no perjudiquen la dignidad personal del autorizante. A su vez el alumno se compromete a no divulgar la imagen propia ni de sus compañeros a través de ningún medio audiovisual ni impreso.

Puesto que la cesión de uso se produce de forma gratuita, este consentimiento expreso será revocable en cualquier momento, siempre que no cause daños y perjuicios al titular de los derechos que usted cede.

Se le informa además que los datos facilitados en este documento se tratarán con las medidas oportunas para asegurar el tratamiento confidencial de todos sus datos y la ubicación de sus derechos de imagen dentro de los limites de la Ley Orgánica 15/1999, de 13 diciembre de Protección de Datos de Carácter Personal.

En_____, a_____de_____2022

Firma: _____

Anexo 6 Consentimiento Informado RCP

UCAM
UNIVERSIDAD CATÓLICA SAN ANTONIO

ANEXO II

CONSENTIMIENTO INFORMADO

Yo, ..., con DNI:.....

DECLARO:

Haber sido informado/a del estudio y procedimientos de la investigación del Proyecto titulado: **"Implementación de la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en nuevos contextos de aprendizaje. Análisis de su aplicabilidad con equipos interdisciplinares y entornos clínicos | reales".**

Los investigadores que van a acceder a mis datos personales y a los resultados de las pruebas son: **Dr. D. José Luis Díaz Agea y D. Giulio Fenzi.**

Asimismo, he podido hacer preguntas del estudio, comprendiendo que me presto de forma voluntaria al mismo y que en cualquier momento puedo abandonarlo sin que me suponga perjuicio de ningún tipo.

CONSIENTO:

1.-) Someterme a las siguientes pruebas: **Encuestas y Sesión Grupo Focal.**

2.-) El uso de los datos obtenidos según lo indicado en el párrafo siguiente:
En cumplimiento del Reglamento (UE) 2016/679 del Parlamento Europeo y del Consejo, de 27 de abril de 2016 y Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y Garantía de los Derechos Digitales, le comunicamos que la información que ha facilitado y la obtenida como consecuencia de las pruebas a las que se va a someter pasará a formar parte del fichero automatizado INVESALUD, cuyo titular es la FUNDACIÓN UNIVERSITARIA SAN ANTONIO, con la finalidad de INVESTIGACIÓN Y DOCENCIA EN LAS ÁREAS DE CONOCIMIENTO CIENCIAS EXPERIMENTALES Y CIENCIAS DE LA SALUD. Tiene derecho a acceder a esta información y cancelarla o rectificarla, dirigiéndose al domicilio de la entidad, en Avda. de los Jerónimos de Guadalupe 30107 (Murcia). Esta entidad le garantiza la adopción de las medidas oportunas para asegurar el tratamiento confidencial de dichos datos.

En…… a…….de…….de 202…

El / La participante, El / La investigador/a,

Fdo:_____ Fdo:_____

Anexo 7 Comité de Ética CE: 052308

UCAM
UNIVERSIDAD CATÓLICA SAN ANTONIO

COMITÉ DE ÉTICA DE LA UCAM

Universidad Católica San Antonio. Vicerrectorado de Investigación. Salida nº 8287 29/05/2023

DATOS DEL PROYECTO

Título:	"Implementación de la Metodología de Autoaprendizaje en Entornos Simulados (MAES©) en nuevos contextos de aprendizaje. Análisis de su aplicabilidad con equipos interdisciplinares y entornos clínicos reales"	
Investigador Principal	**Nombre**	**Correo-e**
Dr.	José Luis Díaz Agea	jluis@ucam.edu

INFORME DEL COMITÉ

Fecha	**26/05/2023**	**Código**	**CE052308**

Tipo de Experimentación

Investigación experimental clínica con seres humanos	
Investigación experimental no clínica con seres humanos	
Utilización de tejidos humanos procedentes de pacientes, personas sanas, tejidos embrionarios o fetales	
Utilización de tejidos humanos, tejidos embrionarios o fetales procedentes de bancos de muestras o tejidos	
Investigación observacional, psicológica o comportamental en humanos	X
Uso de datos personales, información genética, etc.	X
Experimentación animal	
Utilización de agentes biológicos de riesgo para la salud humana, animal o las plantas	
Uso de organismos modificados genéticamente (OMGs)	

Comentarios Respecto al Tipo de Experimentación
Nada Obsta

Comentarios Respecto a la Metodología de Experimentación
Nada Obsta

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UNIVERSIDAD CATÓLICA SAN ANTONIO

COMITÉ DE ÉTICA DE LA UCAM

Sugerencias al Investigador

A la vista de la solicitud de informe adjunto por el Investigador y de las recomendaciones anteriormente expuestas el dictamen del Comité es:

Emitir Informe Favorable	X
Emitir Informe Desfavorable	
Emitir Informe Favorable condicionado a Subsanación	

MOTIVACIÓN
Incrementará conocimientos en su área

Vº Bº El Presidente,

Fdo.: José Alberto Cánovas Sánchez

El Secretario,

UNIVERSIDAD CATÓLICA SAN ANTONIO · UCAM · COMITÉ DE ÉTICA · MURCIA ·

Fdo.: José Alarcón Teruel