



UNIVERSIDAD
COMPLUTENSE
MADRID

Proyecto de Innovación

Convocatoria 2022/2023

Nº de Proyecto: 258

Buscando las claves motivacionales para el estudio de la Farmacología:
aprendizaje significativo con Escape Room

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1. Objetivos propuestos en la presentación del proyecto

1.1. Objetivo general

Contribuir al aprendizaje significativo y profundo de la Farmacología en las asignaturas de Farmacología de la Facultad de Veterinaria de la UCM y de las otras Universidades participantes como la Universidad de Zaragoza (UNIZAR), Universidad Cayetano Heredia (UPCH, Lima) y Universidad Nacional de San Antonio Abad (UNSAA, Cusco) mediante la implementación de una nueva actividad docente, el uso de un *Escape Room* virtual multidisciplinar como herramienta educativa para incrementar la motivación de los alumnos, que tiene como propósito la desvinculación de la selección de contenidos de la mera definición académica o de contenido científico estrictamente, para plantear objetivos que optimicen la adquisición de competencias mediante el uso de recursos que proporciona internet, permitiendo extender más allá de la presencialidad o encuentro físico la comunicación entre cada uno de los sujetos superando las limitaciones espaciales y temporales (*Flores y col., 2013*).

1.2. Objetivos específicos

- Facilitar la gestión del conocimiento para desarrollar las competencias del estudiantado de las asignaturas de Farmacología, de manera que estos logren la mejor consecución de sus objetivos facilitando las habilidades sociales en un ambiente multidisciplinar y multicultural para resolver problemas de índole Farmacológico (resolución de acertijos adaptados al *Escape Room*).
- Definir los contenidos con mayor dificultad para el estudiantado de Farmacología e incorporar material basado en las secciones de las asignaturas de Farmacología y Farmacia y de Farmacología Clínica y Farmacoterapéutica al entorno del *Escape Room*.
- Desarrollar el aprendizaje a largo plazo o profundo (*Fasche, 2007*) de los conceptos básicos de Farmacología y las características de la aplicación de los distintos grupos farmacológicos, como puede ser conocer los protocolos farmacológicos para el tratamiento de patologías de animales de interés veterinario mediante la correlación de experiencias virtuales de resolución de problemas dentro del esquema del *Escape Room*, populares entre los jóvenes, utilizando las técnicas de aprendizaje inductivo-deductivo y cooperativo.
- Hacer más atractiva y entretenida la comprensión de los conceptos básicos de Farmacología utilizando ambientes virtuales que ayuden a un mayor autoaprendizaje, compromiso y satisfacción del/ de la estudiante. Muchos de los problemas y acertijos a los que se enfrentarán las/los estudiantes participantes promueven un pensamiento diferente respecto al concepto abstracto y memorístico de Farmacología, importante para fomentar la creatividad e innovación.
- Incrementar la autonomía y responsabilidad del estudiantado en su autoaprendizaje como proyección hacia el logro de un profesional crítico y reflexivo.

- Facilitar el conocimiento de las diferentes plataformas de acceso a información actualizada, como las bases de datos disponibles en el Sistema de Bibliotecas de la UCM, y la Agencia Española de Medicamentos y Productos Sanitarios (AEMPS), que permiten realizar consultas en cualquier momento y desde cualquier lugar, facilitando el conocimiento más allá de las clases magistrales.
- Fomentar el trabajo multidisciplinar y multicultural con la incorporación de estudiantes de las Facultades de Medicina y Ciencias (UNIZAR), Farmacia y Veterinaria (Universidades peruanas).

2. Objetivos alcanzados

2.1. Objetivo general

Contribuir al aprendizaje significativo y profundo de la Farmacología en las asignaturas de mediante la implementación de una nueva forma de actuación docente, el uso de un *Escape Room* multidisciplinar como herramienta educativa para incrementar la motivación del alumnado, desvinculando la selección de contenidos, de la mera definición académica o de contenido científico estrictamente, para plantear objetivos que optimicen la adquisición de competencias mediante el uso de recursos que proporciona internet, permitiendo extender más allá de la presencialidad o encuentro físico la comunicación entre cada uno de los sujetos superando las limitaciones espaciales y temporales.

Alcanzado. Se propuso estudiar una estrategia de juego basado en el concepto de *Escape Room* para ayudar al estudiantado a aprender de una serie de conceptos de tres secciones importantes en el 3º Curso del Grado de Veterinaria. Según los informes realizados por los estudiantes participantes describieron la actividad como motivadora y divertida para mejorar el aprendizaje.

2.2. Objetivos específicos

- Facilitar la gestión del conocimiento para desarrollar y administrar las competencias de los estudiantes de las asignaturas de Farmacología, de manera que estos logren la mejor consecución de sus objetivos facilitando las habilidades sociales en un ambiente multidisciplinar y multicultural para resolver problemas de índole Farmacológico (resolución de acertijos adaptados al *Escape Room*). Objetivo alcanzado parcialmente con la elaboración de casos-problemas de diferentes desafíos farmacológicos con diferente temática que queremos seguir ampliando en la próxima convocatoria 2023-2024 con el proyecto Innova concedido a la Prof. Marina Arribas (Innova 80), miembro del actual equipo del Proyecto Innova 258, que incluye ampliaciones de estrategias educativas de gamificación e Inteligencia Artificial.
- Definir los contenidos con mayor dificultad para las/los estudiantes de Farmacología e incorporar material basado en las secciones de las asignaturas de Farmacología y Farmacia y de Farmacología Clínica y Farmacoterapéutica al entorno del *Escape Room*. Objetivo alcanzado: tras la realización de un análisis sobre las calificaciones obtenidas en las distintas secciones que abarca el programa docente de la asignatura de Farmacología y Farmacia decidimos centrar esfuerzos en la Sección de Farmacología de la Transmisión Colinérgica y Adrenérgica, así como la Farmacología del Sistema Nervioso Central. Asimismo estas dificultades quedan reflejadas en las encuestas dirigidas al alumnado en las que se les plantea cuestiones en referencia a los posibles problemas con determinadas secciones de las asignaturas de Farmacología.
- Adquirir el aprendizaje a largo plazo o profundo (*Fasche, 2007*) de los conceptos básicos de Farmacología y las características de la aplicación de los distintos grupos farmacológicos, como puede ser conocer los protocolos farmacológicos para el tratamiento de patologías de animales de interés veterinario mediante la

correlación de experiencias virtuales de resolución de problemas dentro del esquema *Escape Room*, populares entre los jóvenes, utilizando las técnicas de aprendizaje inductivo-deductivo y cooperativo. Objetivo alcanzado mediante la gamificación presentamos a los estudiantes participantes un caso-problema para que puedan determinar la elección del protocolo farmacológico más adecuado en función de distintas premisas: raza, edad, gravedad, etc.... El escenario farmacológico puesto a disposición del alumnado induce a un abordaje integrador del problema, asociando conocimientos de otras asignaturas a la par que el hecho de ver la aplicabilidad de los conceptos abstractos les ha permitido plantearse un esquema más realista de la utilidad de la farmacología.

- Hacer más atractiva y entretenida la comprensión de los conceptos básicos de Farmacología utilizando ambientes virtuales que ayuden a un mayor autoaprendizaje, compromiso y satisfacción del/ de la estudiante. Objetivo conseguido y valorado positivamente por los estudiantes participantes a través de formularios de satisfacción. El diseño y planteamientos lúdicos de los problemas propuestos a través del *Escape room*, y la posibilidad de desarrollo de los mismos en ambientes distendidos ha facilitado el logro de este objetivo.
- Incrementar la autonomía y la responsabilidad del estudiantado en su autoaprendizaje como proyección hacia el logro de un profesional crítico y reflexivo. Objetivo parcialmente conseguido, si bien la elaboración de los distintos escenarios farmacológicos virtuales facilitó la involucración del alumno, no obstante, aparecieron algunas dificultades en la decisión de los distintos niveles de complejidad de la presentación del caso que trabajaremos en próximos cursos.
- Facilitar el conocimiento de las diferentes plataformas de acceso a información actualizada, como las bases de datos disponibles en el Sistema de Bibliotecas de la UCM, y la Agencia Española de Medicamentos y Productos Sanitarios (AEMPS), que permiten realizar consultas en cualquier momento y desde cualquier lugar, facilitando el conocimiento más allá de las clases magistrales. Objetivo conseguido, el entorno virtual de gamificación creado ofreció acceso a las diferentes bases de datos disponibles y la bibliografía recomendada para la resolución de los problemas farmacológicos, quedando el alumnado familiarizado con dichas fuentes comprendiendo su utilidad tanto como estudiantes como en su futura vida profesional.
- Fomentar el trabajo multidisciplinar y multicultural con la incorporación de estudiantes de las Facultades de Medicina y Ciencias (UNIZAR), Farmacia y Veterinaria (Universidades peruanas). Objetivo conseguido parcialmente, si bien la aplicación Genially™ permite la utilización de múltiples opciones para la creación de los diferentes escenarios presenta algunas limitaciones en el establecimiento de un tiempo de ejecución y el modo multijugador. Por otra parte, los acontecimientos político-sociales sucedidos en Perú, la paralización de la actividad universitaria normal debido a las sucesivas huelgas, impidieron su implementación en el país colaborador. No obstante, trabajamos para incorporar nuevas Universidades y establecer más colaboraciones para las próximas convocatorias.

3. Metodología empleada en el proyecto

Las fases y actividades que propusimos para el desarrollo de los objetivos anteriormente definidos fueron:

3.1. Fase de Planificación y elaboración de las actividades docentes:

Mediante reuniones con las/los participantes en el proyecto se realizó un análisis retrospectivo de las secciones que resultaron de mayor complejidad para el estudiantado. Una vez fueron definidos los posibles temas a tratar, se continuó con el trabajo de todo el equipo multidisciplinar con el objeto de establecer los elementos y pruebas a realizar dentro de cada módulo de aprendizaje, normas básicas del juego y las secuencias de desarrollo de las actividades. Además, se estableció el número y tipo de pruebas a realizar (acertijos, puzzles, fórmulas, apertura de candados digitales...), el número de pistas, así como las posibles fechas de inicio y finalización para la ejecución del proyecto (Véase Anexo I).

3.2. Fase de implementación del *Escape Room*:

Durante el curso académico 2022/23 los grupos de trabajo de las/los estudiantes se dividieron en 4 miembros como máximo. Cada grupo entró en una “sala de escape” acorde con el calendario previamente establecido con una prueba/enigma a resolver, en sincronización con la impartición de las diferentes secciones teóricas o prácticas de las asignaturas de Farmacología. Como es habitual en estas dinámicas de *Escape Room* los estudiantes contaron con un tiempo máximo por definir con el fin de obtener la resolución del problema planteado, en forma de un código que les permita “escapar” y desbloquear el siguiente nivel. Establecimos diferentes niveles básicos accesibles a todos los grupos y niveles más avanzados para aquellos grupos con puntuaciones más altas, utilizando como aliciente la obtención de un diploma de reconocimiento al trabajo realizado (Véase Anexo II).

