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MEMORIA FINAL INNOVA[1]
COMPROMISOS Y RESULTADOS PROYECTOS DE INNOVACIÓN Y MEJORA DOCENTE 2024/2025

Identificación del proyecto	
Código	**sol-202400284950-tra**
Título	**Integrando Inteligencia Artificial (IA) en el Desarrollo de Aplicaciones Seguras: Una Propuesta Educativa Avanzada Enmarcada en el Ámbito de la Ciberseguridad**
Responsable	**Gabriel José Guerrero Contreras**

1. Describa los resultados obtenidos a la luz de los objetivos y compromisos que adquirió en la solicitud de su proyecto. Incluya tantas tablas como objetivos contempló.

Objetivo nº 1	***Elaboración y mejora de artículos cortos (short papers)***
Actividades previstas en la solicitud del proyecto:	*Este objetivo comprende las siguientes tareas:* ● *Elegir y adaptar plantillas que integren aspectos de seguridad en software, ajustadas a estándares académicos y científicos actuales, con secciones específicas para análisis realizados con herramientas de IA.* ● *Proporcionar directrices para la elaboración del artículo.* ● *Crear grupos de trabajo para su elaboración.* ● *Establecer un cronograma temporal (fecha de entrega límite de trabajos, asignación para revisión, fecha de entrega de revisiones, fecha de entrega de mejoras, fecha de realización de la sesión de presentaciones).*
Resultados obtenidos:	*Se proporcionó al alumnado una plantilla LaTeX basada en LNCS en Overleaf, con estructura obligatoria (Introducción, Trabajos relacionados, Propuesta, Resultados y Referencias), longitud máxima de seis páginas y figuras con capturas anotadas para documentar hallazgos (señalando visualmente la regla/prompt y la línea afectada; y, en el pie de figura, herramienta y versión, fichero/línea y validación como falso positivo/falso negativo). Se solicitó incluir únicamente fragmentos de código relevantes y se detallaron requisitos formales y plazos. Con estas pautas se definió el formato de las prácticas académicas así como de los artículos que debía realizar el alumnado, facilitando a su vez la evaluación comparativa.* *Desde el inicio, la actividad se realizó en grupos de 2–3 estudiantes. Se integró explícitamente la IA generativa como complemento al análisis estático. Cada grupo comparó al menos dos herramientas SAST con una IA generativa (p. ej., LLM/GPT o asistentes tipo Copilot) y documentó con evidencias su comportamiento relativo en cobertura, tiempo de análisis y tasas de falsos positivos/negativos, con el objetivo de determinar en qué medida la IA complementa (o no) a los analizadores estáticos en la detección de vulnerabilidades.*

[1] Esta memoria no debe superar las 6 páginas.

La implementación siguió un itinerario de seis semanas planificado desde el inicio: Semana 1 (sesión de arranque, formación de grupos de trabajo y selección de herramientas/tema); Semana 2 (redacción de secciones clave: propuesta, fundamentos y resultados iniciales); Semana 3 (entrega del artículo completo y asignación de revisiones por pares); Semana 4 (revisión doble ciego y entrega de informes de revisión); Semana 5 (recepción del feedback y preparación de las presentaciones orales); Semana 6 (simulación de congreso y defensa oral). El flujo de desarrollo del proyecto puede observarse en la Figura 1, que sintetiza las actividades y la interacción entre roles del alumnado (autores, revisores y chairs) junto con las intervenciones docentes (orientación inicial, validación de grupos de trabajo y borradores, anonimización y reparto de revisiones, verificación de informes, guía para la comunicación oral, selección y coordinación de chairs, y observación y evaluación durante la simulación).

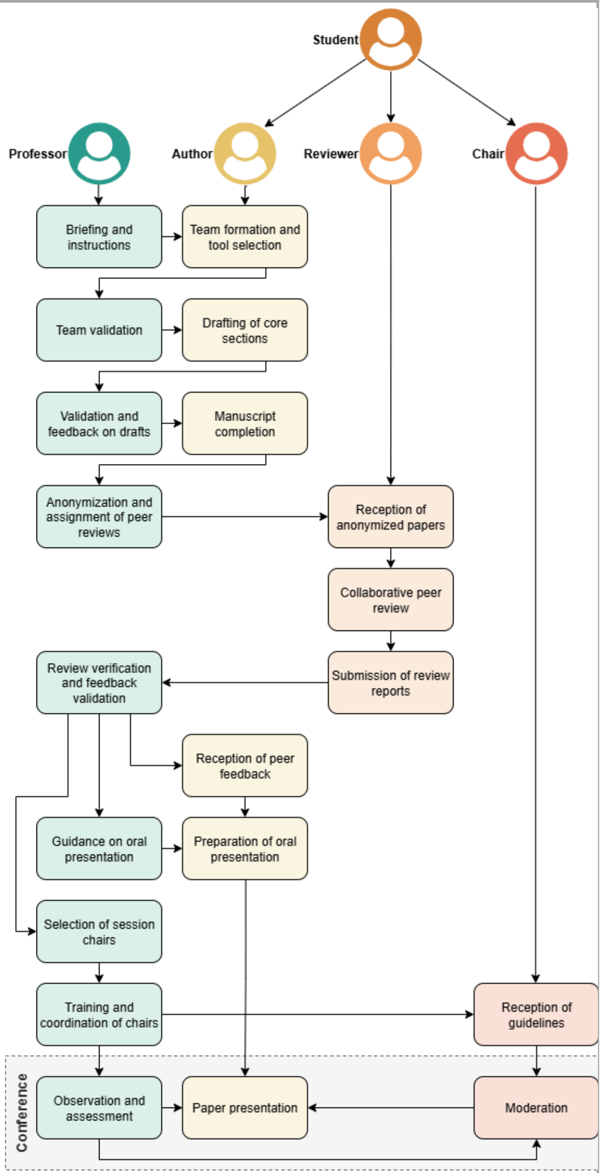

Figura 1. Flujo del proyecto (actividades, roles e intervenciones docentes).

