ClinicalModelling

Implementation Report

D4.4 - Report of the testing and its main findings

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Content

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1. Executive Summary

Work Package 4 of the ClinicalModelling project was set out to test the use of video-modelling and video self-modelling in nursing education, with the dual aim of validating the feasibility of the methodology and assessing its pedagogical and personal impact on students. Building on the ethical, technical, and pedagogical foundations established in earlier work packages, WP4 moved into real educational contexts, involving both undergraduate, graduate and postgraduate cohorts across four countries: Portugal, Slovenia, Poland, and Spain.

The implementation covered a range of clinical procedures, from protocol-driven tasks such as Basic Life Support and surgical handwashing to more complex skills such as intravenous cannulation and surgical instrumentation. Students were organised into intervention and control groups, with the former using smart glasses to record their performance, review the videos with instructors, and repeat the procedure. Control groups followed traditional approaches, receiving only verbal feedback. In all cases, the process was structured within a pedagogical cycle of theoretical preparation, practical execution, video review, debriefing, and repetition.

Evaluation relied on a mixed-method design. Quantitative data were collected through perception questionnaires and the General Self-Efficacy Scale, while qualitative insights were gathered from open survey responses, national reports, and discussions in Peer Learning Events. The results converge on several key findings. Students consistently valued the opportunity to observe their own performance, reporting that video self-modelling enhanced their ability to detect errors, consolidate skills, and take greater responsibility for learning. Teachers confirmed higher levels of engagement and concentration during classes, noting that the methodology deepened reflection and reinforced procedural accuracy. The General Self-Efficacy Scale showed moderate but consistent gains, particularly in domains related to coping with difficulties and problem solving, while qualitative testimonies highlighted increases in confidence, motivation, and resilience.

The testing phase also identified important lessons. The methodology proved particularly effective for structured, sequential tasks, while results were more variable in complex, multi-dimensional procedures, suggesting the need for blended approaches and extended practice. The ergonomics and availability of smart glasses posed challenges, as did the time required for video review in large groups, but these were mitigated through familiarisation sessions, selective use of recordings, and institutional support. The Peer Learning Events provided a transnational platform to address these challenges collectively, generating shared solutions and confirming the adaptability of the methodology across diverse curricula and cultural contexts.

In conclusion, it was demonstrated that video-modelling and video self-modelling are feasible, impactful, and transferable tools for healthcare education. They enrich teaching by combining visual feedback with structured reflection, motivate students

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to engage more actively with their learning, and open opportunities for curricular innovation. To sustain and expand these outcomes, institutions should integrate the methodology into structured pedagogical sequences, ensure adequate technical support and resources, and promote continued exchange of practices across networks. The lessons learned in WP4 provide a strong foundation for the future expansion of the ClinicalModelling project methodologies, offering a pathway for broader transformation in how healthcare professionals are trained in Europe.

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2. Introduction

The ClinicalModelling project was conceived to explore how innovative digital technologies, particularly video-modelling and video self-modelling, can transform health education and professional development. Funded under the Erasmus+ programme (ERASMUS-EDU-2022-PI-ALL-INNO – Partnerships for Innovation: Alliances), the project brings together higher education institutions, hospitals, and technology partners from four European countries — Portugal, Slovenia, Poland, and Spain. Its overarching aim is to develop sustainable methodologies for integrating digital tools into healthcare training, thereby fostering reflective practice, empowering students and professionals, and creating high-quality educational resources.

While earlier project's Work Packages focused on developing ethical and technical foundations (WP2) and on producing pedagogical resources and training materials for teachers and trainers (WP3), Work Package 4 (WP4) represented a decisive step in testing the methodology in real educational contexts. Building on deliverables such as the Common Library of Medical and Nursing Cases (D4.1) and the Catalogues of Lessons (D4.2 and D4.3), WP4 moved into practice by implementing pilot lessons across the four partner countries. The purpose of this stage was not only to validate the quality and usability of the materials developed, but also to assess the impact of using video-modelling and video self-modelling in the teaching and learning of health sciences.

The present deliverable, **D4.4 – Report of the Testing and its Main Findings**, documents this process. It provides an overview of how implementation unfolded in different national contexts, highlights the experiences of students and educators, and analyses the impact of the methodology across multiple dimensions. In doing so, it offers evidence-based insights into how video can be integrated into healthcare curricula to support skill acquisition, reflective practice, and self-efficacy.

The central objective of WP4 was to test the use of video as a pedagogical tool that brings clinical practice closer to the classroom. Students were invited not only to watch professional demonstrations, but also to engage in video self-modelling — analysing their own performance during simulations or practical exercises. This dual perspective, combining observation of expert practice with reflection on one's own performance, is at the core of the ClinicalModelling methodology. It allows learners to benefit from the clarity and structure of guided demonstrations, while at the same time developing metacognitive skills through self-observation and peer discussion.

In order to evaluate the outcomes of this implementation, a mixed-method approach was adopted. Quantitative data were collected through the General Self-Efficacy Scale (GSE), applied to students before and after the intervention, and through a dedicated perception questionnaire capturing their views on the experience. These instruments were complemented by qualitative sources, including the reports submitted by national teams and the minutes of the Peer Learning Events.

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This triangulation of data ensured that both measurable impacts and lived experiences could be documented, providing a comprehensive picture of results.

The evaluation process was guided by a set of predefined criteria:

- **Pedagogical effectiveness** – the extent to which video-modelling enhanced learning and skills acquisition.
- **Student empowerment** – changes in students' confidence, self-efficacy, and motivation to learn.
- **Curricular relevance** – how the methodology aligned with teaching objectives and enriched classroom practice.
- **Sustainability and transferability** – the potential of the approach to be scaled up and integrated into different institutional and cultural contexts.

The four national implementations provided a valuable opportunity to observe the methodology under diverse conditions. Each country integrated video-modelling into different courses, disciplines, and class profiles, thereby generating a rich set of experiences. Taken together, these national cases contribute to a transnational analysis that balances local specificities with overarching patterns.