3.3. Fase de evaluación de la experiencia docente y difusión de los resultados obtenidos:

Se organizó un encuentro entre los miembros del proyecto una vez al mes con el fin de realizar un seguimiento del desarrollo de la actividad. Finalizada la actividad se envió una encuesta anónima de satisfacción al estudiantado participante con el fin de determinar su experiencia emocional, así como la evaluación personal sobre el uso de la nueva herramienta docente. Los resultados preliminares fueron presentados mediante dos comunicaciones orales y la redacción de dos Proceedings en el Congreso de ámbito docente INTED (*International Technology, Education and Development Conference*) realizado en Valencia, y las experiencias de las estudiantes fueron difundidas mediante dos comunicaciones orales en el XIX Congreso de Ciencias Veterinarias y Biomédicas realizado en Madrid (Véase Anexo III).

4. Recursos Humanos

Para la realización del proyecto se ha requerido de la implicación de un equipo humano con experiencia en el plano del trabajo en red. Los miembros del equipo de trabajo han constituido la base fundamental para el desarrollo de este proyecto, ya que los integrantes del grupo tienen una amplia experiencia en participación de proyectos innovadores, con un alto grado de implicación y versatilidad docente, experiencia en la dinamización de grupos, presentación de resultados en diferentes foros como los congresos para estudiantes o de innovación docente (EDULEARN, ICERI, VetDOC, SEF, etc.). En resumen, hemos contado para la preparación y puesta en marcha del proyecto con un equipo multidisciplinar, interuniversitario nacional e internacional, interfacultativo e interdepartamental contando en la composición tanto con PDI, PAS y estudiantes de todos los ciclos formativos.

- Arribas Blázquez, Marina (PDI, Facultad de Veterinaria, UCM)
- Barahona Gomariz, María Victoria (PDI, Facultad de Veterinaria, UCM)
- García Delicado, Esmerilda (PDI, Facultad de Veterinaria, UCM)
- García Barrios, Alberto (PDI, Facultad de Ciencias, UNIZAR)
- Gómez Villafuertes, María Rosa (PDI, Facultad de Veterinaria, UCM)
- Jiménez Burgueño, Emma (Estudiante, Facultad de Veterinaria, UCM)
- Llorente Sáez, Celia (Estudiante, Facultad de Veterinaria, UCM)
- Luesma Bartolomé, María José (PDI, Facultad de Ciencias, UNIZAR)
- Martín Herranz, Ricardo (PDI, Facultad de Medicina, UCM)
- Muelas González, María José (PAS, Facultad de Veterinaria, UCM)
- Ortega de la O, Felipe (PDI, Facultad de Veterinaria, UCM)
- Olivios-Oré, Luis A. (PDI, Facultad de Veterinaria, UCM)
- Paniagua Herranz, Lucía (Estudiante, Facultad de Veterinaria, UCM)
- Pérez Sánchez, Blanca (Estudiante, Facultad de Veterinaria, UCM)
- Ramírez Vicente, Nuria (Estudiante, Facultad de Veterinaria, UCM)
- Santander Ballestín, Sonia (PDI, Facultad de Medicina, UNIZAR)
- Serrano López, Julia (Estudiante, Facultad de Veterinaria, UCM)

Aunque no todos ellos figuran como miembros del equipo, hemos contado con el compromiso de participación de universidades peruanas como: la UNMSM (Facultad de Medicina Veterinaria: Depto. de Zootecnia y Producción agropecuaria; Profa. Mariella Ramos González) con los que hemos mantenido conversaciones recientes de planificación para implementar la actividad con un proyecto más ambicioso de continuidad de la metodología de gamificación e inteligencia artificial que ha sido concedido en la convocatoria de proyectos de innovación docente en el curso 2023-2024 como Proyecto Nº 80 y que será liderado por la Profa. Marina Arribas Blázquez, miembro del actual proyecto, de reciente incorporación al profesorado de la UCM bajo la figura de Profesora Ayudante Doctor.

5. Desarrollo de las actividades

5.1. Reuniones de los miembros del equipo

Se convocaron distintas reuniones informativas telemáticas vía *Meet* del proyecto de innovación docente para conocer distintas propuestas que ayudarán a optimizar los resultados de los “casos-escenarios” que se desarrollaron en la actividad de gamificación. Aún, está pendiente una última reunión de cierre del proyecto que resuma los objetivos que hemos alcanzado y aquellos que podemos seguir trabajando para mejorar en las próximas ediciones.

5.2. Toma de decisiones sobre las aplicaciones a utilizar en el desarrollo del proyecto

Se convocaron distintas reuniones de formación para el aprendizaje de herramientas en línea con el fin de crear los contenidos visuales e interactivos en equipo que se adaptaran a nuestras necesidades en el desarrollo del proyecto. En este punto, agradecemos al Prof. Alberto García Barrios la cesión de la versión de pago Genially™ que utilizan en la UNIZAR que nos permitió el uso de características más avanzadas (Véase Anexo IV):



Actividad sobre
Farmacología del Sistema
Nervioso Autónomo Parte I



Actividad sobre
Farmacología del Sistema
Nervioso Autónomo Parte II



Actividad sobre
Farmacología del Sistema
Nervioso Central

Después de que todo el estudiantado voluntario participara en la actividad de aprendizaje se les evaluó como se había adjudicado anteriormente. Al final de cada actividad, los estudiantes que completaron la actividad tuvieron que rellenar a través de un cuestionario utilizando el *software* de administración de encuestas *Google forms* de uso gratuito que permitió la evaluación de forma sincrónica de los conceptos teóricos/prácticos impartidos en las asignaturas de Farmacología. Asimismo, para la valoración del grado de satisfacción del estudiantado se completó con una encuesta de opinión sobre la actividad con las siguientes preguntas (Véase Anexo V).

- En relación con la actividad interactiva ¿En qué grado te ha gustado aprender farmacología a través de *escape room*?
- ¿En qué grado te parece útil el aprendizaje de conceptos básicos de farmacología a través de esta actividad?
- ¿Señale el grado de dificultad que ha presentado la aplicación?
- ¿Prefieres seguir utilizando métodos tradicionales para reforzar el aprendizaje?

Sobre el grado de evaluación de las preguntas, se estableció una escala de 5 niveles:

Muy poco Satisfactorio	Poco Satisfactorio	NS/NC	Satisfactorio	Muy Satisfactorio
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Por otra parte, la última pregunta del cuestionario se evaluó con respuesta afirmativa o negativa.

Los estudiantes que voluntariamente consintieron participar completaron la encuesta de satisfacción y la prueba evaluativa (n = 104; 77,6% de tasa de respuesta; (Véase Anexo VI superior). La mayoría de los estudiantes eran mujeres (n = 94; 90,4%; Véase Anexo VI inferior). Para el análisis de datos se introdujeron estadísticas descriptivas (medias, porcentajes) en GraphPad (versión 9, San Diego, EE.UU.) para analizar los datos obtenidos en un archivo de Microsoft Excel® (Washington, EE.UU.) a partir de los formularios de Google.

5.3. Cartelería de difusión de la actividad

La realización de la actividad estuvo englobada dentro de la metodología de tipo trabajos dirigidos de las asignaturas de Farmacología en el Grado de Veterinaria, que tuvo una participación voluntaria del estudiantado de tercer curso de las asignaturas de Farmacología. Con el fin de estimular la participación en el proyecto estuvo publicitado tanto en el tablón de anuncios de la facultad como a través del campus virtual de las asignaturas de Farmacología y Farmacia y Farmacología Clínica y Farmacoterapéutica (Véase Anexo VII).

5.4. Preparación de comunicaciones a Congresos

Las actividades desarrolladas en el proyecto se han difundido a través de dos enfoques académicos:

Por una parte, PDI de la UCM que han desarrollado la actividad, en el Congreso *17th annual International Conference of Education, Research and Innovation (INTED2023)* dedicado a la promoción de la educación internacional y la cooperación universitaria, en los que tenemos experiencia participando activamente mediante comunicaciones de los distintos miembros del equipo celebrado en Valencia del 6-8 de marzo de 2023 donde hemos presentado dos comunicaciones con los siguientes títulos (Véase Anexo VIII).

- *“Evaluation of an innovative virtual escape room pilot activity to enhance student learning experience in veterinary pharmacology”.*
- *“An escape room as an implementation of gamification material of learning pharmacology”.*

Por otra parte, estudiantes de la UCM (Ana María Juárez Martínez, Mar Llorente Rosón, Leticia Martínez Maldonado y Laura Couto Martínez) que han vivido la experiencia, en el XV Congreso de Investigación de Estudiantes de Grado en Ciencias de la Salud. XIX Congreso de Ciencias Veterinarias y Biomédicas dedicado a promover un espacio de encuentro abierto y multidisciplinar de toda la Comunidad Universitaria, cuyo objetivo es fomentar habilidades transversales mediante la comunicación de trabajos tutorizados donde hemos presentado dos comunicaciones con los siguientes títulos (Véase Anexo IX)

- *“Escape Room virtual en farmacología veterinaria: evaluamos nuestra experiencia”*
- *“¿Cómo reforzar el aprendizaje de Farmacología Veterinaria mediante un Escape room virtual?”*

5.5. Preparación de dos publicaciones docentes de los resultados obtenidos

Como indican nuestros objetivos, la elaboración de material didáctico sobre la ejecución y el desarrollo que permiten su incorporación en plataformas digitales en internet permitirán una mayor difusión de los logros del proyecto. En este punto, cabe destacar dos publicaciones docentes indexadas en bases de datos bibliográficas académicas con ISBN: 978-84-09-49026-4 que recogen los aspectos más destacados de la primera fase del proyecto con título: *“An escape room as an implementation of gamification material for learning pharmacology”* y *“Evaluation of an innovative virtual escape room pilot activity to enhance student learning experience in veterinary pharmacology”* (Véase Anexo X)

5.6. Tutorías periódicas con los estudiantes participantes

Además, a lo largo del proceso, se ha trabajado con 4 estudiantes de grado voluntarios que han ido recogiendo información sobre las dificultades u opiniones de sus compañeros en el aula donde resolvían el caso con el fin de obtener un *feedback* más extenso sobre cada una de las actividades realizando un breve informe y enviando a los profesores vía *e-mail*.

Cuando se preguntó a los estudiantes si consideraban valiosa la actividad de aprendizaje, mencionaron que era un reto, pero de forma positiva y que "los casos nos han obligado a pensar de forma diferente". Otro comentario decía "Estas actividades me parecen más productivas y agradables que limitarse a leer apuntes o libros".

