DigiCanTrain

Digital Skills Training for Health Care Professionals in Oncology

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WP 5 Quality Control and Evaluation

Deliverable 5.2

Authors	Virtanen L (THL); Kaihlanen A-M (THL); Kuusisto H (TUAS); Mikkonen H (TUAS); Hernon O (GAL); Madrid Alejos C (ICO); Talvik M (TTK); Katsaragakis S (UOA); Curcean S (IOCN); Sulosaari V (Turku UAS)
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Executive Summary

This deliverable *D5.2: Article on Impact of DigiCanTrain Programme on Digital Skills* documents the research process of a pre-post survey study conducted as part of *Work Package 5: Quality Control and Evaluation* within the DigiCanTrain project. The study was designed to evaluate the impact of the DigiCanTrain pilot programme in improving digital health competences among clinical and non-clinical cancer care professionals across different European countries.

Participants self-assessed their digital health competence in six domains: 1) human-centred remote consultation competence, 2) digital solutions as part of work, 3) information and communication technology competence, 4) competence in utilising and evaluating digital solutions, 5) ethical competence related to digital solutions, and 6) cancer care-specific competence. Assessment was conducted through online surveys before the start of the training (November 2024–September 2025) and after completion (March–September 2025). Pre-to-post differences in competence domains were tested for statistical significance using repeated-measures t-tests.

The results indicate statistically significant improvements in self-assessed ability to conduct remote consultations, motivation to use digital health technologies, ability to evaluate them, use them ethically, and apply them in cancer care after completing the programme. The strongest competence gains were observed in remote consultation, the ability to evaluate digital solutions and apply them in cancer care, which may have a meaningful impact on the quality of cancer care delivered through digital platforms in long-term. Participants reported relatively high baseline scores in motivation and ethical competence, so improvements in these areas were smaller but maintaining them through regular training remains important. Therefore, the DigiCanTrain programme can be concluded to have positive impact on developing relevant competences for digital health technology use in clinical and non-clinical cancer care across Europe.

To avoid overlap and potential issues with automatic similarity checks and double publication, this deliverable omits detailed results and academic discussion, which are presented in a separate scientific manuscript. This manuscript was submitted to *BMC Medical Education* for peer review on 31 October 2025 and will be made publicly available upon acceptance.

In this deliverable, chapter one provides background on the training programme and the rationale for conducting the impact study. Chapter two describes the research process and methodology, including the collaboration in the study planning, development of the survey instrument, decisions on outcome

measures, translation procedures, data collection across countries, and methods for data analysis. Chapter three describes the study sample and provides an overview of the findings and their implications.

CONTENTS

1. Introduction

This chapter provides an overview of the DigiCanTrain programme and the rationale for conducting the pre-post survey study assessing its impact.

1.1 Background of the DigiCanTrain programme

The DigiCanTrain programme was launched to strengthen the digital health competence of cancer care professionals across Europe through a structured online training programme. The international initiative responds to a critical challenge in European cancer care: the lack of harmonised continuing education for digital health competences (Kaihlanen et al., 2024) and the limited confidence and skills in using digital health technologies effectively among cancer care professionals (Alotaibi et al., 2025; Navarro-Martinez et al., 2023; Tuominen et al., 2024b). Digital health competence refers to the knowledge, practical abilities, attitudes, and motivation needed to use digital health technologies effectively in patient-centred care, communication, and teamwork (Jarva et al., 2023). It also encompasses the ability to recognise and apply ethical considerations associated with digitalisation (Jarva et al., 2023). Examples of relevant technologies in cancer care include health information systems, messaging platforms, remote consultations, mobile health apps, and AI-based tools used in both patient care and administrative tasks.

The shortcomings in the organisation of continuing education in digital competence and low digital health competence level of professionals are particularly concerning as the implementation of these technologies in cancer care has accelerated, which requires professionals to adopt new tools and workflows (Tuominen et al., 2024b). When successfully integrated, such technologies could improve patient engagement, self-management, and personalised support, while enhancing access to services, enabling timely interventions, and strengthening interprofessional collaboration (Briggs et al., 2022; Tuominen et al., 2024a).