Beyond the classroom, WP4 also created spaces for collective reflection. The Peer Learning Events worked as transnational forums where educators and researchers exchanged experiences, discussed challenges, and identified good practices. These discussions enriched the interpretation of survey data and reinforced the collaborative ethos of the project.

By situating the testing phase within both its immediate outcomes and its broader contribution to the project, this deliverable seeks to answer two central questions:

1. Does video-modelling and video self-modelling enhance learning in healthcare education?
2. Under what conditions can this methodology be effectively and sustainably integrated into curricula?

The following chapters document the methodology of evaluation, describe the implementation processes in each country, present and analyse the results of surveys and scales, and reflect on good practices, lessons learned, and impacts. Together, they provide a structured and evidence-based narrative that not only confirms the feasibility and pedagogical value of video-modelling, but also highlights the institutional, cultural, and personal conditions under which such innovation can thrive.

In doing so, the report contributes to the ultimate aim of the ClinicalModelling project: to foster a culture of reflective practice in healthcare education, where students are empowered to learn from both expert demonstration and their own experience, and where video becomes a central tool for continuous improvement and lifelong learning.

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3. Methodology of Evaluation

The evaluation of Work Package 4 (WP4) was conceived as a comprehensive process aimed at documenting and analyzing the testing of video-modelling and video self-modelling in health education.

Given that the objective of this phase was not only to validate the feasibility of the methodology but also to understand its pedagogical and personal impact, a mixed-method approach was adopted.

This approach combined quantitative and qualitative dimensions, ensuring that measurable outcomes could be complemented by the perceptions, reflections, and experiences of the participants. By doing so, the consortium sought to generate a holistic picture of results, highlighting both the numerical evidence of change and the contextual insights that help explain how and why such change occurred.

Instruments for Data Collection

The first instrument mobilised was the **Students' Perception Questionnaire**, designed specifically for the ClinicalModelling project. This questionnaire was applied to all students who participated in the pilot lessons and served as a structured tool to capture their views on the experience. It included a combination of closed-ended questions, using Likert-type scales, and open questions that invited more detailed and subjective responses. Through the closed-ended items, it was possible to quantify students' perceptions of the clarity of the methodology, the usefulness of video-modelling for their learning, their level of engagement during activities, and their satisfaction with the process as a whole. The open-ended items, in turn, enabled students to express in their own words what they valued most, what difficulties they encountered, and what suggestions they could offer for future improvements.

The dual structure of this questionnaire provided both numerical indicators and qualitative insights, which together contributed to a more nuanced understanding of the student experience.

The second instrument was the **General Self-Efficacy Scale (GSE)**, a validated and widely used tool in education and psychology. The GSE is composed of ten statements that measure an individual's generalized sense of self-efficacy — that is, their belief in their ability to cope with challenges, manage difficulties, and achieve goals even when confronted with obstacles. In the context of WP4, the GSE was applied at two different points in time: before the start of the pilot's activities and after their completion.

This pre-test and post-test design allowed for the comparison of results and the identification of any change in students' self-perceptions of efficacy attributable to the use of video-modelling. By focusing on self-efficacy, the consortium sought to

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evaluate not only the cognitive outcomes of the methodology but also its impact on the personal dimension of student learning — confidence, autonomy, and motivation to face new challenges. The inclusion of this scale was particularly relevant given that video self-modelling is designed to strengthen reflective practice and personal awareness, which are closely related to self-efficacy.

A third source of data was the **minutes of the Peer Learning Events (PLEs)**. These events were organized as structured moments of collective reflection, bringing together educators, researchers, and project partners to discuss the implementation process, exchange experiences, and analyze both opportunities and difficulties encountered in the classroom. The minutes of these meetings provided valuable qualitative evidence, capturing not only the factual content of discussions but also the collective reasoning of the consortium. They documented how national teams interpreted student feedback, how they compared their experiences across different institutional and cultural contexts, and how they identified good practices and common challenges.

The PLEs thus functioned as a transnational mirror of the implementation, ensuring that the interpretation of local results could be situated within a broader European perspective.

The fourth and final instrument was the **national reporting prepared by each team**. Each partner institution involved in the testing was asked to compile a structured report describing how the methodology was implemented in their local context. These reports included details such as the courses and disciplines in which video-modelling was introduced, the number and profile of students involved, the organization of pilot lessons, the type of videos used, and the pedagogical strategies adopted. They also included reflections from teachers on the reception of the methodology, its integration into existing curricula, and the logistical or institutional challenges that needed to be addressed. In addition to complementing the data gathered through questionnaires and scales, these reports offered the indispensable perspective of educators, whose role in guiding and facilitating the methodology was crucial for its success.

Criteria for Analysis

The data gathered from these instruments were analyzed according to a set of predefined criteria that reflect the objectives of WP4. The first was pedagogical effectiveness, understood to the extent to which video-modelling and video self-modelling contributed to the acquisition of knowledge, the development of skills, and the overall improvement of the learning process in healthcare education.

The second criterion was student perception, which focused on how students themselves evaluated the experience. Their satisfaction, motivation, engagement, and willingness to use similar methodologies in the future were considered essential indicators of the success and acceptability of video-modelling.

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A third criterion centered on personal impact, measured primarily through the General Self-Efficacy Scale. The aim here was to verify whether participation in video-modelling activities was associated with an increase in students' confidence in their own capacities, their ability to handle difficulties, and their propensity to take initiative in their learning processes.

The fourth criterion was curricular relevance, which assessed how well the methodology aligned with course objectives, how easily it was integrated into existing teaching structures, and to what extent it enriched or complemented traditional pedagogical approaches.

Finally, the fifth criterion was sustainability and transferability, reflecting the potential of video-modelling to be maintained and expanded beyond the pilot phase. This dimension included questions about institutional support, the adaptability of the methodology to different contexts, and its feasibility for long-term use in healthcare education.

Ethical Considerations

As in other phases of the project, all procedures were conducted in strict compliance with the ethical standards defined in earlier deliverables, particularly D2.1 and D3.1.

Students were fully informed about the objectives of the project and the use of their data, and their participation was voluntary and had no influence on academic grading. Data were anonymized and treated with confidentiality, in accordance with GDPR principles and institutional ethical approvals.