Los estudiantes valoraron la oportunidad de colaborar con sus compañeros o en pequeños grupos. Este tema se articuló cuando los estudiantes respondieron a las preguntas formuladas por los cuatro estudiantes voluntarios: "¿Qué fue lo más destacable?" y "¿Cómo crees que te ha ayudado más esta actividad?". Algunos alumnos describieron como aspecto a recalcar el hecho de "resolver juntos un objetivo común".

5.7. Captación de profesorado y estudiantado

Dentro de ampliar el estudio de la Farmacología en un enfoque de investigación básica y traslacional contaremos con la Profa. Isabel Lastres Becker de la UAM que trabajará en el proyecto sobre aspectos relacionados con las diferentes técnicas *in vitro* e *in vivo* para el desarrollo de nuevos fármacos, y además forma parte del equipo la Dra. Belén López Bouzo, científica del departamento de I+D de Laboratorios ROVI como nuevas incorporaciones para el próximo curso 2023-2024.

5.8. Fomentar la actividad para otros ámbitos de inclusión social

La plataforma ha sido accesible para el alumnado con necesidades específicas de apoyo educativo, con el fin de colaborar con el Proyecto nº 244 (21/22) con título : *“Elaboración y desarrollo de materiales accesibles para la formación de jóvenes con discapacidad intelectual en la Atención y Cuidado de Animales, mediante la intervención en el Proyecto Liceo”* y su continuación a través del Proyecto Innova 164 (22/23) hemos utilizado las herramientas de desarrollo del presente proyecto para facilitar el aprendizaje del temario de adecuación de las instalaciones de aves de corral.



Actividad Adecuación de las
Instalaciones de Aves de
Corral

5.9. Internacionalización de la docencia universitaria

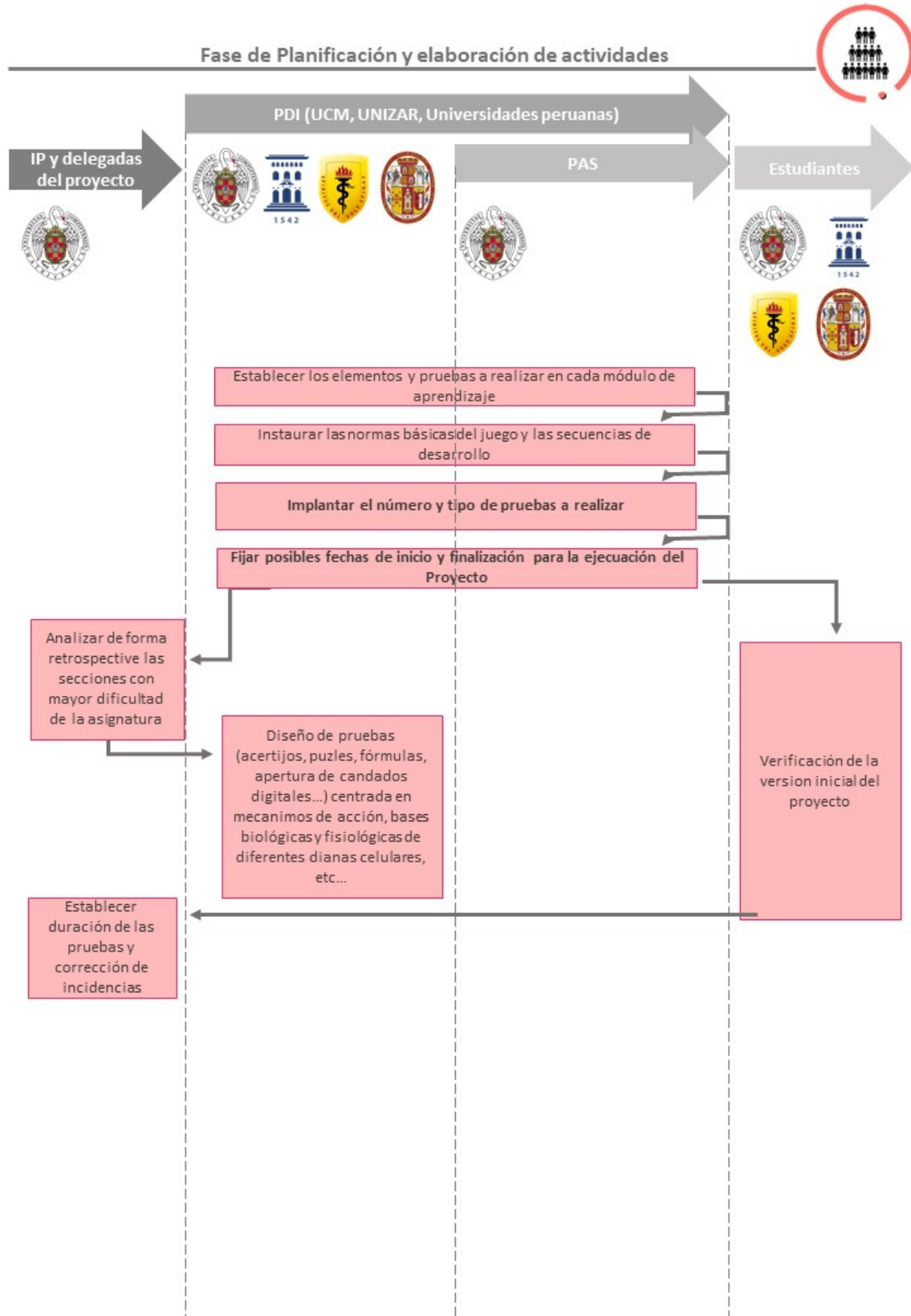
La estrecha relación que venimos manteniendo desde hace años con diferentes universidades peruanas ha permitido la incorporación de nuevos miembros del equipo, tanto de nuevas facultades (Facultad de Farmacia y Bioquímica: Depto. Académico de Farmacotecnia y Administración Farmacéutica; Profa. Norma Ramos Cevallos en la UNMSM) como nuevas universidades peruanas como la UNHEVAL (Facultad de Veterinaria; Prof. Richard Tasayco Alcántara) y finalmente la incorporación de un nuevo país latinoamericano como México con la participación de la UDG (Facultad de Ciencias Biológicas y Agropecuarias de la Benemérita; Prof. Jorge Galindo García) con los que hemos mantenido conversaciones recientes de planificación para implementar la actividad con un proyecto más ambicioso de continuidad de la metodología de gamificación e inteligencia artificial que esperamos que sea apoyada en la siguiente convocatoria de proyectos de innovación docente en el curso 2023-2024.

5.10. Participación en el I Forum de Primavera de la Facultad de Veterinaria

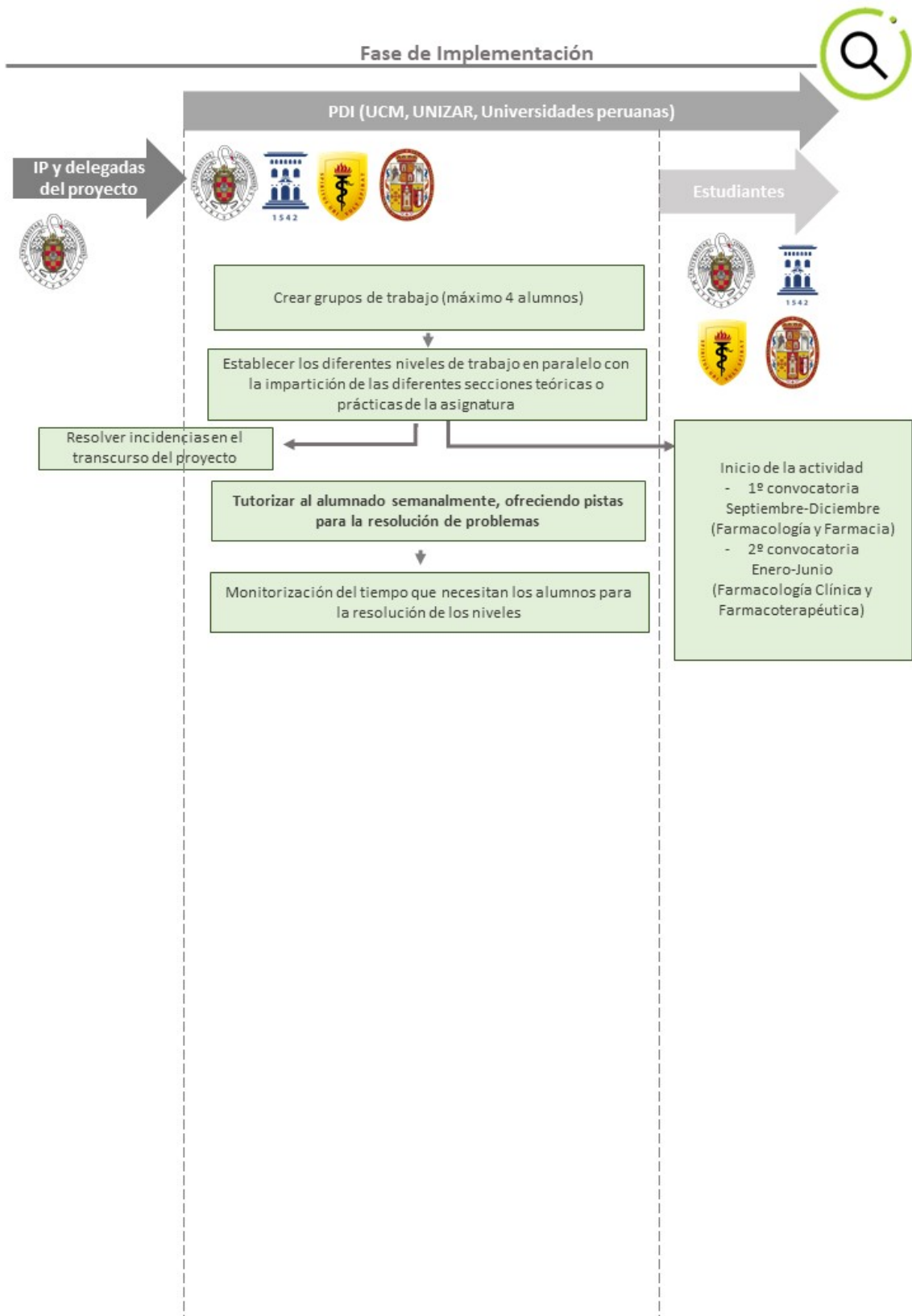
Contribución en el evento realizado la mañana del 21 de abril denominado "PrimaForum", el primer foro de primavera en la Facultad de Veterinaria, este evento incluyó una variedad de actividades como: actividades deportivas, cata de quesos, entrega de premios *Academic Excellence Award-MSD Animal Health*, la presentación de un libro y nuestro Escape room/resuelve el misterio (Véase Anexo XI).