En la sesión inicial también se presentaron los criterios de evaluación y la proyección externa. Se indicó el reparto de calificación: 70 % para la calidad del contenido y del manuscrito (P), 10 % para la presentación oral (O) y 20 % para la actividad de revisión por pares, distribuido entre las dos revisiones realizadas (10 % cada una; R_1 y R_2). La calificación final quedó formalizada como $S = 0{,}70 \cdot P + 0{,}10 \cdot O + 0{,}10 \cdot R_1 + 0{,}10 \cdot R_2$. Entre varios trabajos de alta calidad, dos grupos de trabajo fueron animados a someter sus resultados al [Doctoral Consortium en Informática (JIPII)](), celebrado en 2024 y 2025 en la Escuela de Ingeniería de Puerto Real (Cádiz). El proyecto se integró plenamente en la evaluación continua y fue complementario en contenidos y objetivos al desarrollado el curso anterior. Participaron 15 estudiantes (8 grupos) en 2023/24 y 20

	estudiantes (10 grupos) en 2024/25. Para diversificar las comparativas, se promovió la exploración de alternativas SAST diferentes entre los grupos de trabajo, ampliando el espectro de análisis y las discusiones sobre cobertura y contexto. Como entregables, cada grupo presentó el PDF y la fuente LaTeX, los repositorios analizados y un README con el procedimiento y las salidas de herramienta, garantizando trazabilidad y reproducibilidad de los resultados.
Objetivo nº 2	***Proceso de revisión***
Actividades previstas en la solicitud del proyecto:	*Se prevé, llevar a cabo las siguientes actividades:* ● *Implementación de un sistema de revisión doble ciego con criterios evaluativos claros y formación sobre cómo realizar evaluaciones constructivas.* ● *Reparto equitativo y automatizado de trabajos para el proceso de revisión (double blind peer reviews).* ● *Sesiones de feedback grupal para discutir los comentarios y mejorar los artículos.*
Resultados obtenidos:	*Se implementó la revisión doble ciego con anonimización de manuscritos y un reparto imparcial y sin reciprocidades. Cada grupo revisó dos trabajos y recibió dos revisiones, evitando que un par de grupos se evaluaran mutuamente (p. ej., si el Grupo A evaluó al B, el B no evaluó al A). Antes de revisar, se impartió una breve formación sobre evaluación constructiva, centrada en el uso de evidencias y en el tono de los comentarios, y se facilitó una plantilla estructurada que incluía la decisión global (escala de rechazo–aceptación fuerte), la identificación de puntos fuertes y débiles, recomendaciones accionables y comprobaciones de calidad (claridad de figuras, validez de las conclusiones, actualidad de las referencias y ajuste al formato).* *Las revisiones se elaboraron de forma colaborativa dentro de cada grupo y se entregaron en plazo. El profesorado verificó la consistencia y el cumplimiento estricto del doble ciego. Tras la devolución, se proporcionó una retroalimentación grupal para discutir patrones de mejora comunes, lo que dio lugar a versiones finales de los manuscritos más claras y mejor justificadas, con mayor precisión metodológica, métricas mejor reportadas y figuras revisadas.*
Objetivo nº 3	***Dinamización de sesiones de presentación***
Actividades previstas en la solicitud del proyecto:	*Se desempeñarán las siguientes tareas:* ● *Seleccionar y preparar a los estudiantes para actuar como moderadores (chairs).* ● *Proporcionar a los estudiantes directrices sobre el curso de la sesión que simulará una sesión de ponencias de un congreso.* ● *Ejecución de la sesión de presentación de trabajos, donde los moderadores y los presentadores interactúen dinámicamente con el público, simulando un entorno de conferencia real, enriqueciendo la experiencia educativa y promoviendo una participación activa.*
Resultados obtenidos:	*Se seleccionó y preparó al alumnado que actuó como chairs, proporcionándoles directrices operativas (apertura y cierre, presentación de ponentes, control de tiempos, gestión de turnos de preguntas y resolución de incidencias). Se ensayaron estrategias de moderación (preguntas de arranque, síntesis de respuestas, reconducción de debates) y señales de tiempo.* *Las sesiones se desarrollaron con normalidad, con alta participación del alumnado y un*

	flujo de preguntas variado que favoreció la discusión técnica. El profesorado mantuvo un rol observacional, registrando la calidad expositiva y la moderación sin interferir en la dinámica. Al cierre se discutieron las lecciones aprendidas (claridad de objetivos, visualización de resultados y defensa de decisiones técnicas, se revisó qué salió bien, qué puede mejorarse, qué aprendizajes se extrajeron y se resolvieron diferentes curiosidades que surgieron relacionadas con los congresos y conferencias reales.

2. Realice una breve valoración sobre la influencia del proyecto ejecutado en la evolución de las asignaturas implicadas.

Análisis del impacto de la innovación en las asignaturas relacionadas con el proyecto

Para valorar el impacto en competencias de escritura científica, revisión por pares y comunicación oral, se aplicó un cuestionario post-actividad (n = 20). El instrumento recogió percepciones sobre la experiencia global, el aprendizaje en seguridad del software asociado a la redacción del artículo, el desarrollo de pensamiento crítico derivado del doble ciego, la comunicación oral y la argumentación tras la simulación de congreso, la comprensión del funcionamiento de los congresos académicos y la recomendación de replicar la actividad en otras asignaturas; además, incluyó dos preguntas binarias sobre experiencia previa asistiendo a congresos y participación en su organización/moderación.