Overall Approach

The combination of these instruments and criteria of analysis made it possible to capture the complexity of the testing phase in WP4. Quantitative tools such as the perception questionnaire and the GSE provided structured and comparable data, while qualitative evidence from the Peer Learning Events and national reports enriched the analysis with lived experience and contextual depth.

By triangulating these sources, the consortium was able to validate findings across different perspectives and ensure that conclusions were grounded both in numbers and in narratives. This approach reflects the conviction that innovation in education cannot be understood solely through statistical change but must also be interpreted through the voices of students, teachers, and institutions that bring the methodology to life.

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4. National Implementation Processes

The testing phase of Work Package 4 was carried out across the four participating countries — Portugal, Slovenia, Poland, and Spain — with each national team responsible for integrating video-modelling and video self-modelling into selected courses and classroom activities. The purpose of this stage was to assess the feasibility of the methodology in diverse educational contexts, while capturing the perceptions of students and teachers and evaluating its pedagogical and personal impact.

Although the consortium established a common framework to guide implementation, the activities in each country reflected the specificities of local curricula, institutional priorities, and student profiles. This diversity proved to be one of the strengths of the project, as it allowed for the observation of how video-modelling could be adapted to different teaching and learning environments, from undergraduate nursing courses to specialized modules at postgraduate's and specialization levels.

In all cases, implementation followed a similar structure: students were introduced to the methodology, engaged in practical sessions that involved the recording and observation of clinical or simulation activities, and participated in structured discussions or reflective exercises. The use of video resources varied between contexts, combining professional recordings available in the ClinicalModelling Library with self-produced materials created during class. Students were subsequently invited to complete the perception questionnaire and the General Self-Efficacy Scale (GSE), while educators contributed with local reporting and feedback.

The following subsections provide an overview of how the implementation unfolded in each of the four national contexts. For each country, the report presents the educational background in which the methodology was applied, a description of the classroom activities and videos used, the main results and student perceptions, and the challenges and solutions identified by the teams. Taken together, these national experiences constitute the empirical basis for the comparative analysis developed later in this deliverable, demonstrating both the common benefits of video-modelling and the local adaptations that ensured their successful integration.

4.1. Poland

At the Jagiellonian University Medical College in Kraków, implementation focused on two fundamental nursing skills: surgical handwashing and peripheral vein cannulation using a Venflon-type cannula. These procedures were deliberately selected because they combine high pedagogical value with broad applicability in professional practice. Surgical handwashing represents a cornerstone of infection prevention, while cannulation constitutes a technical skill of central importance in patient care.

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The activities took place in the Nursing Skills Lab and the Center for Innovative Medical Education, ensuring access to simulation environments that closely mirrored clinical settings.

Students first received preparatory materials that introduced the ClinicalModelling methodology and reviewed the theoretical aspects of the procedures. Two separate modules were then organized. In the handwashing module, the intervention group comprised 24 third-year students, while the control group included 23. In the cannulation module, 38 first-year students formed the intervention group and 32 formed the control group.

During the sessions, students in the intervention groups wore Vuzix M400 smart glasses to record their performance. The recordings were later reviewed on laptops in the presence of instructors, creating opportunities for structured reflection and feedback. After this review, students repeated the procedure, integrating the corrections discussed. Control groups performed the same procedures under teacher supervision, with immediate verbal feedback, but without video recording.

The implementation, conducted in March and April 2025, involved seven nursing instructors and one technical support staff member. The instructors ensured pedagogical guidance and feedback, while the technical staff provided assistance with equipment setup and calibration. Data collection included the General Self-Efficacy Scale (GSE), administered before and after the intervention, and a custom perception questionnaire aligned with Kolb's Experiential Learning Cycle.

4.2. Portugal

In Portugal, implementation was carried out in two different contexts, corresponding to undergraduate and postgraduate/specialization nursing education at Santa Maria Health School.

The first setting involved 76 undergraduate nursing students during Basic Life Support (BLS) training. After attending a theoretical session, students were randomly assigned to an experimental group (n=40) or a control group (n=36). In the practical sessions, the experimental group performed the BLS algorithm while wearing smart glasses, recording their actions for subsequent review and repetition under instructor guidance. The control group followed the same process but without video recording, relying solely on verbal feedback. The activity was evaluated using a BLS-specific performance checklist, applied before and after the intervention, and the General Self-Efficacy Scale (GSE).

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The second implementation took place in a postgraduate surgical instrumentation course, involving 11 students divided into an experimental group (n=6) and a control group (n=5). Following theoretical preparation, participants engaged in simulated practice of preparing and managing a surgical table for a knee replacement procedure. Students in the experimental group recorded their performance using smart glasses, reviewed the videos, and repeated the tasks, while the control group worked under traditional supervision. Assessment was carried out using a surgical instrumentation checklist and the GSE, both administered before and after the sessions.

In both contexts, the sessions were facilitated by nursing instructors experienced in simulation pedagogy, who ensured consistency in instruction and feedback.

The dual setting of BLS and surgical instrumentation allowed for testing the methodology in both highly structured, time-critical tasks and in more complex, cognitively demanding procedures.

4.3. Slovenia

At the University of Ljubljana Faculty of Health Sciences, the implementation was conducted in the Nursing Department and focused on two procedures: surgical handwashing and peripheral intravenous catheter (PIVC) insertion. These skills were chosen because they combine aseptic technique with technical dexterity, offering students opportunities to train both safety-related and complex manual competencies.

The testing, carried out between March and May 2025, was structured into five lessons. The first introduced the project and explained the use of smart glasses and the methodology of video-modelling and self-modelling. The second focused on the theoretical framework of the selected skills. Lessons three and four involved practical sessions: control groups performed the procedures under teacher supervision and received immediate verbal feedback, while intervention groups wore smart glasses, recorded their performance, reviewed the videos with instructors, and repeated the procedures. The fifth lesson was devoted to debriefing, reflection, and evaluation.