The development and implementation of the DigiCanTrain programme are described in detail in Dowling et al. (2025) publication. The programme targeted both trainers and trainees from diverse professional backgrounds: nurses (both general and cancer-specialised), doctors in primary or specialist care (e.g., clinical oncology, radiology, or surgery), allied healthcare professionals (e.g., psychologists, counsellors, and social workers), and non-clinical healthcare professionals such as advocacy staff and health managers. Trainers were expected to be experienced cancer care professionals with prior technological competence and familiarity with e-learning.

The curriculum comprised an introductory module and five e-learning modules: one designed to prepare trainers to deliver the programme and support trainees, one focused on the effective use of digital health technologies in interprofessional collaboration, and three tailored to specific professional groups (i.e., nurses, doctors, and non-clinical healthcare professionals). The training modules were accessible during the pilot phase from November 2024 to September 2025. Trainers were expected to complete up to 140 hours of learning. In addition to the trainers' module, they undertook the interprofessional education module and one profile-specific module and supported programme implementation in their countries. Trainees, in contrast, completed two modules, interprofessional education and one profile-specific module, totalling 80 hours of learning.

1.2 DigiCanTrain programme impact study

A systematic and rigorous evaluation of training programmes is essential, as it provides evidence on whether the training is relevant and translates into real improvements in clinical practice (Kulju et al., 2024). Therefore, we conducted a pre-post survey study to assess whether participation in the DigiCanTrain training pilot programme led to measurable improvements in self-assessed digital health competence among cancer care professionals. The objective was to generate insights into the implementation of such training at scale.

The study was carried out by a multidisciplinary research team with expertise in healthcare digitalisation, cancer care, and professional education. It was led by projects partners from the Finnish Institute for Health and Welfare, Finland, in close collaboration with partners from Turku University of Applied Sciences, Finland; University of Galway, Ireland; the Catalan Institute of Oncology, Spain; Tallinn Health Care College, Estonia; the Institute Oncologic "Prof. Dr. Ion Chiricuta" Cluj-Napoca, Romania; and the National and Kapodistrian University of Athens, Greece.

1.3 Scope of the deliverable

This deliverable focuses on describing the research process of the pre-post study examining the impact of DigiCanTrain pilot programme on improving digital health competence among cancer care professionals. We outline the planning and design of the study, the development of the survey instrument, data collection procedures, and the approach to data management and analysis within a large international collaboration. A high-level summary of findings and their implications is included, while detailed statistical outcomes and interpretation are reserved for the scientific manuscript submitted for peer review.

2. Research process and methodology

This chapter details the steps taken to design and implement the pre-post survey study in international research collaboration within the DigiCanTrain project.

2.1 Research plan and ethical review

The research plan was initially drafted by Turku University of Applied Sciences and subsequently refined in collaboration with the research team as the study progressed to ensure consistency and comparability of data. The study adopted a pre-post survey design to evaluate short-term changes in participants perceived digital health competence following the DigiCanTrain pilot training programme. This design is commonly used in educational intervention research as it enables the measurement of within-subject change, which is particularly relevant when the focus is on individual learning outcomes rather than between-group comparisons (e.g., Cotta et al., 2024; Langdridge et al., 2024; Schweitzer et al., 2019). The choice of this approach was also influenced by practical considerations: the pilot was implemented across multiple countries with varying organisational contexts, making randomisation or the inclusion of a control group infeasible within the project's timeframe and resources. Furthermore, the participation to the training was voluntary and piloted in real-world organisational settings, which supports ecological validity and reflects how such training would typically occur in practice.

Prior data collection, the study was reviewed and approved by Research Ethics Committee of Turku University of Applied Sciences (approval number 3/2024). Ethical review was required because the findings are intended for publication in peer-reviewed journals that mandate an ethics statement. In addition, research permissions were obtained in accordance with national and institutional requirements.

2.2 Survey instrument

The initial draft of the content of the baseline and post-surveys was created by Turku University of Applied Sciences and developed further in collaboration with researchers from the Finnish Institute for Health and Welfare. Both pre and post surveys included the same outcome measures to allow comparison over time. We also asked respondents' e-mail address in both surveys to be able to match the responses. The baseline questionnaire gathered demographic and professional background information as well as digital health technology use, prior training in digital health competence, and training needs to describe the sample and help interpret the results. The follow-up survey included questions about participants' involvement in the DigiCanTrain programme, including their role (trainer or trainee), modules completed, and estimated time spent on the

training. The full list of questions in the baseline and post-survey is included in Table 1.