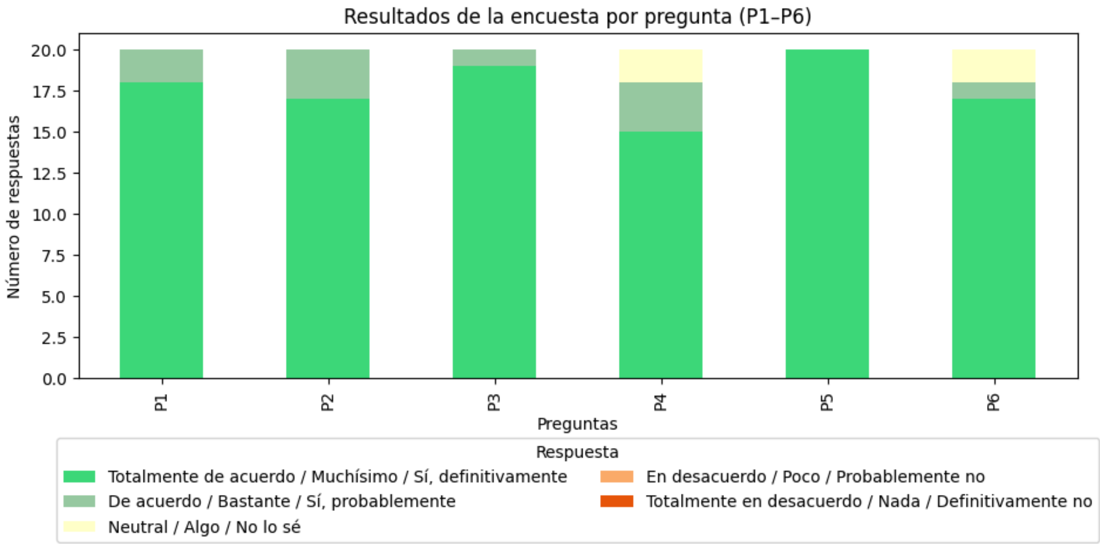

Figura 2. Respuestas a las preguntas P1–P6 (escala Likert).

En la Figura 2 (P1–P6, escala Likert 1–5) se observa una tendencia claramente positiva. En P1 se refleja la experiencia global, 18 respuestas en el nivel superior y 2 en el siguiente nivel de acuerdo; en P2 se refleja el aprendizaje en seguridad con 17 respuestas en el nivel superior y 3 en el inmediatamente anterior; en P3, se reflejan las habilidades críticas por el doble ciego, 19 en el nivel superior y 1 en el inmediatamente anterior; en P4 queda recogida la percepción en la comunicación/argumentación por la simulación de la conferencia con 15 respuestas en el nivel superior, 3 en el inmediatamente anterior y 2 neutras; en P5 se recoge el reconocimiento en comprensión de los congresos, 20 en el nivel superior; P6, recomendación de replicar la actividad, 17 en el nivel superior, 2 en el inmediatamente anterior y 1 neutra. En conjunto, los dos niveles más altos (totalmente de acuerdo/muchísimo/sí, definitivamente y de acuerdo/bastante/sí probablemente) concentran la práctica totalidad de respuestas, lo que sugiere un impacto formativo amplio en las dimensiones evaluadas.

La Figura 3 (P7–P8, respuestas Sí/No) muestra que ningún estudiante había asistido previamente a congresos académicos ni había participado en su organización o moderación; este punto de partida refuerza el valor de la simulación como primera exposición a prácticas de congreso y ayuda a explicar el aumento de confianza y participación observado. En la Figura 4 se resume la distribución de calificaciones por grupo en la asignatura donde la mediana se sitúa en torno a 6,7, con la mayoría de valores concentrados entre 5,5 y 7,1 y un rango aproximado 5,4–7,7.

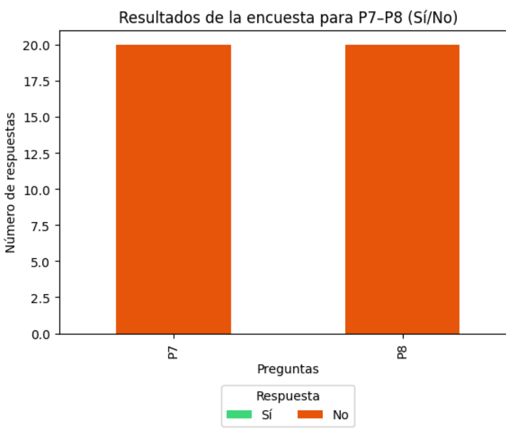

Figura 3. Respuestas a las preguntas P7–P8 (escala Likert)

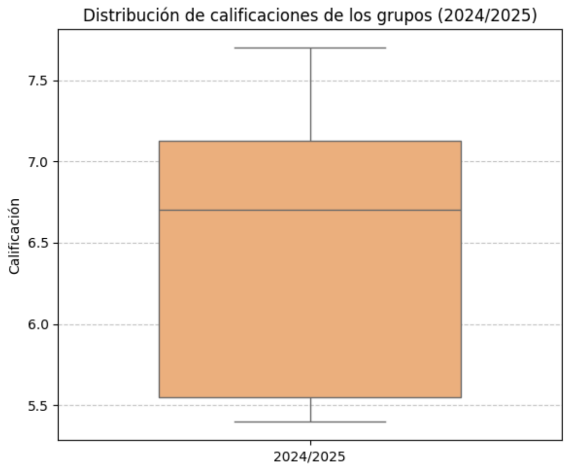

Figura 4. Distribución de calificaciones de los grupos

Estos hallazgos son coherentes con los objetivos de la innovación y respaldan su escalabilidad a otras asignaturas del área.

3. Incluya en la siguiente tabla el número de alumnado matriculado y el de respuestas recibidas en cada opción y realice una valoración crítica sobre la influencia que el proyecto ha ejercido en la opinión del alumnado.