A total of 9 second-year students in the elective course Basics of Perioperative Nursing participated in the surgical handwashing sessions, while 58 first-year students were involved in the PIVC lessons. Students were divided into intervention and control groups in order to ensure comparability.

The implementation was coordinated by four nursing teachers, who facilitated both the technical learning and the reflective process. Each student completed the

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General Self-Efficacy Scale (GSE) before and after the intervention, as well as a final survey on the educational experience. The systematic progression from theoretical preparation to practical repetition and structured debriefing ensured that video-modelling was embedded in a broader pedagogical cycle of experiential learning.

4.4. Spain

At the University of Santiago de Compostela, the ClinicalModelling methodology was integrated into the Occupational Nursing course for second-year nursing students. A total of 40 students were randomly assigned to control and experimental groups, ensuring methodological robustness.

The intervention followed a six-session sequence spread across three weeks. The first session introduced the ClinicalModelling project, presented the smart glasses to the experimental group, and gathered baseline data. The second session provided theoretical instruction on surgical handwashing and donning sterile gloves, while the third used case-based learning to stimulate reasoning and decision-making. Sessions four and five consisted of practical training under faculty supervision: control groups practiced the skills traditionally, while experimental groups used smart glasses to record and review their performance before repeating the procedures. The sixth and final session was dedicated to individual evaluation, with performance assessed through standardized rubrics.

A wide set of instruments was used to document the process and collect evidence for evaluation. These included the General Self-Efficacy Scale (GSE), the Instructional Materials Motivation Survey (IMMS), and a confidence questionnaire on clinical procedures. Knowledge tests, rubrics for procedural performance, a final perception questionnaire, and semi-structured interviews were also employed. This comprehensive data collection ensured that both the implementation process and student engagement were systematically captured.

Taken together, the national implementations demonstrated that video-modelling and video self-modelling could be integrated across diverse nursing curricula, from undergraduate simulations of basic procedures to postgraduate training in advanced skills.

While the organization of lessons and the choice of procedures varied, all contexts confirmed the feasibility of combining smart glasses with structured reflection and repetition. The experiences also revealed points of convergence, such as the importance of careful preparation, guided debriefing, and the need for technical support, as well as divergences related to class size, task complexity, and institutional resources.

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These commonalities and contrasts became central themes in the Peer Learning Events, where educators and researchers came together to compare experiences, validate solutions, and refine the methodology. The following section presents a synthesis of those discussions, highlighting the good practices that emerged, the challenges that required collective problem-solving, and the recommendations that were developed to improve the implementation process and to guide its future use in healthcare education.

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5. Peer Learning Events – Discussions and Outcomes

In the project proposal, the Peer Learning Events were conceived as transnational opportunities for dialogue and collective reflection, designed to bring together educators, researchers, and students involved in the implementation of video-modelling and video self-modelling. Their primary purpose was to create a space where practical experiences could be compared, challenges discussed openly, and good practices identified, thus complementing the quantitative results of questionnaires and scales with qualitative insights.

By combining different institutional and cultural perspectives, these events were expected to strengthen the methodological coherence of the project, support the refinement of teaching strategies, and contribute directly to the production of D4.4, which synthesizes the testing phase and its findings.

The first Peer Learning Event, held in February 2025, had a primarily organizational and exploratory focus. It provided the consortium with an opportunity to align expectations regarding implementation and to share early experiences, notably the pilot conducted at Santa Maria Health School in Portugal.

During this meeting, partners exchanged views on the feasibility of integrating smart glasses into practical sessions, on the adequacy of the evaluation tools, and on the ethical considerations surrounding the recording of student performances. Several key points of convergence emerged. There was broad agreement on the value of combining video feedback with structured instructor guidance, and on the potential of video self-modelling to strengthen reflection and error correction.

At the same time, questions were raised regarding the suitability of the General Self-Efficacy Scale (GSE) as the primary measure of impact, with some partners considering it too broad to capture specific procedural learning. The event also clarified practical aspects, such as protocols for data collection, anonymization of videos, and the technical challenges of handling recordings.

The second Peer Learning Event, held in May 2025, expanded the scope of the discussion by incorporating student voices directly. This represented a crucial step in validating the methodology, as it allowed the consortium to hear first-hand accounts of how learners experienced video self-modelling in different contexts.

Students from all four partner countries participated, either live or through recorded testimonies. Their reflections revealed a consistent pattern of enthusiasm and recognition of the added value of recording and reviewing their own performance. Portuguese students emphasized the benefits of identifying errors in Basic Life Support simulations, while Spanish students highlighted how video review helped consolidate their technique in surgical handwashing and sterile glove application. Slovenian students noted initial stress when adapting to the equipment but nonetheless valued the opportunity to observe and correct their actions. Polish students particularly appreciated the first-person perspective offered by smart glasses, which allowed them to scrutinize critical details of procedures such as cannulation.

Teachers and institutional representatives also contributed, confirming the pedagogical benefits observed in practice. They emphasized that video-modelling is most effective when integrated into a structured sequence of theoretical preparation, supervised practice, and guided debriefing. Several participants underlined the importance of aligning the methodology with student maturity and experience: while more advanced students can benefit from greater autonomy in analyzing their recordings, beginners often require closer support to ensure that the technology does not distract from the learning objectives.

Challenges were also openly acknowledged, including the limited number of devices available, the time required for familiarization with smart glasses, and ergonomic issues when procedures were lengthy. Suggestions for improvement included developing additional professional demonstration videos, ideally annotated with subtitles or key steps, and ensuring dedicated time for reflection after video review.

Across both events, common themes emerged that helped shape the consortium's collective understanding. First, there was consensus that video self-modelling fosters deeper engagement with clinical skills by making errors visible and enabling their correction in subsequent practice. Second, the methodology was recognized as a motivational tool, encouraging students to take greater ownership of their learning. Third, the events highlighted that successful implementation depends not only on technology but also on careful pedagogical design, adequate technical support, and institutional commitment to integrating video into curricula.