Responding was possible in English, Estonian, Finnish, Greek, Spain, or Romanian, and estimated to take approximately 10 to 15 minutes. Before survey launch, consortium partners tested each language version of the surveys to evaluate clarity, cultural appropriateness, and technical functionality, and minor adjustments were implemented based on their feedback.

2.3 Outcome measures

Two core competence measures were incorporated into the surveys to evaluate the impact of the programme in improving the confidence, skills, and motivation in using digital health technologies in cancer care. *DigiHealthCom* instrument developed by Jarva et al. (2023) served as the principal measure for this assessment. We entered into an agreement with the original authors to use the instrument in our study.

The instrument (see Question 13 in Table 1) included a structured set of statements covering five competence dimensions: human-centred remote consultation competence, digital solutions as part of work, information and communication technology (ICT) competence, competence in utilising and evaluating digital solutions, and ethical competence related to digital solutions. Participants rated each statement on a five-point scale, and composite scores were calculated for each dimension. To ensure relevance for cancer care professionals, we adapted some wording from the original measure. For example, references to 'client' were clarified to include patients with cancer and their families, and 'remote counselling' was replaced with 'remote consultation' to better reflect oncology practice.

To guarantee that the survey captured the specific digital competence targeted by the training programme, the curriculum development leads from the University of Galway systematically mapped the programme's learning outcomes against the items of the DigiHealthCom instrument. Furthermore, the instrument was assessed against the digital competence framework developed for the DigiCanTrain programme. This mapping revealed substantial alignment, indicating that several items could measure competence development and potential improvement attributable to the programme. However, the process also highlighted gaps: some core competences and learning outcomes specific to digital competence in cancer care, as envisaged by the DigiCanTrain programme, were not addressed by the DigiHealthCom instrument, which was originally designed for general healthcare settings.

Consequently, we introduced Question 14 (Table 1) to establish a new cancer care-specific digital competence dimension, thereby complementing the

DigiHealthCom instrument. This dimension comprised a concise set of items focusing on areas such as supporting patients emotionally during virtual interactions, delivering sensitive information remotely, and collaborating effectively within interprofessional teams using digital platforms. These items were drafted collaboratively by the Finnish Institute for Health and Welfare and Turku University of Applied Sciences partners, grounded in the digital competence framework and learning objectives of the DigiCanTrain programme. We then piloted the items with a group of cancer care professionals in master's degree studies from Finland and refined the items before translation and use in the surveys.

Moreover, we observed that a few items within the DigiHealthCom instrument reflected competences that were not directly relevant to the scope of the programme. These items were primarily located within the ICT competence dimension, which focuses on generic digital skills such as operating computers and performing routine tasks commonly associated with general office work. While these skills are important for professional practice, they were not prioritised within DigiCanTrain, which aimed to strengthen specialised digital competences directly applicable to cancer care rather than provide introductory training in everyday ICT use. This focus was underpinned by an implicit assumption that participants possessed basic digital literacy, as the programme was delivered entirely through an online platform requiring navigation skills from the outset. Nevertheless, we retained less relevant items in the surveys for completeness but approached their interpretation with caution and transparently reported their limited applicability to the programme's aims.

Table 1.

Included questions and response options in pre-post surveys.

Baseline, post-survey, or both		Question	Response options
Both	1.	Email address for identification: In order to be able to evaluate the effectiveness of the DigiCanTrain programme, the respondents must be identified. In this study, the email address is used for respondents' identification purposes only. The respondents will be anonymised, and your email address will not be visible in the processed data nor in the results. For more information, open the link for the Privacy Notice above. Your email address:	Open-ended response
Baseline	2.	Country where you work (not necessarily the same country where you are from):	• Estonia • Finland • Greece • Ireland • Romania • Spain • Other, please specify:
Baseline	3.	Your age:	In years
Baseline	4.	Your gender:	• Female • Male • Other • Prefer not to say

Baseline	5.	Your (healthcare) profession at the moment:	• Diploma Nurse
			• Registered nurse
			  ○ Staff nurse
			  ○ Specialist nurse, please specify specialty:

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Baseline, post-survey, or both		Question	Response options
			○ Advanced practice nurse (nurse practitioner or clinical nurse specialist) ○ Other, please specify: • Medical doctor ○ Medical oncologist ○ Radiation oncologist ○ Clinical oncologist ○ Oncology Surgeon ○ Haematologist ○ Palliative care specialist ○ General practitioner ○ Other, please specify: • Allied Health Professional ○ Physicist ○ Pharmacist ○ Physiotherapist ○ Occupational therapist ○ Psychologist ○ Dietician ○ Hospital priest ○ Other, please specify: • Non-clinical (e.g., manager, director, learning technologist, clinical trainer, educator, or counsellor), please specify:
Baseline	6.	Your highest academic degree:	• Diploma degree • Bachelor's degree • Master's degree • Doctoral degree
Baseline	7.	Your experience in healthcare in years:	In years
Baseline	8.	Your experience in cancer care (haematology and/or oncology) in years:	In years
Baseline	9.	Digital health technologies refer to tools and services used for work with patients or administrative work, including, for example, health information systems, messaging platforms,	• For my work with patients • For administrative work

Baseline, post-survey, or both	Question	Response options
	remote consultation, remote monitoring, mobile health applications, digital interventions, and systems based on artificial intelligence. I use digital health technologies:	• For both my work with patients and administrative work • None of the above
	10. How often does your main employment involve digital communication with patients by using, for example, messaging platforms, remote consultation, or remote monitoring?	• Not at all • Less frequently than monthly • Monthly • Weekly • Daily
Baseline	11. Have you previously participated in continuing education on digital skills?	• Yes • No
Baseline	12. If you answered "Yes" to the previous question, please briefly describe the training. E.g., who was the organiser, what was the topic, the duration and time period of the training:	Open-ended response
Both	13. Please assess the following statements regarding your digital competence. In this survey, a client refers to both patients with cancer and people affected by cancer (including those who are close to patients such as relatives). *Human-centred remote consultation competence* A. I am able to act in reciprocal (aiming towards respect and equality) interaction with the client in remote consultation B. I am able to set goals together with the client in remote consultation C. I am able to form a confidential relationship with the client in remote consultation D. I am able to recognise the client's need for support and guidance in remote consultation E. I am able to motivate the client into action/self-care in remote consultation F. I am able to take into consideration the special characteristics of online interaction (e.g. wording, addressing empathy) in remote consultation G. I am able to recognise when the client's service (e.g. care or guidance) can be delivered remotely H. I am able to guide the client verbally in remote consultation (e.g. on the phone without video) I. I am able to guide the client by utilising a video connection in remote consultation J. I am able to guide the client in writing (e.g. chat service) in remote consultation K. I am able to evaluate the client's situation (need for care or service) in remote consultation L. I am able to evaluate whether clients receive equal service in remote consultation M. I am able to recognise the client's willingness to use digital solutions N. I am able to act professionally in remote consultation	• Completely disagree • Somewhat disagree • Somewhat agree • Completely agree

Baseline, post-survey, or both	Question	Response options
	O. I am able to evaluate the client's digital readiness P. I am able to guide the client to find reliable information *Digital solutions as part of work* A. The transfer to digital services is a positive change B. Digital solutions should be used more in social and health services C. I am motivated to use digital solutions in my work D. I consider digital solutions as useful E. I am interested in learning about digital solutions in my work F. Digital solutions support my work G. Digital services are a good way to deliver social and health services (e.g., client work, care, rehabilitation) H. Digital solutions are a natural part of my work I. Digital solutions do not slow down my work *Information and communication technology competence* A. I am able to use the most common computer programs and services (e.g., email, intranet) in my work B. I am able to use equipment based on information technology (e.g., computer) in my work C. I am able to ask for help in information technology issues (e.g., ICT support) D. I am able to use the patient/client information system in my work E. I am able to solve most common information technology challenges (e.g., login problems, display settings, printer settings) in my work *Competence in utilising and evaluating digital solutions* A. I am able to recognise what digital solutions are in social and health services B. I am able to recognise factors (e.g., resources, motivation) that influence the utilisation of digital solutions C. I am able to utilise digital solutions (e.g., smart devices, applications) in client care/guidance D. I am able to utilise digital solutions creatively (e.g., usage according to different client needs) in my work E. I am able to boldly experiment and implement digital solutions in my work F. I am able to explain digital social and health services to clients G. I am able to use my professional skills when using digital solutions H. I am able to critically evaluate new digital solutions	