6. Anexos

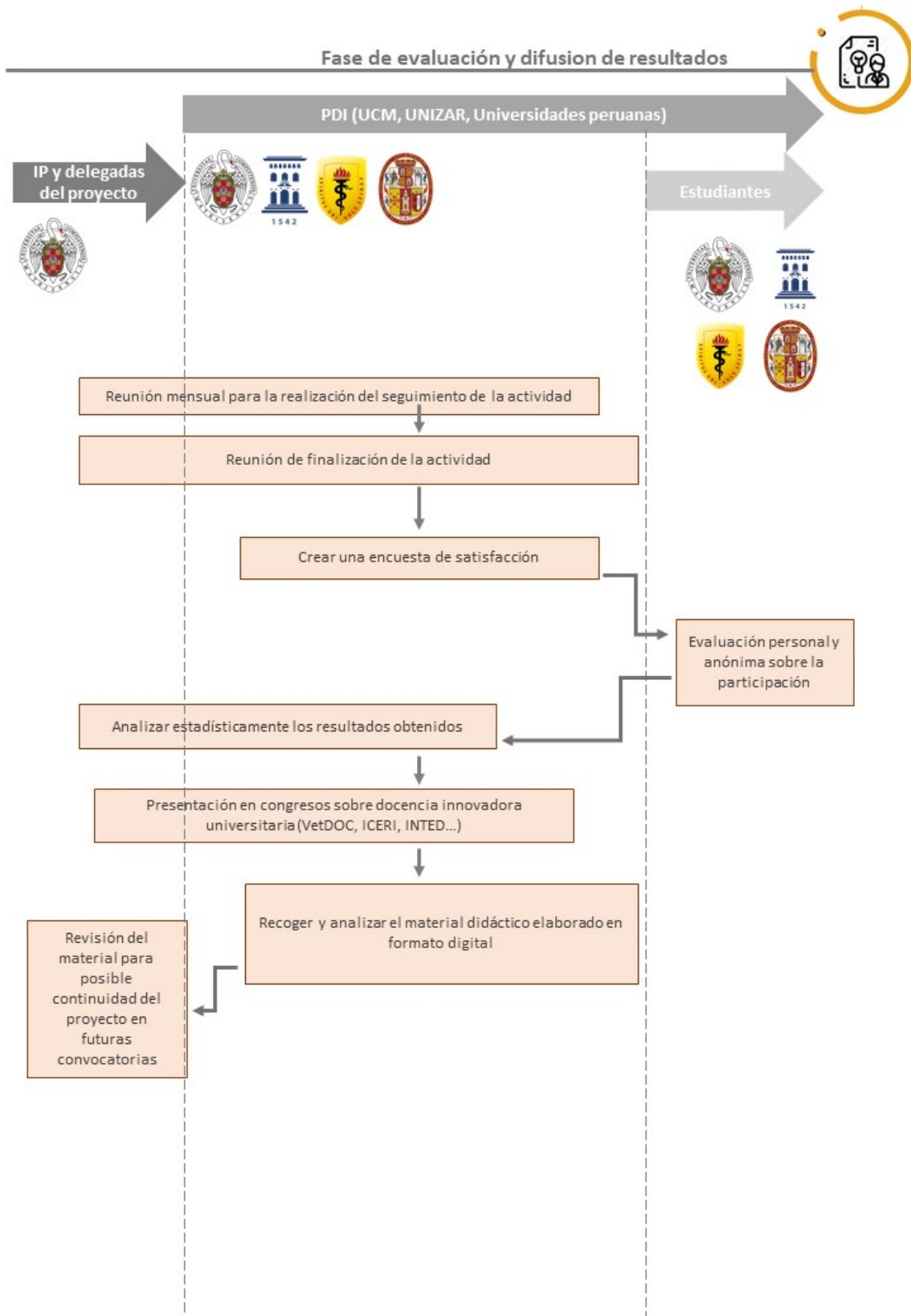
Anexo I. Fase de Planificación y elaboración de actividades

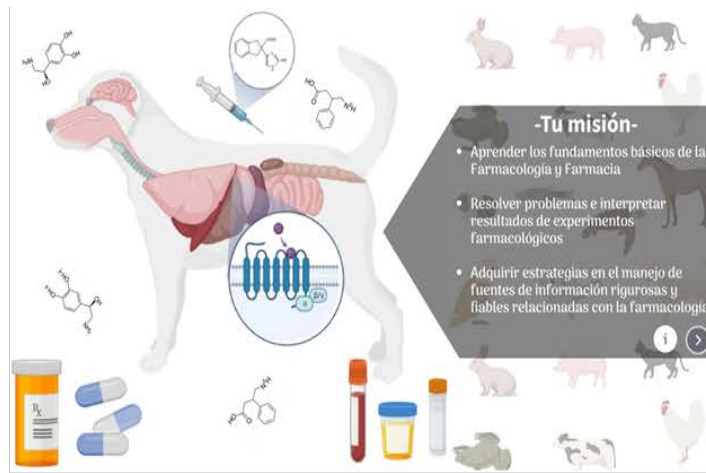


Anexo II. Fase de Implementación



Anexo III. Fase de Evaluación y difusión de resultados





Anexo V. Preguntas de las encuestas proporcionadas al estudiantado participante



En relación a la actividad interactiva, valora de 1 (poco satisfactorio) a 5 (muy satisfactorio). *

¿En que grado te ha gustado aprender farmacología a través de escape room?

1

2

3

4

5

¿En que grado te parece útil el aprendizaje de conceptos básicos de farmacología a través de esta actividad? *

1

2

3

4

5

¿Señale el grado de dificultad que ha presentado la aplicación?. (valora 1 si te pareció sencillo * y valora 5 si presentó gran dificultad)

1

2

3

4

5

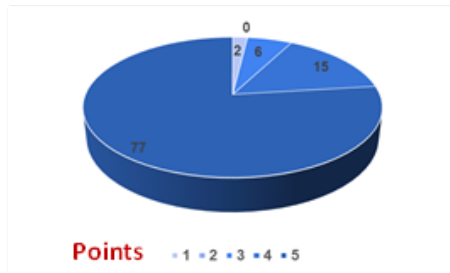
¿Prefieres seguir utilizando métodos tradicionales para reforzar el aprendizaje? *

Sí

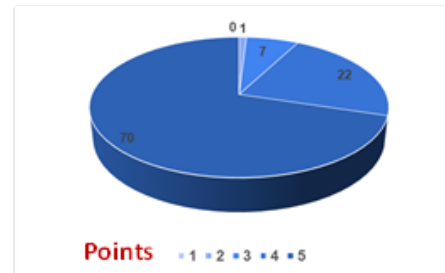
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Anexo VI. Resultados de las encuestas proporcionadas al estudiantado participante

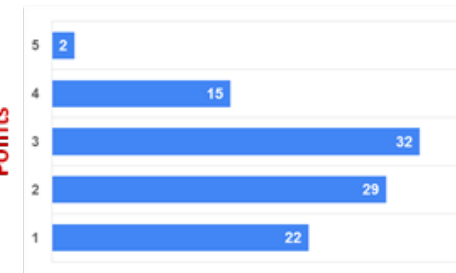
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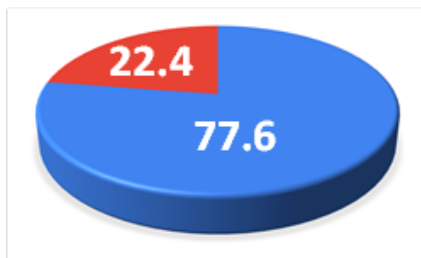
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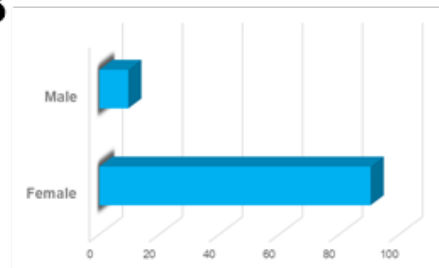
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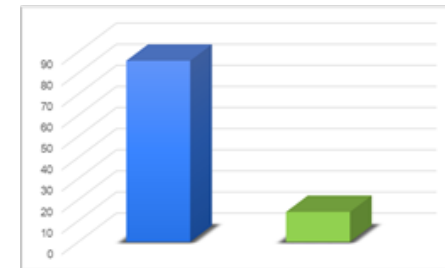
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Anexo VII. Cartelería y Difusión




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“AN ESCAPE ROOM AS AN IMPLEMENTATION OF GAMIFICATION MATERIAL FOR LEARNING PHARMACOLOGY”

Marina Arribas-Blázquez¹, María Victoria Barahona Gomariz², Emma Jiménez Burgueño³, Celia Llorente Sáez¹, Felipe Ortega de la O¹, María Rosa Villafuertes¹, Julia Serrano López¹, Esmerilda García Delicado¹, Ricardo Martín Herranz¹, Alberto García Barrios¹, Sonia Santander Ballestín¹, Luesma Bartolomé², Santos Wilton Calderón Ruiz¹, Lucía Paniagua Herranz¹, Blanca Pérez Sánchez¹, Nuria Ramírez Vicente¹, María José González¹, Luis Alcides Olivos-Ore⁴

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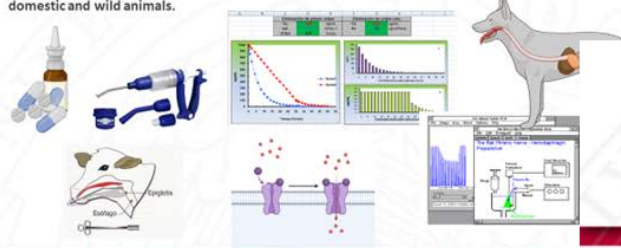





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INTRODUCTION

Pharmacology is the biomedical science devoted to the study of the basic and clinical aspects of drugs employed in the treatment of diseases of human and both domestic and wild animals.





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EVALUATION OF AN INNOVATIVE VIRTUAL ESCAPE ROOM PILOT ACTIVITY TO ENHANCE STUDENT LEARNING EXPERIENCE IN VETERINARY PHARMACOLOGY

Luis A. Olivos-Ore¹, María Victoria Barahona Gomariz², Emma Jiménez Burgueño³, Celia Llorente Sáez¹, Felipe Ortega de la O¹, María Rosa Gómez Villafuertes¹, Julia Serrano López¹, Esmerilda García Delicado¹, Ricardo Martín Herranz¹, Alberto García Barrios¹, Sonia Santander Ballestín¹, María José Luesma Bartolomé², Santos Wilton Calderón Ruiz¹, Lucía Paniagua Herranz¹, Blanca Pérez Sánchez¹, Nuria Ramírez Vicente¹, María José Muelas González¹, Marina Arribas Blázquez¹

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Buscando las claves motivacionales para el estudio de la Farmacología mediante *Escape room*

6 de octubre de 2022

Universidad Complutense de Madrid. Prof. Luis A. Olivero-Ora

Proyecto 258: Fases

Universidad Complutense de Madrid. Prof. Luis A. Olivero-Ora

- a) Fase de Planificación y elaboración de las actividades docentes



- b) Fase de implementación del Escape Room



- c) Fase de evaluación de la experiencia docente y difusión de los resultados obtenidos

Proyecto 258

Universidad Complutense de Madrid. Prof. Luis A. Olivero-Ora





INTED 2023

30th of December, 2022

ABSTRACT ACCEPTANCE LETTER

This is a confirmation that the abstract entitled:

“EVALUATION OF AN INNOVATIVE VIRTUAL ESCAPE ROOM PILOT ACTIVITY TO ENHANCE STUDENT LEARNING EXPERIENCE IN VETERINARY PHARMACOLOGY”

Author(s): Luis Alcides Olivos-Oré, María Victoria Barahona Gomariz, Emma Jiménez Burgueño, Celia Llorente Sáez, Felipe Ortega de la O, María Rosa Gómez Villafuertes, Julia Serrano López, Esmerilda García Delicado, Ricardo Martín Herranz, Alberto García Barrios, Sonia Santander Ballestín, María José Luesma Bartolomé, Lucía Paniagua Herranz, Blanca Pérez Sánchez, Nuria Ramírez Vicente, María José Muelas González, Marina Arribas Blázquez

has been accepted as a VIRTUAL presentation at INTED2023.