The discussions also generated a set of good practices and recommendations. These included the need to introduce smart glasses only after students have achieved sufficient theoretical knowledge of the procedure; to ensure additional training time for handling the equipment; to combine video review with structured feedback from instructors; and to adapt the methodology to the complexity of the task, reserving video self-modelling for procedures where visual reinforcement offers clear added value. At the institutional level, partners recommended investing in more devices to reduce logistical constraints and embedding video-modelling into the curriculum as a regular practice rather than an isolated innovation.

In conclusion, the Peer Learning Events proved to be essential forums for mutual learning, enabling the consortium to triangulate evidence from surveys, scales, and reports with lived experiences from classrooms and laboratories. They provided not only a space for sharing successes and difficulties but also a mechanism for building consensus on how to refine and sustain the methodology. The insights gathered from these events now feed directly into the analysis of results, which will examine in greater

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detail the quantitative and qualitative impacts of video self-modelling on student performance, motivation, and self-efficacy.

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6. Results from Questionnaires and Surveys

The evaluation of Work Package 4 combined the administration of perception questionnaires with the application of the General Self-Efficacy Scale (GSE). Together, these instruments provided a dual perspective: the questionnaires captured the students' immediate experience with methodology, while the GSE offered a broader lens on the personal and psychological dimension of learning. This section presents the global analysis of these results, considering the aggregated data across all participating institutions and contexts.

The focus is not on comparing countries, but rather on understanding the overall impact of video-modelling and video self-modelling on nursing students' learning, motivation, and self-efficacy.

6.1. Students' Perception Questionnaires

Learning effectiveness and error identification

One of the strongest and most consistent findings across the project was the recognition by students that video self-modelling enhanced their capacity to identify errors. Most participants agreed that watching their own recordings allowed them to see mistakes that were not apparent during the performance itself. Many noted that this opportunity to "step outside" their own action made them more conscious of the sequence of procedures, the accuracy of their movements, and the importance of details such as hand placement, rhythm, or respect for aseptic protocols.

This effect was not limited to error detection: students also reported that they could more effectively consolidate the correct performance of procedures. By comparing their initial attempt with the expected standard, and then repeating the procedure, they experienced a reinforcement cycle that strengthened skill acquisition.

In many of the surveys, high mean scores were obtained for items such as "*the opportunity to repeat the exercise after reviewing the video was beneficial*" and "*watching my own performance helped me identify areas for improvement.*" This pattern was confirmed in both simpler, protocol-driven tasks (e.g., Basic Life Support or handwashing) and more complex skills (e.g., surgical instrumentation), although the degree of perceived usefulness varied with task difficulty.

Feedback and integration with teaching

Another recurrent theme in the perception questionnaires was the complementarity between video review and instructor feedback. Students valued the fact that teachers could point out mistakes during the debriefing while simultaneously having visual evidence of their own actions. This dual mode of feedback — external and internal feedback, was described as more persuasive and memorable than verbal guidance alone.

Several students commented that, while oral feedback often faded after the session, the recorded video created a permanent trace that could be revisited, thus extending learning beyond the classroom. In some institutions, students suggested that recordings should remain accessible for longer periods, possibly within institutional platforms, to support ongoing review before assessments or clinical placements.

Motivation and engagement

Survey results also indicated that video self-modelling increased students' motivation and engagement with the learning process. Participants described the methodology as innovative and stimulating, breaking with routine teaching practices and introducing a degree of novelty that captured their interest. Many respondents highlighted that the chance to *"see themselves"* increased their sense of responsibility for performance and made them more attentive to detail.

This motivational effect was also linked to a sense of empowerment. Several students indicated that being able to review their own recordings gave them greater autonomy in monitoring their progress, shifting the balance from a teacher-centered model to a more self-directed learning approach. This aligns with current literature on video feedback in health education, which points to its role in fostering self-regulation and learner accountability.

Ergonomics and usability of smart glasses

The questionnaires also explored students' perceptions of the equipment. In general, the smart glasses were rated as intuitive and easy to use, with acceptable recording quality in terms of image and sound. Most students reported that the glasses were comfortable enough for short procedures, though less so for longer sessions. Some difficulties were noted with camera positioning and the need to adjust the device when moving the head, particularly in complex tasks such as cannulation.

These limitations did not significantly undermine the perceived value of the methodology, but they highlight the importance of adequate familiarization time and technical support. Students suggested improvements in ergonomics, the inclusion of indicators showing the recording field of view, and the possibility of producing additional demonstration videos with subtitles or highlighted key steps.

Attractiveness and future applications

Finally, the perception surveys asked students to evaluate the overall attractiveness of the methodology and its potential for application to other areas of nursing education. The results were highly favorable. Students found the approach engaging and expressed a strong interest in extending it to other skills, such as intravenous therapy, injection techniques, catheter care, wound dressing, and patient mobility.

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This openness to broader application is a significant outcome, as it indicates that students not only accepted but actively embraced video self-modelling as a valuable addition to their training. It also reflects the potential scalability of the methodology beyond the pilot context tested in WP4.

6.2. General Self-Efficacy Scale (GSE)

The General Self-Efficacy Scale (GSE) was applied across all contexts as a common measure of students' perceived competence in dealing with challenges. The scale consists of 10 items rated on a four-point scale, with higher scores indicating stronger self-efficacy. It was administered at two points: before the intervention (baseline) and after the completion of the sessions.

Global evolution of self-efficacy

Across the total sample, mean self-efficacy scores increased between baseline and post-test. Although the magnitude of change was moderate, the improvement was statistically significant in most contexts. This indicates that participation in the training sessions — whether experimental or control — contributed to strengthening students' general sense of efficacy.

It is important to underline that self-efficacy is a broad and relatively stable construct, not easily shifted by short-term interventions. The fact that the project recorded consistent improvements across multiple cohorts and institutions is therefore notable. It suggests that engaging in simulation-based practice, combined with structured feedback and opportunities for repetition, has a positive cumulative effect on students' confidence.

Differential sensitivity to task complexity

A closer look at item-level changes shows that the largest improvements occurred in items related to coping with difficulties, remaining calm under pressure, and finding solutions to problems. These are precisely the dimensions most directly linked to clinical performance under stressful conditions, which reinforces the pedagogical relevance of the methodology.