Opinión del alumnado al inicio del proyecto				
Número de alumnado matriculado:				
Valoración del grado de dificultad ***que cree que va a tener*** *en la comprensión de los contenidos y/o en la adquisición de competencias asociadas a la asignatura en la que se enmarca el proyecto de innovación docente*				
Ninguna dificultad	Poca dificultad	Dificultad media	Bastante dificultad	Mucha dificultad
8	7	5	0	0
Opinión del alumnado en la etapa final del proyecto				
Valoración del grado de dificultad ***que ha tenido*** *en la comprensión de los contenidos y/o en la adquisición de competencias asociadas a la asignatura en la que se enmarca el proyecto de innovación docente*				
Ninguna dificultad	Poca dificultad	Dificultad media	Bastante dificultad	Mucha dificultad
7	4	9	0	0
Los elementos de innovación y mejora docente aplicados en esta asignatura han favorecido mi comprensión de los contenidos y/o la adquisición de competencias asociadas a la asignatura				

<table>
<tr><td colspan="2">Nada de acuerdo</td><td>Poco de acuerdo</td><td>Ni en acuerdo ni en desacuerdo</td><td>Muy de acuerdo</td><td>Completamente de acuerdo</td></tr>
<tr><td colspan="2">0</td><td>0</td><td>9</td><td>8</td><td>3</td></tr>
<tr><td colspan="6">En el caso de la participación de profesorado invitado</td></tr>
<tr><td colspan="6">La participación del profesorado invitado ha supuesto un gran beneficio en mi formación</td></tr>
<tr><td>Nada de acuerdo</td><td>Poco de acuerdo</td><td>Ni en acuerdo ni en desacuerdo</td><td>Muy de acuerdo</td><td>Completamente de acuerdo</td><td>Nada de acuerdo</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Valoración crítica sobre la influencia que ha ejercido el proyecto en la opinión del alumnado</td></tr>
<tr><td colspan="6">El proyecto de innovación docente mejoró la comprensión de contenidos y la adquisición de competencias, manteniendo la dificultad en un nivel asumible y sin respuestas en las categorías de mayor dificultad. La valoración positiva de la experiencia (escritura, revisión y defensa) y el aumento de confianza observados respaldan su efectividad y aconsejan extender actividades similares en la asignatura.</td></tr>
</table>

4. Describa las medidas de difusión a las que se comprometió en la solicitud y las que ha llevado a cabo[2].

<table>
<tr><td>Descripción de las medidas comprometidas en la solicitud</td></tr>
<tr><td>Para difundir las conclusiones y beneficios del proyecto, se organizará una charla abierta dirigida al profesorado de la Escuela Superior de Ingeniería, donde se presentarán los resultados, aprendizajes y materiales desarrollados, con especial énfasis en el uso didáctico de herramientas de IA generativa. Durante la sesión, se explicarán las metodologías empleadas, los retos encontrados y las soluciones adoptadas, con el fin de ofrecer una visión práctica y realista de la experiencia.
La actividad será anunciada con antelación para facilitar la participación y promover un espacio de intercambio que favorezca la transferencia de buenas prácticas y fomente nuevas iniciativas docentes dentro del centro. De forma paralela, se contempla la preparación de una comunicación científica para su presentación en el Simposio Internacional de Informática Educativa (SIIE), un foro de referencia en el ámbito de la innovación educativa en Ingeniería Informática. Las actas del congreso se publican en IEEE Xplore, lo que asegura la difusión académica y una proyección internacional de la experiencia desarrollada en el proyecto.</td></tr>
<tr><td>Descripción de las medidas que se han llevado a cabo</td></tr>
<tr><td>El jueves, 11 de septiembre, a las 18:30 h, se celebró en el seminario FS06 de la ESI la charla abierta al profesorado anunciada en la solicitud. En ella se presentaron los resultados, aprendizajes y materiales del proyecto, con especial énfasis en el uso didáctico de herramientas de IA generativa, así como las metodologías aplicadas, los retos encontrados y las soluciones adoptadas, favoreciendo un espacio de intercambio de buenas prácticas entre el profesorado.

En paralelo, se ha preparado y enviado la comunicación científica al Simposio Internacional de Informática Educativa (SIIE), que ha sido aceptada con el título: “Research Writing and Tool Evaluation in Cybersecurity Education: A Methodological Framework” que será presentado en noviembre en Viseu (Portugal). Esta aceptación cumple la medida prevista de difusión académica en el foro de referencia indicado en la solicitud y asegura su proyección internacional conforme a la política de publicación del congreso. Se adjunta artículo aceptado.</td></tr>
</table>

[2] Si en la solicitud no indicó compromiso de difusión de resultados, este criterio no se tendrá en cuenta en la evaluación.

Research Writing and Tool Evaluation in Cybersecurity Education: A Methodological Framework

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***Abstract*—As academic programmes in cybersecurity evolve to meet the demands of an increasingly complex and research-driven technological landscape, there is a growing need for pedagogical strategies that promote not only technical proficiency but also scholarly engagement. This study presents an instructional methodology that integrates research-based learning and peer assessment into a postgraduate cybersecurity course. Over two academic years, students engaged in the full research cycle by writing scientific short papers, conducting double-blind peer reviews, and participating in a simulated academic conference. The approach combined technical analysis of code vulnerabilities using both conventional SAST tools and generative AI systems, along with the development of academic skills such as scientific writing, critical evaluation, and oral communication. Survey results and evaluation scores from 35 students indicate high levels of perceived learning, engagement, and understanding of authentic academic practices. The successful submission of two student papers to an international doctoral consortium further highlights the academic relevance and impact of the initiative.**

***Index Terms*—Pedagogical innovation, secure software development, generative AI, peer review, and research-based learning**

I. Introduction

Recent challenges in cybersecurity demand that educational programs in software engineering not only address technical skill acquisition, but also promote scientific literacy, analytical thinking, and the ability to communicate research findings effectively. In postgraduate programs, it is particularly relevant to engage students in educational practices that simulate authentic research contexts, allowing them to interact with complex technical content while developing critical skills necessary for academic and professional environments [1].