Name of event: INTED2023 (17th annual International Technology, Education and Development Conference)

Dates: 6th-8th of March, 2023

Place: Valencia (Spain)

Organising entity: IATED

INTED2023 Local Organising Committee





INTED 2023

9th of January, 2023

ABSTRACT ACCEPTANCE LETTER

This is a confirmation that the abstract entitled:

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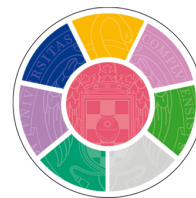
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*"Las ideas no duran mucho.
Hay que hacer algo con ellas"*
Santiago Ramón y Cajal

El Comité Científico del
**XV Congreso de Investigación de Estudiantes de Grado en
Ciencias de la Salud.**
XIX Congreso de Ciencias Veterinarias y Biomédicas

CERTIFICA:

Que: **LUIS A. OLIVOS ORÉ, MARINA ARRIBAS BLÁZQUEZ** han tutorizado el trabajo titulado:

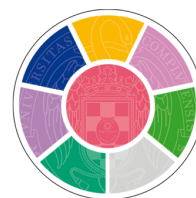
***CÓMO REFORZAR EL APRENDIZAJE DE FARMACOLOGÍA VETERINARIA
MEDIANTE UN ESCAPE ROOM VIRTUAL/HOW TO REINFORCE THE
LEARNING OF VETERINARY PHARMACOLOGY THROUGH A VIRTUAL
ESCAPE ROOM***

presentado en el Congreso organizado por la Facultad de Odontología, con la participación de las Facultades de Ciencias Biológicas, Enfermería-Fisioterapia-Podología, Farmacia, Medicina Óptica-Optometría, Psicología y Veterinaria de la Universidad Complutense de Madrid, celebrado del 21 al 23 de abril de 2023.

El presidente del Comité Científico



Prof. Dr. Gonzalo Hernández Vallejo



El Comité Científico del
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Ciencias de la Salud.**
XIX Congreso de Ciencias Veterinarias y Biomédicas

CERTIFICA:

Que: **LUIS A. OLIVOS ORÉ, MARINA ARRIBAS BLAZQUEZ** han tutorizado el trabajo titulado:

***ESCAPE ROOM VIRTUAL EN FARMACOLOGÍA VETERINARIA:
EVALUAMOS NUESTRA EXPERIENCIA / VIRTUAL ESCAPE ROOM IN
VETERINARY PHARMACOLOGY: WE EVALUATE OUR EXPERIENCE***

presentado en el Congreso organizado por la Facultad de Odontología, con la participación de las Facultades de Ciencias Biológicas, Enfermería-Fisioterapia-Podología, Farmacia, Medicina Óptica-Optometría, Psicología y Veterinaria de la Universidad Complutense de Madrid, celebrado del 21 al 23 de abril de 2023.

El presidente del Comité Científico



Prof. Dr. Gonzalo Hernández Vallejo

EVALUATION OF AN INNOVATIVE VIRTUAL ESCAPE ROOM PILOT ACTIVITY TO ENHANCE STUDENT LEARNING EXPERIENCE IN VETERINARY PHARMACOLOGY

L.A. Olivos-Oré¹, M.V. Barahona Gomariz¹, E. Jiménez Burgueño¹, C. Llorente Sáez¹, F. Ortega de la O¹, M.R. Gómez Villafuertes¹, J. Serrano López¹, E. García Delicado¹, R. Martín Herranz¹, A. García Barrios², S. Santander Ballestín², M.J. Luesma Bartolomé², S.W. Calderón Ruiz³, L. Paniagua Herranz¹, B. Pérez Sánchez¹, N. Ramírez Vicente¹, M.J. Muelas González¹, M. Arribas Blázquez¹

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Abstract

Gamification in university learning methodologies has a relatively recent application, one of the methods is the Escape room, considered an immersive learning environment, which promote learning through teamwork and problem solving [1]. The virtual Escape room adaptation is a simulation methodology to learn Pharmacology that aims to favours integration of knowledge and promotes lifelong learning. The main strategy for each Escape room case in Pharmacology was to use a relevant and challenging problem to provide a scaffold for the integration of previously taught pharmacological knowledge [2].

In this work, we have implemented virtual Escape room series of “case-scenario” of Pharmacology for the 3rd year of Veterinary students from Complutense University of Madrid as a complement to traditional lecture and laboratory based activities. We are working to extend this experience to other Faculties of the Complutense University, the University of Zaragoza and Peruvian universities that collaborate in the project such as Cayetano Heredia and Nacional de San Antonio Abad (Lima and Cusco, respectively in Peru).

Each Escape room case evaluated in this work was related to three main areas within the Pharmacology curriculum (autonomic Pharmacology, Central Nervous System Pharmacology and respiratory Pharmacology) selected as a pilot with the intention of extending it to other programme areas. Each activity were delivered immediately after teaching the corresponding lectures. Two big groups of 60-80 students each were enrolled in the activity by including it as an activity within the obligatory but free-choice (among other activities such as monographs) practical credits.

The students were provided one week after with the link to the Escape room case through the Pharmacology and Pharmacy subject webpage, Campus Virtual. At the end of each activity, every student had to fill through a Google forms questionnaire an assessment of the activity and an evaluation of the knowledge acquired. Additionally, four volunteer students have been assigned to give us more extensive feedback on each of the activities via email. The professors met with them in face-to-face sessions, each discussion session lasted for a maximum of one hour.

The student comments included the reports, the degree of participation and the survey results for these activities were assessed by a specifically designed survey. We can conclude that the Escape room activity is associated with a greater motivation as well as with enhanced abilities to solve pharmacological problems that require a holistic view across several subjects they have in the Veterinary curriculum and that is helpful in reinforcing lifelong learning.

Keywords: Escape room, Pharmacology, lifelong learning.

1 INTRODUCTION

The Complutense, Zaragoza and San Antonio Abad Universities as well as the Faculties of Veterinary through their respective quality departments encourage the teachers to evaluate curricula to ensure that competencies are addressed and students remain engaged in their learning process. With this objective, we work in a continual search for innovative ways to deliver or complement course content.

The demographics of today's students include Millennials with diverse needs and expectations in comparison with precedent generations fact that encourages us to work in a variety of teaching methods to creating innovative and engaging learning experiences [3].

The Pharmacology has traditionally been taught using a lecture approach, some laboratory practices with occasional case studies where the students often struggle to learn drug names and mechanisms of action, calculate the medication dosages, and understand medication administration techniques. It is crucial that students learn the fundamental pharmacological concepts to deliver safe and effective care of veterinary patients. In an attempt to address these challenges, a novel approach to reviewing the fundamental concepts of Pharmacology was introduced in Pharmacology and Pharmacy subject in 3rd year of Veterinary degree at Complutense University using an escape room concept to facilitate learning about different sections of the programme.

The Escape room are gaining popularity as a strategy to problem solving, and cooperation in an entertainment approach. The goal for the students is work together or alone to solve pharmacological problems called case-scenario and find clues to open locks to escape from a virtual room.

2 METHODOLOGY

In this work, we have implemented virtual Escape room series of "case-scenario" of Pharmacology for the 3rd year of Veterinary students from Complutense University of Madrid as a complement to traditional lecture and laboratory based activities. We are working to extend this experience to other Faculties of the Complutense University, the University of Zaragoza and Peruvian universities that collaborate in the project such as Cayetano Heredia and National de San Antonio Abad (Lima and Cusco, respectively in Peru). We have also carried out a pilot case in the Escape Room modality with students with intellectual disabilities who are studying Animal Care course at the Complutense University.

We used the basic escape room concept on a virtual model by using a case-scenario with pharmacological questions to be solved where the answers able to open locked spaces or simply allow you to switch screens to the next level or question [Figure 1]. Undergraduate pharmacology students were divided into two big groups according to their turn of studies, although the evaluation of the results made in this work is based on all the students who participated.

2.1 The scenario and process

Each Escape room case evaluated in this work was related to three main areas within the Pharmacology curriculum (autonomic Pharmacology, Central Nervous System Pharmacology and respiratory Pharmacology) and were held immediately after teaching the corresponding lectures. Two groups of 60-80 students each were enrolled in the activity by including it as an activity within the obligatory but free-choice (among other activities such as monographs) practical credits.

Specifically, each of the cases was designed with Genially® as a pharmacological case-scenario in which different questions (about the drug used) were posed to the student so that, as he/she solved them appropriately, he/she could progress to the next levels [Figure 1]. The following activity levels or pages corresponded to the effects of the test drug on the different organs or tissues as well as any possible adverse effects. Access for students was posted one week after the lecture through a link to the Escape room case in the Pharmacology and Pharmacy subject webpage, Campus Virtual through Moodle.

Teachers created a case-scenario for each area of the curricula. The objective of the game was to be the veterinary who save the patient with the correct medicine in order to solve the pathophysiological alterations. The students were instructed to have a device (smartphone, tablet or computer) and specific verbal instructions on how-to play the game were given beginning with the objective, rules of the game, as well as some reminders throughout the resolution of the questions.