However, the data also indicates that task complexity influenced the impact on self-efficacy. In contexts where procedures were highly structured and time-sensitive, such as Basic Life Support, gains were clearer and more consistent. In more complex domains, such as surgical instrumentation, improvements were less pronounced or more variable, possibly because students were simultaneously grappling with the technical demands of the procedure and the novelty of the equipment. This suggests that video self-modelling may be particularly effective for reinforcing confidence in standardized, protocol-driven tasks, while its impact on self-efficacy in cognitively demanding skills may require longer exposure or blended approaches.

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Interpretation of GSE findings

Taken together, the GSE results highlight both the potential and the limitations of generalized measures of self-efficacy. While improvements were documented, they did not always differ significantly between experimental and control groups. This is consistent with the idea that general self-efficacy, as a stable personal trait, may not fully capture the specific pedagogical impact of innovative methodologies in the short term. Nevertheless, maintaining or slightly increasing self-efficacy while introducing new technologies is an encouraging outcome, suggesting that students were not discouraged or destabilized by the unfamiliarity of video self-modelling.

6.3. Integration of Quantitative and Qualitative Evidence

The integration of survey data, GSE results, and qualitative feedback paints a coherent picture of the testing phase. Students consistently reported that video self-modelling enhanced their capacity to identify mistakes, correct them, and consolidate skills. The quantitative evidence supports this, with high ratings for items related to error detection, usefulness of video review, and repetition of procedures.

The GSE results complement this picture by showing moderate but consistent gains in overall self-efficacy, particularly in domains linked to coping and problem-solving. Even where differences between groups were minimal, the general trend was positive, indicating that the introduction of smart glasses and video review did not hinder students' confidence and, in several cases, reinforced it.

The qualitative testimonies collected during Peer Learning Events add depth to this analysis. Students described the methodology as empowering, motivating, and particularly valuable for visual learners. They acknowledged initial discomfort with the equipment but quickly adapted and found the process beneficial. Teachers confirmed that students were more attentive and reflective when using video self-modelling, and several emphasized that the method encouraged a culture of self-assessment and responsibility.

In summary, the results from questionnaires and surveys demonstrate that the ClinicalModelling methodology:

- Enhanced students' ability to identify and correct mistakes through first-person video review.
- Increased motivation and engagement, making learning more attractive and participatory.
- Fostered a sense of autonomy and responsibility in learning.

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- Produced consistent, though moderate, gains in general self-efficacy, particularly in dimensions linked to coping with difficulties and problem solving.
- Showed greater effectiveness in structured, protocol-based tasks, while results in complex, multi-dimensional skills were more variable.

These findings confirm the feasibility and pedagogical value of integrating video self-modelling into nursing education. They also underline the need to adapt the methodology to different types of skills, ensuring adequate preparation, reflection time, and complementary instructor support. As such, video self-modelling should be seen not as a substitute for traditional teaching but as a powerful enhancement that strengthens experiential learning, particularly in areas where visual feedback is critical to procedural mastery.

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7. Good Practices and Lessons Learned

The testing phase of Work Package 4 produced a wealth of insights that go beyond the specific results of questionnaires and self-efficacy scales. By implementing the ClinicalModelling methodology in diverse contexts, institutions were able to identify not only the benefits of video self-modelling but also the conditions under which it is most effective. These collective experiences highlight a set of good practices, reveal critical points that required attention and adaptation, and provide inspiration for the broader application of video-modelling in health education and beyond.

7.1. Good Practices across Contexts

One of the clearest good practices was the integration of video self-modelling into a structured learning cycle. In all countries, the methodology proved most effective when embedded in a sequence of theoretical preparation, practical execution, video review, and repetition. Students consistently emphasized the value of this cyclical process, which allowed them to build knowledge, test it in practice, reflect on their performance, and improve in subsequent attempts. The inclusion of structured debriefing sessions, guided by instructors, further reinforced this cycle and ensured that the insights drawn from video review were translated into improved practice.

A second good transversal practice was the combination of video evidence with instructor feedback. While the videos provided objective documentation of student performance, it was the discussion with teachers that enabled students to contextualize their errors, understand their significance, and identify strategies for correction. This dual approach created a robust feedback loop, enhancing both the technical and reflective dimensions of learning.

Another positive practice was the promotion of student autonomy and responsibility. By encouraging learners to analyze their own recordings, the methodology fostered a sense of ownership over performance and progress. Many students reported that, for the first time, they felt fully accountable for identifying and correcting their own mistakes. This aligns with contemporary pedagogical models that privilege self-regulated learning and student-centered approaches.

The methodology also proved effective in terms of student engagement and motivation. The novelty of smart glasses, combined with the personalized feedback of video review, increased students' interest in practical sessions and made them more attentive to details. Teachers noted higher levels of concentration and seriousness during practice when video recording was in place, confirming its motivational value.

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Finally, the use of professional demonstration videos emerged as an important support strategy. In several contexts, students benefited from watching pre-recorded materials prepared by teachers or professionals, which served as reference points for their own performance. The availability of these resources enhanced the effectiveness of self-modelling, as students could compare their recordings with established standards.

7.2. Critical Points and Solutions

Despite these positive outcomes, the implementation process also revealed several challenges. A recurrent issue was the ergonomics and technical usability of smart glasses. While most students found the equipment intuitive for short procedures, longer or more complex tasks highlighted limitations such as discomfort, narrow camera angles, or the need to adjust the device during performance. These issues occasionally caused distraction and added cognitive load. The solution found in most cases was to provide additional familiarization sessions, allowing students to practice handling the equipment before using it in high-stakes tasks. Teachers also suggested improvements in device design, including lighter weight, better balance, and clearer indicators of the recording field.

Another critical point was the time required for video review and reflection. In classes with large groups, the logistics of recording, transferring files, and reviewing them individually created pressures on scheduling. To mitigate this, institutions adopted different strategies: some limited the number of recordings reviewed in class, focusing on selected examples, while others ensured that videos were uploaded to institutional platforms for later review by students. These adaptations highlight the importance of aligning the methodology with available resources and time constraints.