Among the pedagogical frameworks that support this objective, research-based learning has received increasing attention in higher education. This methodology is characterized by its emphasis on student autonomy, evidence-informed investigation, and alignment with academic standards of reasoning and presentation. Rather than focusing solely on content delivery, it fosters engagement with disciplinary methods and encourages learners to produce work that reflects the logic and structure of scientific research. These benefits are amplified when accompanied by peer assessment mechanisms, such as double-blind peer review, which have been shown to reinforce evaluative judgment, reflective practice, and academic responsibility [1], [2]. Collaborative learning environments that integrate project-based learning (PBL) and virtual monitoring have also demonstrated increased engagement, reduced isolation, and improved academic outcomes [3].

In parallel, recent advancements in generative artificial intelligence (AI) have introduced new tools for code generation and analysis that are being gradually incorporated into educational settings. Tools such as GitHub Copilot and large language models like GPT (Generative Pre-trained Transformer) are capable of providing context-sensitive coding suggestions and dynamic vulnerability detection [4]–[6]. However, several studies have noted that these tools can also introduce security risks by producing incorrect or insufficiently validated code, especially in critical software development tasks [4], [6]. This dual nature of generative AI tools makes them ideal subjects for comparative evaluation alongside established static application security testing (SAST) systems [6].

This paper presents a structured methodology implemented in a postgraduate cybersecurity course over two consecutive academic years. The instructional design integrates core elements of academic practice, including the preparation of scientific short papers, peer review, and public presentations, along with technical analysis of software vulnerabilities using both conventional SAST tools and generative AI-based systems [7], [8]. Students work in small teams to produce six-page research papers that examine code vulnerabilities and conduct comparative evaluations of static analysis and generative AI-based tools used in secure software development. Peer review is conducted anonymously using a structured rubric, and presentation sessions are moderated by students acting as session chairs.

The remainder of this paper is structured as follows. Section II reviews related work on research-based learning, peer assessment, and the use of AI-assisted tools in software security education. Section III details the instructional methodology, including its pedagogical foundations, structure, and implementation over two academic years. Section IV presents observations from student participation and scores obtained during the evaluation. Finally, Section V offers conclusions and discusses future directions for refining the approach.

II. Related Work

Education in Software Engineering (SE) and related scientific disciplines must evolve beyond traditional didactic models to address the demands of increasingly complex professional environments. This shift requires pedagogical frameworks that not only ensure technical competence but also foster higher-order cognitive skills, such as critical thinking, creativity, autonomous learning, and problem-solving [1], [9]. SE graduates frequently enter the workforce with deficits in essential skills such as written and oral communication, collaborative work, and effective use of development tools—competencies that are critical in professional practice [10].

Thinking-Based Learning (TBL) has emerged as a pedagogical strategy designed to enhance effective thinking through structured and deliberate reflection. Empirical studies have shown that implementing TBL in SE education leads to significant improvements in students' higher-order thinking skills (HOTs), particularly through collaborative discussions and project-based learning activities [11].

Another strategy is Project-Based Learning (PBL), which has been particularly effective in SE units focused on hardware, such as embedded systems and robotics. A notable extension of this model is Research-Integrated PBL (RI-PBL), which introduces explicit research components into traditional PBL. RI-PBL was implemented in the SIT210 Embedded Systems Development course across Australian and Indian institutions, resulting in improved student understanding, project quality, and engagement [12]. Despite initial challenges, such as difficulties in formulating research questions and adapting to academic writing, structured support in research methodology significantly improved student outcomes.

Authentic assessment is an important element of educational innovation. It refers to tasks that simulate real-world situations, helping students develop practical skills instead of simply memorizing information. One example is the peer review of scientific preprints, where students evaluate unpublished scientific articles. This activity introduces them to how the scientific community improves its work through critical feedback and revision [9], [13]. When supported with clear rubrics and teacher guidance, peer review helps students improve their critical thinking and understanding of scientific texts. It also reduces plagiarism, as shown by lower text similarity in the assignments [13]. In addition, students who participate in this process often feel more connected to the scientific community and develop a stronger sense of scientific identity.

Mentoring in writing and publishing is essential to help students understand the less visible aspects of academic research, such as how to write scientific papers, review the work of others, and publish results. These tasks often belong to what is called a "hidden curriculum" because they are rarely taught directly without expert guidance. According to cognitive apprenticeship theory, mentors should make expert thinking visible, offering examples, guidance, and gradually allowing students to take responsibility [14]. While scientists and educators may focus on different goals, such as producing results or supporting learning, both agree that active involvement in academic communication is important. Still, more attention is needed to organize this support clearly and progressively, so that students can develop all aspects of their identity and skills in STEM fields in a balanced way.

Educational trends increasingly support teaching approaches that are more practical and connected to real-world academic work. TBL helps students develop important thinking and self-reflection skills in software engineering. PBL and RI-PBL improve problem-solving, creativity, and preparation for real challenges. Reviewing scientific preprints helps students better understand how science works and improves their ability to read and evaluate research. Finally, having mentors who guide students through tasks like writing, reviewing, and publishing plays a key role in helping them take part in the academic community and build their confidence as future professionals. However, few initiatives integrate these pedagogical strategies with the technical evaluation of cybersecurity tools and active participation in simulated academic events. This proposal addresses that gap by combining research writing, peer review, and tool analysis within an authentic, student-led conference format.