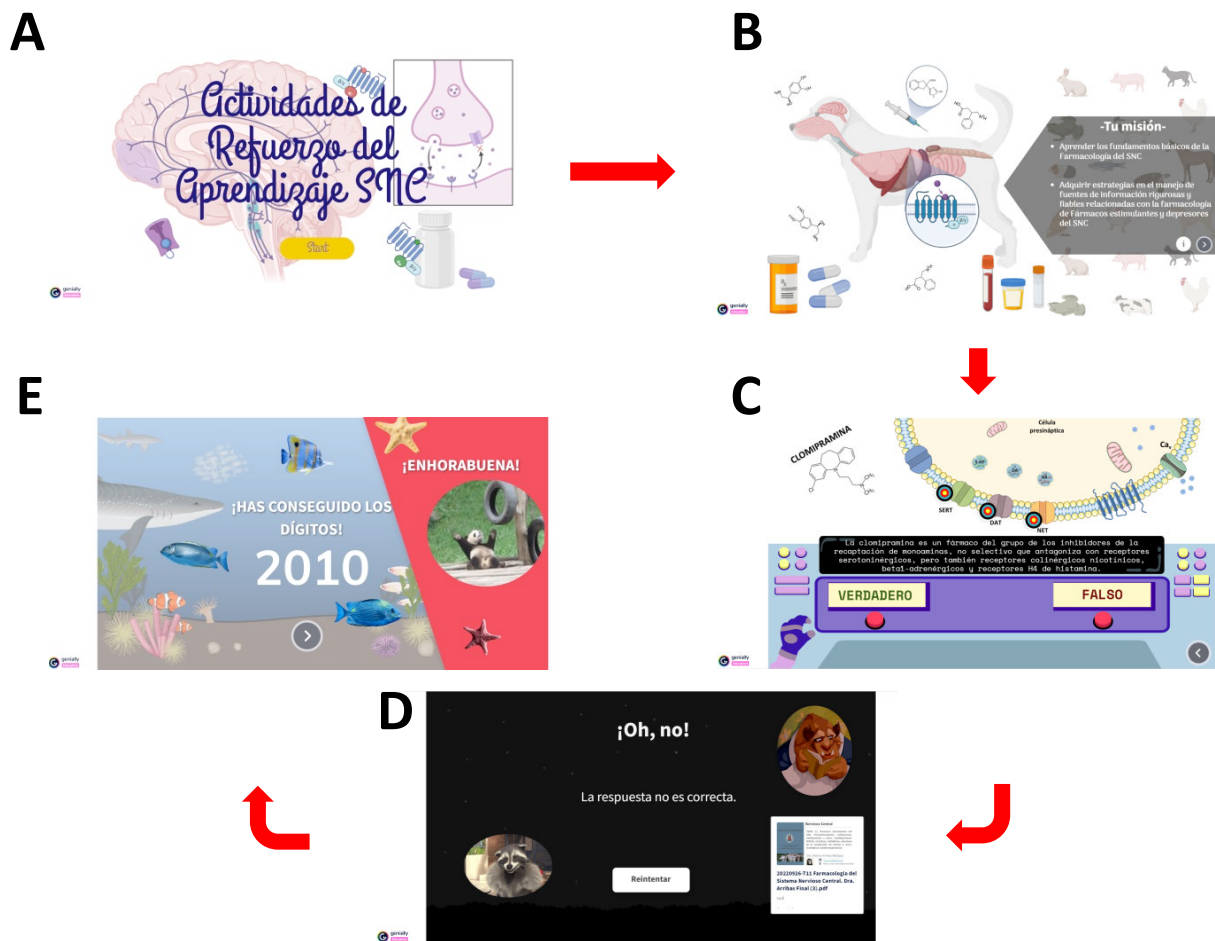


Figure 1. Escape room representative screens. **A.** Cover image of the case on the central nervous system. **B.** Image of the case objectives named as "your mission". **C.** Some of the questions were as simple as choosing between true or false. **D.** If the answer chosen was incorrect, the option to revise is given, as well as the option, via a link, to access the specific place in the master class where the answer to the problem would be. **E.** Different codes with numbers or letters can be obtained to access the next level or screen.

2.2 Data collection

After all students participated in the learning activity they were evaluated as it was previously awarded. At the end of each activity, every student had to fill through a Google forms questionnaire an assessment of the activity and an evaluation of the knowledge acquired. Some of questions were based on Eukel and colleagues work [4]. Additionally, throughout the process, we have worked with 4 volunteer undergraduate students who have been collecting information about the difficulties or opinions of their classmates in the classroom where they were solving the case in order to obtain more extensive feedback on each of the activities they made a short report and sent it to the teachers via e-mail. The teachers of the project met with them in face-to-face sessions, each discussion session lasted for a maximum of one hour.

2.3 Data analysis

Descriptive statistics (means, percentages) were entered into GraphPad (*version 9*, San Diego, USA) to analyze the data obtained in a Microsoft Excel® (Washington, USA) file from Google forms. The student comments with their evaluative criteria forms were read in order to describe the learning experience.

3 RESULTS

3.1 Background

The advent of interactive adventure games, such as escape rooms for adult entertainment have been increasing in popularity across the world. Universities and faculties encouraged us to use a variety of teaching/learning strategies to engage veterinary students from diverse backgrounds. We consider the escape room as a teaching strategy as a framework in progress in the education for the purposes of providing interactive game-based learning experiences. The literature reflects that simulation is an effective learning modality to enhance long life learning that is gaining popularity as a strategy that fosters a deeper understanding of didactic content especially in pharmacology, the content of which is highly abstract for students who often fail to link the concepts of mechanism of action with the actual uses of drugs [1] [5].

Hermanns and colleagues (2018) from the University of Texas [2] consider that Escape room as an immersive learning games platform, as a novel learning concept for teachers and students. However, there is a very low quantity of published experiences description of this type of activity used in Pharmacology education. While simulation and games have been used in education, for example Xu (2016)[3] discussed a variety of teaching strategies used in nursing education, a literature review of different database report very few articles about using an escape room concept in veterinary Pharmacology subject.

The purpose of this study was to describe the use of a gaming strategy based on an escape room concept to help students learn about three important sections in a pharmacology course in Veterinary Degree. In this sense, this work has examined undergraduate students from UCM Veterinary Faculty who participated in a type of simulation through Escape room in virtual modality. Thus, according to the reports of the 4 students volunteers who participated as observers, it was described the transference of knowledge which is a goal of education. The game strategies have been used to engage students in a fun way as a means to enhance learning.

3.2 Student demographics. Engaging

The activities were offered to the students from the two groups of pharmacology course in the third year of Veterinary studies (n = 134). They carried out the activity during their free time out of class, although the time spent on the activity is considered as part of the activities included in the ECTS of the subject. Students who voluntarily consented to participate completed the satisfaction survey and evaluative test (n = 104; 77.6% response rate; Figure 2A). The majority of the students were female (n = 94; 90.4%; Figure 2B).

The majority of students (n = 89, 85.8%) felt that this was a valuable learning activity (Figure 2C). A large majority of the students (97 %) indicated that they learned from this activity and would like more of this concept learning for upcoming pharmacological content and appreciated the innovation from the normal lecture and laboratory practices format of classes. The students viewed this activity as a fun way to review and apply their knowledge of Pharmacology. Specifically, as a result of participating in the virtual escape room activity, the students indicated that their understanding of pharmacology was increased and allowed them to 'think in an applicative way about pharmacology'.

When the students asked if they found the learning activity valuable, they mentioned that it was challenging but in a positive way and "cases have forced us to think in a different way." Another commentary said: "I find these activities more productive and enjoyable than just reading notes or books."

Students valued the opportunity to collaborate with their peers or small groups. This theme was articulated as the students answered the questions asked by the four student volunteers, "What was most memorable?" and "How do you think this activity has helped you the most?" Some students described as a memorable aspect the fact "to solve together a common goal".

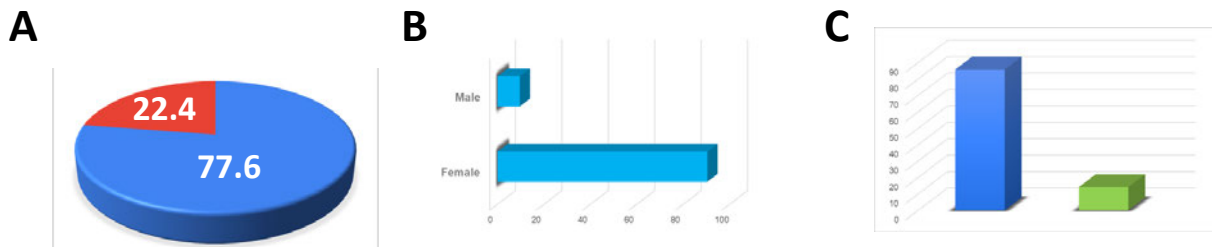


Figure 2. Student demographics and engaging. **A.** Percentage of participation (104; 77.6%) of students of pharmacology course in the third year of Veterinary studies ($n = 134$). **B.** The majority of the students were female ($n = 94$; 90.4%). **C.** The majority of students ($n = 89$, 85.8%) felt that this was a valuable learning activity.

3.3 Surveys and evaluation

Apart from the feedback that the student volunteers were able to collect from their peers, more student comments, the degree of participation and the results for these activities were obtained through surveys specifically designed in Google forms while the evaluation of learning was assessed through questionnaires designed in the virtual campus through Moodle.

The satisfaction survey had 4 main questions, as follows:

In relation to the interactive activity, please rate from 1 (very unsatisfactory) to 5 (very satisfactory) [Figure 3].

- 1 What extent did you enjoy learning pharmacology through escape room?
- 2 What extent do you find it useful to learn basic pharmacology concepts through this activity?
- 3 How difficult was the application (rate 1 if you found it easy and 5 if it was very difficult)?
- 4 Do you prefer to continue using traditional methods to reinforce learning?

The final question, related to the fact of preferring traditional classes and their methods, the students answered with 97% (101 out of 104) in favour of having innovative methods as a complement to the classes and laboratory practices as it induces them to think differently about pharmacological problems and they get a more real vision of their application in the clinic as well as their relationship with other subjects of the veterinary degree. Three preferred more of a traditional approach to learning, such as case studies or master classes. One student reported not benefitting from the activity, "The games at the university do not help me learn Pharmacology". Likewise, students with intellectual disabilities ($n = 12$) in animal care course, who were offered the work of one of their items, showed full interest in the activity and demanded more similar activities.

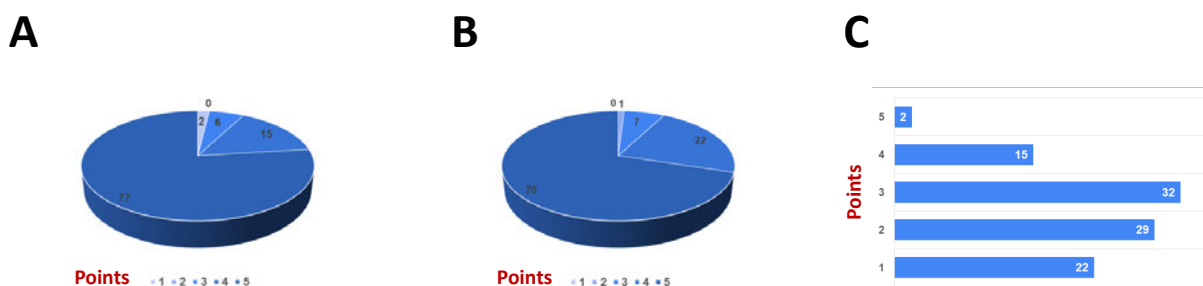


Figure 3. Survey results. Percentage of satisfaction rating from 1 (very unsatisfactory) to 5 (very satisfactory) of students of pharmacology course in the third year of Veterinary studies ($n = 104$). The students were asked three main questions: **A.** What extent did you enjoy learning pharmacology through escape room? **B.** What extent do you find it useful to learn basic pharmacology concepts through this activity? And **C.** How difficult was the application (rate 1 if you found it easy and 5 if it was very difficult)?