A further challenge was the variability of results in complex tasks, such as surgical instrumentation. In these contexts, students struggled with the dual demands of mastering intricate procedures and adapting to new technology. Performance gains were less consistent, and in some cases control groups improved more than experimental ones. Teachers concluded that, for such tasks, video self-modelling should not stand alone but be combined with complementary strategies, such as step-by-step demonstrations, multiple practice opportunities, and guided reflection supported by detailed rubrics.

The breadth of the GSE as an evaluation tool was also debated. While the scale captured global trends in self-efficacy, it was considered insufficiently sensitive to detect specific changes linked to procedural learning. This limitation was partially addressed by combining GSE results with task-specific performance checklists and perception questionnaires, which provided a more granular picture of impact.

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Finally, the availability of devices was a practical limitation. With only a small number of smart glasses available, classes with larger groups had to be organized carefully to ensure equitable access. Rotating students through recording sessions and combining live practice with later video review were among the solutions adopted. Nevertheless, this challenge underscores the importance of resource planning when considering large-scale adoption of the methodology.

7.3. Inspirations for Other Contexts

The lessons drawn from WP4 extend beyond the immediate scope of the ClinicalModelling project. The success of video self-modelling in helping students identify errors, reflect on performance, and consolidate skills suggests that the methodology has potential applications in many other areas of health education. Students themselves suggested new domains, such as injections, catheter care, wound management, and patient mobility, where visual self-feedback could be particularly valuable. Also communication and soft skills training can represent future evolution fields for this methodology.

More broadly, the approach offers inspiration for other fields of professional education where procedural accuracy, reflection, and self-efficacy are critical. Disciplines such as physiotherapy, dentistry, or even teacher training could benefit from first-person video recording and self-analysis. The core principle — combining action, reflection, and repetition through visual evidence — is transferable to any domain where learning by doing is central.

The methodology also demonstrates how technology can be harnessed not as a substitute but as a complement to traditional teaching. Video self-modelling does not replace instructor guidance or peer learning; rather, it enriches them by providing new layers of evidence and reflection. This reinforces the idea that technological innovation should be embedded within broader pedagogical frameworks rather than treated as an isolated novelty.

Finally, the experiences of WP4 show the value of collaborative peer learning across institutions and countries. By sharing challenges and solutions through the Peer Learning Events, the consortium built a collective knowledge base that strengthened the methodology and ensured its adaptability to different contexts. This model of transnational exchange can serve as inspiration for other projects seeking to test and refine educational innovations across diverse settings.

In conclusion, the implementation of video self-modelling in WP4 revealed a set of robust good practices, identified critical challenges and workable solutions, and opened pathways for broader application in health education and beyond. The

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methodology's strengths lie in its capacity to combine visual evidence with structured feedback, promote student responsibility, and reinforce procedural accuracy.

At the same time, its successful integration depends on careful attention to ergonomics, logistics, and task complexity. The lessons learned in this project therefore provide not only validation of the ClinicalModelling approach but also valuable guidance for educators, institutions, and policymakers seeking to innovate in competency-based education.

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8. Impact Assessment

The testing activities carried out under Work Package 4 revealed a significant and multi-layered impact on students, teachers, and institutions. Beyond the immediate outcomes measured by questionnaires and scales, the broader value of the methodology became evident in the way teaching practices, student engagement, and collective reflection across the consortium.

At the pedagogical level, the integration of video-modelling and video self-modelling brought clear benefits for the teaching and learning of practical skills in nursing education. The methodology introduced a structured cycle of preparation, practice, reflection, and repetition, which enhanced the effectiveness of simulation-based learning. Students were not limited to performing procedures once under instructor supervision; instead, they were invited to critically analyze their performance, confront their errors, and make improvements in a second attempt. Teachers consistently reported that this cycle increased the depth of learning and encouraged students to pay closer attention to details that are often overlooked during traditional practical sessions. The ability to visualize their own errors in real time through recorded video proved to be a powerful pedagogical tool, creating a lasting impression that verbal feedback alone could not achieve. In this sense, the methodology moved beyond skill training and contributed to embedding reflective practice into the very structure of clinical education.

The methodology also influenced how learning was perceived and valued by students themselves. Across the project, learners described the approach as innovative, motivating, and aligned with their needs as visual and experiential learners. For many, the opportunity to *"see themselves in action"* created a new form of self-awareness that was at once challenging and empowering. Students reported feeling more responsible for their learning outcomes and more capable of evaluating their own performance critically. This shift towards self-directed learning is one of the most meaningful pedagogical impacts of the project, as it signals a transition from a teacher-centered model to one in which students play an active role in monitoring and improving their competencies.

At a personal level, the impact of the methodology is also reflected in the results of the General Self-Efficacy Scale and in qualitative testimonies. While the quantitative improvements in self-efficacy were moderate, the qualitative evidence makes it clear that the intervention fostered resilience, adaptability, and confidence. Students highlighted that video review helped them to cope better with difficulties, to remain calm when under pressure, and to find practical solutions when confronted with problems. Even in contexts where no statistically significant differences were observed between experimental and control groups, the maintenance of stable self-efficacy levels in the presence of a new and potentially intimidating technology is itself a positive outcome. It shows that students were not discouraged or disoriented by the

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introduction of video self-modelling but instead embraced it as part of their learning process. This aspect is particularly important in health education, where confidence and self-efficacy are closely linked to safe and competent practice.

At an institutional level, the impact of the methodology was evident in the willingness of partner organizations to embed it within different curricular structures. The fact that it was successfully implemented both in undergraduate training for basic skills and in postgraduate programs dealing with complex procedures demonstrates its versatility and adaptability. Institutions benefited from the opportunity to experiment with new pedagogical models, to rethink the use of technology in education, and to align their teaching with student-centered and active learning principles. In several cases, the project acted as a catalyst for institutional innovation, prompting discussion about broader curricular reform and the role of digital technologies in competency-based education. The preparation of professional demonstration videos and the integration of recordings into digital platforms also demonstrated that the sustainability of the approach is not dependent solely on external funding but can be incorporated into routine teaching practices, provided that institutional support and resources are allocated.