III. Methodology

A. Academic Context and Student Profile

This project was implemented within the course "Secure Application Development", a compulsory 4 ECTS subject taught during the first semester of the Master's Degree in Information Security at the University of Cádiz. The course belongs to the "Security Technologies" module and aims to provide students with the technical and methodological skills to design, develop, and audit secure software systems according to both academic and professional standards in cybersecurity.

The initiative was fully embedded into the continuous assessment structure of the course during the academic years 2023/2024 and 2024/2025. In particular, the project aligned with the learning outcomes related to secure software engineering practices and vulnerability analysis in source code, as defined in the official syllabus.

A total of 15 students participated in 2023/2024, and 20 students in 2024/2025. Gender distribution showed a pronounced imbalance, with 14 men and 1 woman in the first year, and 16 men and 4 women in the second (see Table I).

Most participants had prior academic backgrounds in Computer Engineering or related fields, with solid technical skills but limited or no previous experience in scientific writing, peer review processes, or academic dissemination.

TABLE I: Student enrollment and gender composition by academic year.

Year	Total	Men / Women	% Men / Women
2023/2024	15	14 / 1	93.3% / 6.7%
2024/2025	20	16 / 4	80.0% / 20.0%

B. Implementation Stages

The activity was distributed over six consecutive weeks, following the schedule summarized in Table II, which outlines the temporal structure applied uniformly across both academic years. The complete instructional workflow, including the sequence of actions, role transitions, and interactions among students and teaching staff, is depicted in Figure 1.

TABLE II: Timeline of the scientific writing project across a six-week implementation cycle.

Week	Activity focus
Week 1	Project briefing, team formation, and tool/topic selection
Week 2	Drafting of core sections (proposal, background, initial results)
Week 3	Submission of complete article and peer review assignment
Week 4	Double-blind peer review and review report submission
Week 5	Feedback reception and preparation of oral presentations
Week 6	Conference simulation and oral defense of student papers

1) Project briefing, team formation, and tool/topic selection: The project was introduced during the first week of the course through a briefing that outlined the activity's purpose, deliverables, and evaluation criteria. Students were informed that the exercise would simulate the core stages of academic research dissemination, from the writing of a short scientific paper to peer review and oral presentation.

The instructions emphasized the need for each group to conduct a comparative analysis of two *Static Application Security Testing* (SAST) tools. To encourage diversity of topics and prevent redundancy, the use of commonly adopted tools, such as Semgrep[1], SonarQube[2] and Snyk[3], was explicitly restricted, including their respective extensions and web-based implementations. Students were encouraged to explore alternative solutions, assessing their ability to detect vulnerabilities in real or synthetic code examples.

Students formed teams of two or three members according to their own organizational criteria. In the first academic year of implementation, this resulted in the formation of eight distinct groups, while the second year accommodated ten groups. Each team selected their tools and proposed a preliminary plan of action, including a rationale for the comparison and a description of the target codebase. These proposals were reviewed and validated by the teaching staff to ensure feasibility and topic differentiation across groups.

To support the writing process, a LaTeX template based on the Springer Lecture Notes in Computer Science (LNCS) was

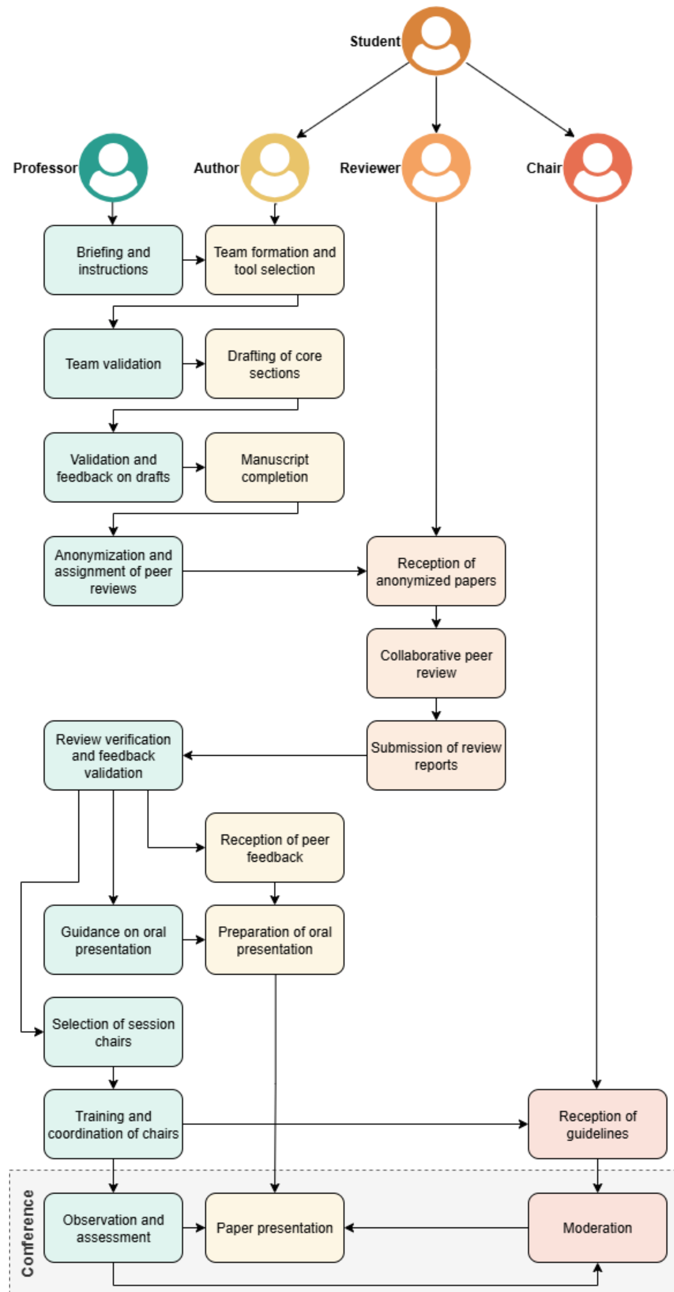


Fig. 1: Instructional workflow of the project, showing the sequential activities and role transitions assumed by students (authors, reviewers, and chairs), and the interventions of the teaching staff across the different implementation phases.