With regard to the assessment of the knowledge acquired, this was carried out by means of a Moodle form with traditional questions on the mechanisms of action and the beneficial and adverse effects of the drugs. Thus, 93 (89%) students obtained a score of 4-5 points out of 5, while 11 scored below, coinciding with the failure in the score with students who were not very convinced of the usefulness of the activity or had problems in following the procedures reflected in the instructions.

3.4 Frustration

Some of the negative aspects that reported the students were that they feeling frustrated that they did not have enough time to complete the activity. This is congruent with feedback from four volunteers students who observed their colleagues all of the activities and sessions in all three case-scenario of the pharmacology activity. As the time was nearing to the end, students became increasingly anxious to solve the activity. This student expressed concern that the activity under pressure of time did not increase knowledge of pharmacology. In addition to the time constraints, students felt frustrated because they did not fully understand the instructions and needed more direction. Additionally, they felt like they did not know how to start the activity. Students wanted the teachers to provide them with more guidance and answers.

The four volunteers noted that while most of the student groups were actively communicating with each other, other students were working quietly with more of an individualized focus. While all of the groups were concentrated on the task some of them were interested in the rank of their evaluation.

3.5 Limitations

This study has several limitations. Any time you use a derivative of technology in a non-traditional way. This innovation limits the conclusions that we can extract from an activity because there are many variables which cannot be controlled. However, using technology in a new way is vital to growth, so a further limitation is a lack of historical documentation presenting the material in this new way.

Since knowledge and self-confidence were not measured, it is impossible to determine the efficacy of this escape room strategy in actually conveying information or building competence in participating veterinary students.

A final limitation may be the fact that the majority of the student participants were female also decreased generalizability beyond the target population although in the veterinary degree in Complutense University this proportion can be considered representative. However, some approximations could be made to see if gender could somehow influence the parameters evaluated.

4 CONCLUSIONS

We can conclude that the pilot Escape room activity is associated with a greater motivation as well as with enhanced abilities to solve pharmacological problems that require a holistic view across several subjects they have in the Veterinary curriculum and that is helpful in reinforcing lifelong learning.

This pilot study revealed important findings for us to consider before planning and conducting similar learning activities in other drug mechanisms or drugs from the curriculum in Pharmacology. We observed that students were engaged and recognized that this activity was a novel approach to learn and make decisions about pharmacological properties and adverse effects of the drugs. This innovative strategy appears to have the potential to benefit both the teachers and the students. Perhaps more students would have responded positively if the activity had been pre-tested with better instructions and more time for the completion of the activity, actions that would have helped decrease student frustration.

The work carried out to learning required students to be immersed in a scenario with greater facilities for the communication with each other to solve the problems.

We recommend this escape room strategy as a way for teachers that add some spark and innovation to a course which traditionally has a lot of reading and memorization and there is a real need for activities that are adapted to the technological learners who have grown up with virtual strategy games who need more dynamic work to achieve deeper and longer learning.

We do recommend that future studies be conducted to quantify the students' academic success, i.e., by making comparisons between students who have done the escape room activities and those who have not, looking at the degree of success obtained in the official exams of veterinary studies.

ACKNOWLEDGEMENTS

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AN ESCAPE ROOM AS AN IMPLEMENTATION OF GAMIFICATION MATERIAL FOR LEARNING PHARMACOLOGY

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Abstract

There has always been a need for engaging assessments in online learning environments, though the COVID-19 pandemic further emphasized this need [1]. The rise of technologies, especially video games, has contributed to the use of elements of these environments in other areas. To this end, gamification is the use of game techniques in non-game contexts and their application in methodologies in the learning process, the purpose of which is to attract and strengthen the attention of students, the formation of cognitive interest, the desire to solve problems, increase motivation, and further modify external motivation into internal [2].

Gamification in higher education is a relatively recent application, one of the methods, online educational role-playing games that teachers and students can play in class are escape rooms and breakout games. Escape rooms and breakout games are considered immersive learning environments, which promote learning through teamwork and problem-solving [3]. The premise of an escape room is a teaching/learning strategy to help students, in consolidating fundamental concepts and basic procedures for professional development and at the same time, teach important skills to deal with stressful situations under time pressures in a fun and enjoyable way. The implementation of this type of resource presents a new experience with pharmacology students of the Degree in Veterinary of Universidad Complutense de Madrid (Spain) with an international group of students from different universities such as Zaragoza (UNIZAR, Spain) and Cayetano Heredia and Nacional de San Antonio Abad (Lima and Cusco, Perú). The virtual escape room consisted of 6 tracks (elaborate by Genially®) related to the theoretical contents (Central Nervous System, Autonomous Nervous System, etc...) of the Pharmacology and Pharmacy subject using clues involving specific objectives to "escape" from the room before they run out of time. Specifically, 104 students aged between 21 and 24 and 11 professors participated. After the activity, feedback on the experience of inserting gamification elements into the learning process of the subject was discussed.

The virtual escape room is available at the following link:

<https://view.genial.ly/633d82133555c700187c6452/interactive-content-actividades-de-refuerzo-del-aprendizaje-snc>

Keywords: Gamification, Escape room, Pharmacology.

1 INTRODUCTION

If the students' academic performance can be improved, the teacher must take responsibility and change the model that has existed up to now. This model is basically unidirectional, from teacher to student. In addition, it does not support collaboration or reflection on the teaching process. Thus, we must offer the possibility of adapting to new forms of inquiry, the diversity of the classroom, the reality of the educational context and the continuous training of teachers and students. In this context, social transformation requires a change in the educational system that must begin with teacher training itself. Active methodologies, as defined by López (2005) [4], are "an interactive process based on teacher-student, student-student, teacher-teacher, student-teaching material and student-medium communication that promotes the responsible involvement of students and leads to the satisfaction and mutual enrichment of teachers and students". These methodologies are supported by a mix of computer resources, multimedia resources,

telematic activities, and telecommunications and media services. This mix allows, in an interdisciplinary way, teachers and students to work with a varied range of resources with resources which they can achieve their objectives in formal and informal contexts, face-to-face, and distance learning while developing their digital competence or literacy.

Gamification is a relatively current phenomenon with different definitions that have evolved over time (Table 1). It is the use of game techniques in non-game contexts and their application in methodologies in the learning process, the purpose of which is to attract and strengthen the attention of students, the formation of cognitive interest, the desire to solve problems, increase motivation, and further modify external motivation into internal [4]. Originally Nick Pelling (2011) [5] described gamification as a process of changing the interface to make electronic transactions more fun and game-like, but later it was expanded with the emphasis on using game elements in a non-gaming environment to improve user engagement and experience.

Table 1. Definitions of Gamification.

(Pelling, 2011)	“Applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast.”
(Burke, 2012)	“The use of game mechanics and game design techniques in non-game contexts to design behaviors, develop skills or to engage people in innovation.”
(Werbach, 2014)	“The process of making activities more game-like.”

Similarly, to the approach to innovation, the relationship between gamification and innovation is two-fold: gamification is regarded as an innovative approach in certain areas, for example, education [6].

This project arose to liven up and innovate the learning of Pharmacology, which is traditionally characterized by memorization and assimilation of many complex and abstract concepts. Our educational community should take advantage of the information available on the web and new media related to educational technology to improve the academic performance of Veterinary Pharmacology students. The teaching of Pharmacology lends itself very well to the use of cooperative learning since this subject is at the interface between the basic disciplines (Anatomy, Physiology, Biology, Biochemistry...) and the clinical disciplines (Pathological Anatomy, Surgery...) of the different Health Sciences degrees (Medicine, Veterinary Medicine, Pharmacy...), thus allowing an integration of the knowledge learned in the different subjects taken. One way of effectively integrating the basic and clinical aspects, and facilitating their deep learning (cooperative, interactive...) was the elaboration of problem-scenarios ("escape rooms") that allowed, after learning the theoretical knowledge, the analysis of the multiple real circumstances that condition the choice of the best pharmacological treatment (clues, solving puzzles, etc.) in situations where they performed the analysis and self-learning. The general objective of this project was to contribute to the significant and deep learning of Pharmacology in the subjects of Pharmacology of the Faculty of Veterinary Medicine of the UCM and other participating universities such as the University of Zaragoza (UNIZAR), Cayetano Heredia University (UPCH, Lima) and the National University of San Antonio Abad (UNSAAC, Cusco) through the implementation of a new way of teaching, the use of a multidisciplinary Escape Room as an educational tool to increase student motivation, separating the selection of content from the mere academic definition or strictly scientific content, to establish objectives that optimize the acquisition of skills through the use of resources provided by the Internet, allowing to extend beyond the face-to-face or physical meeting the communication between each of the subjects, overcoming the spatial and temporal limitations. [7].

2 METHODOLOGY

In this work, we have implemented virtual Escape room series of “case-scenario” of Pharmacology for the 3rd year of Veterinary students from Complutense University of Madrid as a complement to traditional lectures.

Implementation of this strategy in Pharmacology in the project has considered different elements defined by Werbach and Hunter (2012) [8] to guarantee its success:

- 1 Defining the objectives by making the understanding of the basic concepts of Pharmacology more attractive and entertaining using virtual environments that help greater self-learning, commitment, and satisfaction of the student. Many of the problems that the participating students will face

promote a different way of thinking with respect to the abstract concept of Pharmacology, which is important to encourage creativity and innovation.

- 2 Enhancing the knowledge (theoretical-practical), attitudes (autonomous learning...), and skills (networking, multidisciplinary...) of the students. To promote multidisciplinary and multicultural work with the incorporation of students from the Faculties of Medicine and Science (UNIZAR), Pharmacy and Veterinary Medicine (Peruvian Universities).
- 3 Clearly identify the most complex sections for students within the programs of Pharmacology subjects to design activities relevant to their interests or real needs.
- 4 Establish the design of the activity cycles, defining the gamification system (game mechanics, order of events, interaction).

The phases and activities proposed for the development of the previously defined objectives were as follows:

2.1 Planning and elaboration phase of the teaching activities

Through meetings with the participants in the project, a retrospective analysis of the most complex sections for the students was carried out. In this phase, the faculty members of the Project of the Department of Pharmacology of the Faculty of Veterinary Medicine of the UCM analyzed the grades obtained by the students in each of the sections of the subject of Pharmacology and Pharmacy with the aim of identifying and editing a list of topics that would be adapted to the Escape Room.