The transnational character of the project added a further layer of impact. By comparing experiences across countries, the consortium was able to validate the methodology in diverse cultural and educational contexts, showing that the benefits were not limited to a particular institutional tradition. The Peer Learning Events created a shared space for critical dialogue, where challenges such as the ergonomics of the smart glasses, the time required for video review, or the integration of reflection into tight curricula were openly discussed. These meetings produced common solutions, such as dedicating more time to equipment familiarization, combining video review with structured instructor feedback, and selectively applying the methodology to tasks where visual reinforcement adds the most value. The cross-national exchange also reinforced the sense that video self-modelling is a scalable and transferable innovation, capable of being adapted to a wide variety of contexts while retaining its core pedagogical strengths.

The overall impact of WP4 can therefore be summarized as an integrated improvement in three dimensions: the enhancement of pedagogical quality through more effective and reflective learning processes; the reinforcement of students' motivation, self-awareness, and confidence; and the encouragement of institutional innovation and transnational collaboration. The methodology demonstrated that technology, when carefully embedded within a pedagogical framework, can act not as a replacement for traditional teaching but as a catalyst for its transformation. It validated the role of video not merely as a record of practice but as an active tool for reflection, feedback, and growth.

In conclusion, the testing activities carried out under WP4 confirmed that video-modelling and video self-modelling hold considerable potential for advancing health education. They provided evidence that students learn more effectively when they

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are given the tools to observe, critique, and improve their own performance; that self-efficacy can be nurtured not only through success but also through structured self-observation; and that institutions can use this methodology to innovate and to build curricula that are more engaging, reflective, and responsive to the needs of learners. The impact observed during this phase provides a strong foundation for the recommendations outlined in the final section of this deliverable, which aims to ensure that the lessons learned can be sustained and extended in the future.

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9. Conclusions and Recommendations

Work Package 4 of the ClinicalModelling project was set out to test the use of video-modelling and video self-modelling in real educational contexts, with the dual aim of validating the feasibility of the methodology and assessing its impact on nursing students' learning, motivation, and self-efficacy.

Over the course of the implementation, the consortium succeeded in integrating the methodology across four national contexts, involving both undergraduate and postgraduate students, and embedding it into courses that addressed fundamental as well as advanced clinical skills. The process engaged teachers, technical staff, and students in a shared effort to experiment with new forms of experiential learning, combining recording, reflection, and repetition in a structured pedagogical cycle.

The evaluation confirmed that the methodology was not only feasible but also impactful at multiple levels. For students, it created opportunities to observe their own performance, to identify errors that would otherwise go unnoticed, and to consolidate skills through structured repetition. The methodology strengthened their engagement and motivation, fostered a stronger sense of responsibility for their learning, and supported the development of reflective practice. At a personal level, it contributed to maintaining and, in some cases, improving their self-efficacy, particularly in dimensions related to coping with challenges and problem solving. For teachers, it provided a complementary tool that enriched feedback processes, added new layers of evidence to debriefing, and encouraged the adoption of more student-centred strategies. At the institutional level, it demonstrated that video-modelling can be embedded into curricula at different stages of education, stimulating reflection on teaching practices and promoting a culture of innovation. Transnationally, it validated the adaptability of the methodology across diverse contexts and reinforced the value of peer learning as a driver of collective problem-solving.

Several recommendations emerge from these findings, which are relevant both for sustaining the outcomes of WP4 and for guiding future initiatives that seek to integrate video self-modelling into healthcare education. First, the project has demonstrated the value of structuring the methodology within a clear pedagogical sequence. The cycle of theoretical preparation, practical execution, video review, and repetition proved essential to ensure that students not only performed procedures but also engaged critically with their own learning process. Future implementations should preserve and reinforce this structure, making reflection an integral part of skills training.

Second, the methodology works best when combined with complementary forms of feedback. Students consistently valued the combination of instructor guidance with the objective evidence provided by their own recordings. Institutions should ensure that video review is always accompanied by structured debriefing, enabling learners to contextualize their mistakes and to translate observation into improved practice.

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Third, adequate preparation and support for the use of smart glasses is indispensable. Students require time to familiarize themselves with the devices, particularly in complex procedures where the cognitive load is high. Teachers should introduce the technology progressively, starting with simpler tasks before moving to advanced ones, and institutions should guarantee that technical assistance is available during sessions.

Fourth, sustainability depends on resource planning. The limited availability of devices was a constraint in several contexts, requiring careful scheduling. Institutions seeking to mainstream the methodology should consider investing in additional equipment and in the production of professional demonstration videos, which students identified as highly valuable reference materials. Ensuring that recordings can be stored securely and accessed for later review will also extend the pedagogical benefits beyond the classroom.

Fifth, attention should be paid to the match between methodology and task complexity. The testing phase confirmed that video self-modelling is particularly effective for protocol-driven tasks that demand precision and adherence to sequences, such as Basic Life Support or surgical handwashing. In more complex, multi-dimensional domains, such as surgical instrumentation, the immediate benefits were less evident, suggesting that blended approaches may be required. Future research should explore how the methodology can be adapted to complex skills, possibly by combining video review with step-by-step demonstrations, extended practice, or the use of task-specific self-efficacy measures.

Finally, the cross-national dimension of the project has highlighted the importance of peer learning. The consortium benefited greatly from the exchange of experiences, which enabled partners to compare contexts, share solutions to common challenges, and identify transferable practices. Institutions adopting the methodology should embed similar opportunities for exchange and reflection, whether within national networks or across international partnerships, to ensure continuous improvement and adaptation.

In conclusion, Work Package 4 has demonstrated that video-modelling and video self-modelling are powerful and viable tools for healthcare education. By combining technological innovation with pedagogical structure, reflective practice, and institutional commitment, the consortium has developed a methodology that motivates students, strengthens their responsibility for learning, and produces transferable insights for curriculum development. The recommendations outlined above provide a roadmap for sustaining these achievements and for guiding future initiatives, ensuring that the lessons of WP4 contribute to a broader transformation in healthcare education across Europe.

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