[1] https://semgrep.dev/
[2] https://www.sonarsource.com/es/products/sonarqube/
[3] https://snyk.io/es/

made available through Overleaf[4]. The paper was expected to include a structured introduction, a review of related work, a detailed methodological proposal, a results section with annotated evidence, and a list of references, with a maximum length of six pages. Students were instructed to use annotated screenshots as part of their evidence base and to include only code relevant to the vulnerabilities detected by the selected tools. Formal requirements and submission deadlines were also explained.

This preparatory stage provided students with the necessary methodological stages, formal constraints, and organizational autonomy to initiate the writing process under conditions aligned with academic standards.

2) Drafting of core sections: Following the initial project setup, students progressed to the drafting phase, where they began constructing the core sections of their short papers. The objective during this stage was not only to articulate a coherent research narrative but also to familiarize students with the conventions of academic discourse.

Each group was expected to complete the following core sections of the paper: the "Proposal", which described the selected tools, their expected capabilities, and the rationale for comparison; the "Background and Related Work", which contextualized the study by reviewing previous academic or industrial work on static analysis, vulnerability detection, and tool benchmarking; and the "Results", in which students began documenting the empirical evaluation, integrating early observations from the application of the selected tools to real or synthetic codebases.

Throughout this phase, the teaching staff provided formative supervision. Feedback focused on methodological clarity, consistency in terminology, citation practices, and the balance between technical content and explanatory narrative. Particular emphasis was placed on the articulation of a reproducible analysis pipeline, encouraging students to justify their test scenarios and interpret the results with appropriate caution and precision.

3) Submission of complete article and peer review assignment: Students submitted their papers through the Virtual Campus (Moodle), including the article in both PDF and LaTeX source format, the analyzed code repositories, and a README file explaining the procedure followed and the tool outputs obtained.

Immediately after submission, each group was assigned two anonymized articles (double-blind peer review protocol) from their peers to review. The assignments were manually made to prevent reciprocal evaluations. Reviewers were instructed to approach the task collaboratively, discussing the assigned papers within their teams before composing a unified response.

This stage marked the transition from the production to the evaluation phase, requiring students to shift perspective from authors to reviewers.

4) Double-blind peer review and review report submission: To ensure consistency and depth in the reviews, all students were required to use a structured review template inspired by established conference evaluation protocols. The template included a categorical recommendation, ranging from outright rejection to strong acceptance, with intermediate levels. Reviewers were also asked to classify the paper's orientation along the theory–practice spectrum and to identify the type of value added to the field, including contributions such as clarification of current understanding, introduction of new perspectives, or confirmation of existing knowledge.

Additional metadata were collected to assess reviewer familiarity with the subject matter, perceived award-worthiness of the submission, and suitability of the article's length. A series of specific quality checks focused on the adequacy of figures, the validity of conclusions, the currency and relevance of references, and compliance with formatting guidelines.

All peer reviews were submitted through the Virtual Campus and subsequently verified by the teaching staff. This validation ensured that each group received coherent, constructive, and appropriately framed feedback. The process also allowed instructors to identify misconceptions, omissions, or exemplary contributions, and to guide students in interpreting the comments received.

By engaging directly with the work of their peers, students developed an appreciation for clarity, argumentation, and empirical grounding, while simultaneously identifying points of improvement in their own submissions.

5) Feedback reception and preparation of oral presentations: No formal resubmission of the article was required, however, all teams were instructed to reflect on the critiques and incorporate relevant modifications into the narrative of their oral presentations.

The teaching staff provided guidance on effective scientific communication, with particular emphasis on structuring a talk, selecting illustrative material, and anticipating audience questions. Students were encouraged to rehearse their delivery, ensure visual clarity of diagrams and screenshots.

6) Conference simulation and oral defense of student papers: The final stage of the project ended in a simulated academic conference, designed to emulate the dynamics and formalities of a real scientific event. To structure the session according to academic standards, four students were selected to serve as session chairs. These students were briefed in advance on their responsibilities, which included opening the session, introducing each group, managing time constraints, moderating the discussion phase, and ensuring a respectful and orderly environment.

The conference was divided into two consecutive parts. Each presentation was allocated a maximum of 12 minutes, followed by a 5-minute round of questions and discussion. The discussion segments encouraged peer interaction, clarification of assumptions, and spontaneous reflection on alternative approaches.

Participants were encouraged to observe and learn from each other's communication styles, argumentation techniques, and visual strategies. The teaching staff adopted an observatory role, assessing the content and delivery of the presentations as

[4]https://www.overleaf.com/latex/templates/springer-lecture-notes-in-computer-science/kzwwpvhwnvfj

well as the performance of the chairs, without interrupting the autonomous flow of the event.

C. Evaluation

The final score for each group was calculated as a weighted sum of four components: 70% for the quality of the content and written paper, 10% for the oral presentation, and 20% for the peer review activity, divided equally between the two reviews each group completed (10% each). This calculation is formalized in Equation (1), where P denotes the paper score, O the oral presentation score, and R_1, R_2 the scores for the two peer reviews submitted.

$$S = 0.70 \cdot P + 0.10 \cdot O + 0.10 \cdot R_1 + 0.10 \cdot R_2 \quad (1)$$

Among several high-quality projects, two student teams were encouraged to submit their work to the *Doctoral Consortium in Computer Science (JIPII)*[5], held in 2024 and 2025 at the School of Engineering in Puerto Real, Cádiz, Spain. Although more teams were invited, only these two accepted the challenge and completed the submission process. Both papers were accepted [7], [8], highlighting the academic quality and relevance of the student contributions. The JIPII consortium is considered an international forum for emerging research in computing disciplines.