Once the possible topics were defined, the work of the entire multidisciplinary team continued in order to establish the elements and tests to be performed within each learning module, the basic rules of the game and the sequences of development of the activities. In addition, the number and type of tests to be performed (riddles, puzzles, formulas, digital lock picking...), the number of clues, as well as the possible start and end dates for the execution of the project were established.

For the development of the pharmacological scenarios, Genially® was used as an online tool to create all types of visual and interactive content easily and quickly, for individual or team use. For the verification of the initial version and the proposal of project themes, we had the collaboration of undergraduate students; as well as master's and PhD students, with whom we established the design, the duration of the tests, as well as the initial assessment of the activity and correction of the incidences found throughout the process of the pilot version (Fig. 1).

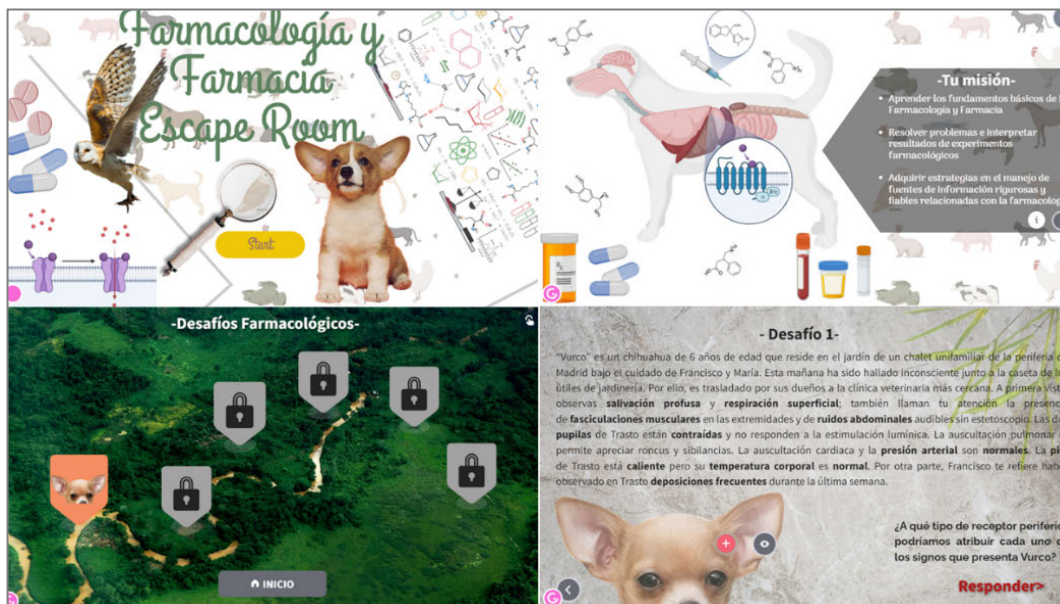


Figure 1. Escape room design. Graphic representation of one of the cases used in the virtual escape room. It began with the cover page and the presentation of different sources of information. Then, visualization of the different stages to overcome and the beginning of the first clinical case to be developed.

2.2 Escape Room implementation phase

The realization of the activity was included within the methodology of directed work type of the subjects of Pharmacology in the Degree of Veterinary Medicine, which had voluntary participation of the third-year students of the subjects of Pharmacology. To encourage students to participate in the project, it was advertised both on the faculty bulletin board and through the virtual campus Moodle, which is a free online learning system that allows teachers to create an online course portal (Fig. 2).

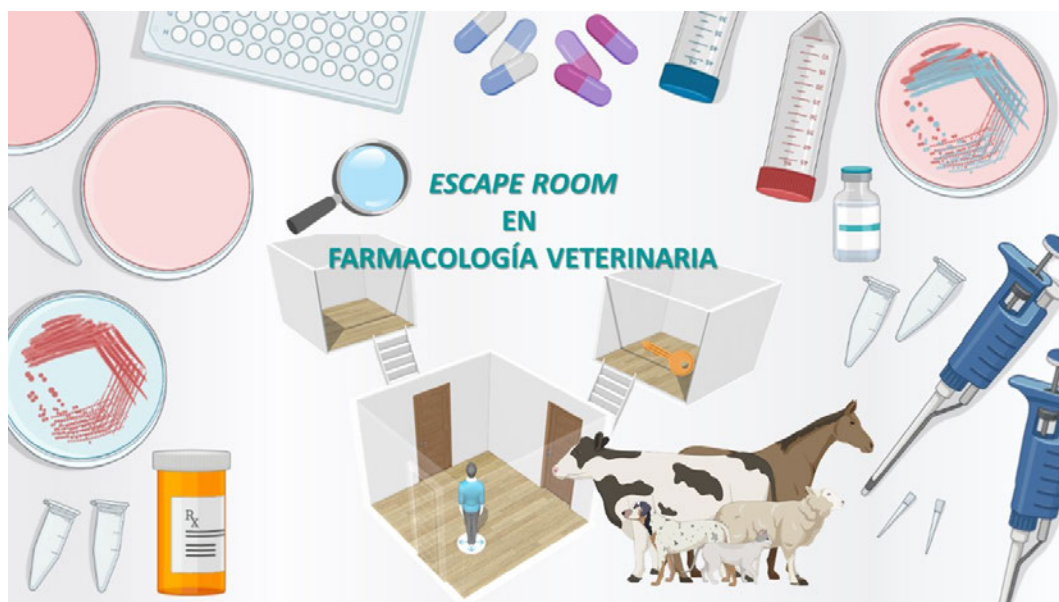


Figure 2. Announcement of project participation used for posting on bulletin boards and virtual environments to encourage student participation

The student working groups were divided into a maximum of 4 members. Each group entered a "virtual escape room" according to the previously established schedule with a test/enigma to be solved, in synchronization with the teaching of the different theoretical or practical sections of the Pharmacology subjects. As usual in these Escape Room dynamics, students had a maximum time of 45 minutes to obtain the resolution of the problem posed, in the form of a code that allowed them to "escape" and unlock the next level. We established basic levels accessible to all groups and more advanced levels for those groups with higher scores, using them as an incentive to obtain a diploma of recognition for the work done.

3 RESULTS

The use of educational technology will only be successful if it also shapes the evaluation process. For the evaluation of resources, three main criteria will be considered: pedagogical three main criteria will be considered: pedagogical, technical, and functional. In this topic we have also mentioned mobile learning and how mobile learning can be and how it can take advantage of a large number of existing applications to assess student learning with new technologies (e-evaluation), with the use of rubrics and virtual feedback.

This project has been included in the following priority lines:

- 1 Innovation of open educational resources and virtual teaching.
- 2 Training of university teachers for the acquisition of competencies in the field of distance education and self-learning.
- 3 Internationalization of university teaching. The project contemplated the participation of Peruvian universities to create a multicultural group.
- 4 Promote an inclusive, accessible, diverse university focused on the objectives of the 2030 agenda for sustainable development. The platform was accessible to students with specific educational support needs that are referred from the office for the inclusion of people with diversity.

A meeting between the members of the project was organized once a month to follow up on the development of the activity. At the end of the activity, an anonymous satisfaction survey was sent to the participating students to determine their emotional experience, as well as their personal evaluation of the use of the new teaching tool. The preliminary results were very positive, although they were aware that lectures are essential for learning the subject, they emphasized the use of this type of active methodologies as a reinforcement of learning and as a way of reviewing the contents for the exam. With all the material collected and analyzed, an edited material will be prepared in digital format, with sections according to the common pharmacological topics following the teaching programs of the Pharmacology subjects of the participating Universities. All this will allow the continuity of the project in successive courses, extending and updating the available material.

When asked to describe the best aspect of the escape room experience, one student reported, "it has helped me to implement what I have studied in the theoretical classes in a more practical way with clinical cases." Another student shared "through the support of videos and images, it has been easier to memorize the mechanism of action of different drugs used in veterinary medicine."

4 DISCUSSION AND CONCLUSIONS

Gamification as an activity provided with game elements or thoughts induces the release of dopamine, a central neurotransmitter associated with attention and concentration, as well as movement, memory, and learning. With the development of this project, we wanted to integrate, connect, and understand the different problems related to the scenarios linked to pharmacology from a very broad perspective. Students were able to connect their pharmacological knowledge with those of a biochemical, and physiological nature and make projections to possible future cases in subjects of the following courses in which they see tangible applicability of the concepts learned in Pharmacology.

By making the proposed material available online, including interactive activities, the direct online learning capabilities were reinforced.

This work shows the analysis of an escape room experience with students of Pharmacology of the Degree in Veterinary Medicine. The results obtained allow us to know the students' assessment of the escape room intervention and inform us about the learning process, mediated by mobile technologies, achieved by the participants in this study. Thus, this escape room experience has been interesting for the students, who value it as rewarding.

At the same time, the escape room application has promoted different types of emotions, highlighting fun, motivation, and anxiety about solving the proposed enigma.

In this sense, some authors point out that gamification promotes the motivation of university students, allowing them to work on the contents of transversal subjects present in university degrees [9], [10], [11]. Thus, the potential offered by the escape room lies in its motivation, the promotion of active learning and its educational usefulness for working on values and skills in different educational contexts. As in other studies, there is agreement on the idea that, through this type of game, learning a specific subject can be facilitated in a motivating way [9], [12].

More research is needed to delve deeper into the teaching-learning processes promoted by game-based learning methodology and the application of gamification. At the same time, the preference and predisposition of students for this type of active methodologies mediated by technologies, and the improvement in their motivation, with the consequent commitment to their own learning, stand out.

However, some studies published on the subject also warn of the risk that some students, unaccustomed to working within a time limit and in competition with others, may feel marginalised or frustrated.

If we want to avoid this nervousness, it is advisable to always consider the number of missions and challenges we set, as well as their difficulty. The more difficult the tests are, the easier it is for students to become frustrated, and the game loses interest and motivation. Being too easy does not guarantee success either, as it can be boring and too easy to overcome.

The teacher must analyse the group, their interests, and the theme in which the escape room is to be used, create an engaging story, choose the right environment in which it will take place, pre-test and offer help during the virtual game so that they can progress.

The experience allows students to enter a parallel world, where they can consolidate content and deal with it in a different way. This increases motivation and interest in the subject [13].

It is therefore highly recommended to try it out, starting with something simple that breaks the monotony of the classroom and allows us to observe the reaction of the students.

It is important to note that, although its direct impact on learning outcomes has not yet been demonstrated, it has had an impact on students' motivation, thus indirectly influencing the results.

The results also showed an improvement in motivation to improve learning, although on the contrary it reduced students' preferences for cooperative work.

In conclusion, gamification still shows potential but, on the one hand, it requires much more work from the teacher than expected and, on the other hand, it is still necessary to continue to carry out objective evaluations that allow us to measure which elements of gamification have an objective influence on learning.

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