IV. Survey Results

To assess the impact of the instructional design, a post-activity survey was administered to all students who took part in the scientific writing and peer review project, which also included simulated academic conference participation and student-led session moderation. The instrument included eight questions designed to assess students' perceptions of learning outcomes, skill development, and exposure to academic practices. The full set of survey items is listed below.

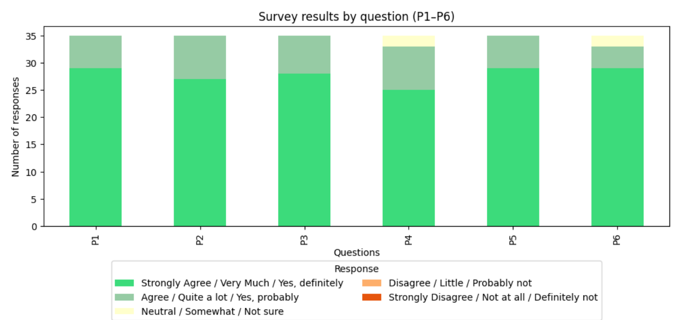
- **P1.** How would you rate your overall experience participating in this educational innovation project?
- **P2.** Do you believe that writing the scientific paper significantly enhanced your understanding of software security concepts?
- **P3.** Do you think the double-blind peer review process improved your critical and analytical skills?
- **P4.** To what extent did participating in the simulated conference session help you develop oral communication and argumentation skills?
- **P5.** Do you feel this experience provided you with a better understanding of how academic conferences are organized and conducted?
- **P6.** Would you recommend implementing similar innovative activities in other subjects?
- **P7.** Have you ever attended an academic conference?
- **P8.** Have you ever participated in organizing or moderating a conference session?

[5]https://jipii.uca.es/

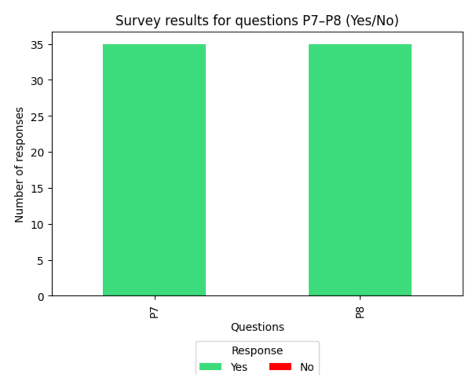
A total of 15 students from the 2023/2024 cohort and 20 students from the 2024/2025 cohort completed the full questionnaire. Items P1 through P6 were rated on a five-point Likert scale, where 5 indicated "Strongly Agree / Very Much / Yes, definitely" and 1 indicated "Strongly Disagree / Not at all / Definitely not." Items P7 and P8 were answered using binary response options (Yes/No).

The distribution of survey responses is shown in Figures 2a and 2b. Figure 2a illustrates a strong positive trend across Likert-scale items (P1–P6), with most students selecting the top two agreement levels. These results indicate that participants perceived the activity as highly valuable for improving their understanding of software security, developing critical and communication skills, and engaging with academic practices.

Figure 2b summarizes responses to binary questions (P7 and P8), showing unanimous participation in the simulated conference despite students having no prior experience with similar academic events. This suggests that the activity effectively introduced them to core practices of scholarly communication and event organization.



(a) Responses to questions P1–P6 (Likert scale).



(b) Responses to questions P7–P8 (binary).

Fig. 2: Survey results: (a) Likert-scale items and (b) binary items.

In addition to perception-based feedback, final evaluation scores were also analyzed to identify trends in performance across cohorts. Figure 3 shows the distribution of group scores for the 2023/2024 and 2024/2025 cohorts. While both groups achieved satisfactory results, a noticeable difference in score dispersion is evident. The 2023/2024 cohort demonstrated a more consistent and higher scoring pattern, whereas the 2024/2025 cohort showed greater variability and lower median performance. These trends may reflect differences in group dynamics, topic selection, or engagement levels with the instructional activities.

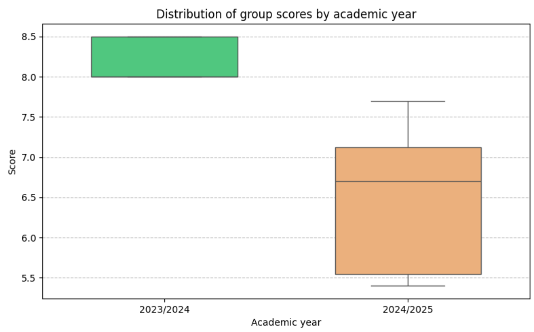


Fig. 3: Distribution of group evaluation scores by academic year. The 2023/2024 cohort showed more consistent and higher scores, while the 2024/2025 cohort exhibited greater dispersion.

V. Conclusions and Future Work

As higher education increasingly prioritizes authentic, research-integrated learning experiences, the integration of scientific communication practices into technical curricula has gained renewed relevance. In this context, a postgraduate cybersecurity course was adapted to incorporate core components of academic research, including scientific writing, peer review, and conference simulation, within the framework of secure software development.

The results demonstrate that the methodology effectively fostered key competencies in software security, research communication, and critical thinking. Students expressed strong satisfaction with the process, and evaluation scores reflected consistent academic performance across both cohorts. The unanimous engagement in conference simulation, despite a lack of prior experience, highlights the activity's success in demystifying academic practices.

Moreover, the acceptance of two student-authored papers in an international doctoral consortium underscores the authenticity and quality of the work produced. Future iterations of this project may explore extending the activity to interdisciplinary teams, incorporating live peer feedback sessions, or integrating additional support for academic writing to further enhance student outcomes and professional preparedness.

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