Baseline, post-survey, or both	Question	Response options
	Ethical competence related to digital solutions A. I am able to secure the client's privacy when using digital solutions B. I am able to ensure the secure processing of client data C. I am able to acknowledge the client's autonomy when using digital solutions D. I am able to recognise the ethical aspects of digital solutions (e.g., freedom of choice, privacy, fairness)	
Both	14. Please assess the following statements regarding your digital competence specifically in cancer care. A. I am able to create a human-oriented relationship with people affected by cancer in remote consultation. B. I am able to deliver human-oriented support to people affected by cancer in remote consultation. C. I am able to address the emotions of people affected by cancer in remote consultation. D. I am able to deliver difficult news to people affected by cancer in remote consultation. E. I am able to recognise enablers of digital communication and collaboration within an interprofessional cancer care team. F. I understand the benefits of using digital health technologies in cancer care.	• Completely disagree • Somewhat disagree • Somewhat agree • Completely agree
Baseline	15. Do you want to say something about your training needs related to digital skills?	Open-ended response
Post	16. Did you participate in the DigiCanTrain programme as a:	• Trainer • Trainee
Post	17. I completed the following modules of the DigiCanTrain programme.	List of modules, possible to select multiple.
Post	18. Approximately how many hours did you spend in total completing your selected learning modules?	In hours

2.4 Translation procedures

We first drafted the survey content in English and subsequently adapted for use in five additional languages (Estonian, Finnish, Greek, Spanish, and Romanian). To ensure linguistic accuracy and conceptual equivalence across all versions, we implemented a rigorous multi-step translation process.

For the DigiHealthCom instrument, certified translators applied a forward–backward translation method for the Greek and Romanian versions, following established best practices for cross-cultural adaptation of measurement tools. For Finnish, Spanish, and Estonian, validated translations were obtained directly from the original authors of the instrument, who had previously employed the same protocol. This approach ensured consistency with the original conceptual framework while maintaining linguistic precision.

Project partners who were native speakers of the respective languages and familiar with the cancer care context translated other survey components, including instructions and programme-specific questions using a simple forward translation approach. We also considered cultural and professional differences across participating countries during the translation process. For example, we tailored questions about job roles to reflect variations in healthcare systems and titles. Minor translation needs, such as navigation instructions and technical prompts for progressing through the Webropol platform, emerged when the survey content was transferred to that platform. All translation needs were addressed collaboratively through coordinated communication among partners, using emails and the project's Teams workspace.

2.5 Data collection

The target population comprised trainers and trainees who completed the DigiCanTrain programme. Most participants were based in Estonia, Finland, Greece, Ireland, Spain, and Romania, with some representation from other European countries. Participants were invited to complete two surveys: a baseline survey administered before the start of the training (from November 2024 for trainers and from March 2025 for trainees) and a follow-up survey after completion. Both surveys were implemented by a statistician from Turku University of Applied Sciences using the secure online platform Webropol. Each

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language version of the surveys was accompanied by a research invitation, a participant information sheet, and a data protection notice. Only those who consented at the start of the pre-survey by selecting '*I have been informed about this study, and I will give my permission to use my answers in the study*' and who also responded to the post-survey were included in the study sample.

We assigned country coordinators for each participating country of the DigiCanTrain project. While instructing on the training, coordinators encouraged participants to complete the *DigiCanTrain Digital Skills Pre-Survey* before commencing the modules. They used materials prepared by researchers from the Finnish Institution of Health and Welfare and Turku University of Applied Sciences, which explained the purpose of the study and emphasised the voluntary nature and importance of participation. The pre-survey link was distributed via the programme's e-learning platform and remained open throughout the pilot period, from November 2024 to September 2025.

After training, country coordinators invited participants to complete the *DigiCanTrain Digital Skills Post-Survey* via email. The partners from the Catalan Institute of Oncology sent completion rate updates at regular intervals to the country coordinators. This enabled timely invitations as participants finished the training. To maximise response rates, reminders were sent for the post-survey, and trainers also encouraged trainees to complete the surveys. Post-survey responses were gathered from March to September 2025.

2.6 Data management and analysis

Turku University of Applied Sciences acted as the data controller and were responsible for collecting, processing, and storing the pre- and post-survey data in compliance with the principles of the Declaration of Helsinki, the General Data Protection Regulation, and the Finnish National Board on Research Integrity.

Data curation and statistical analysis were carried out by a statistician from Turku University of Applied Sciences in collaboration with researchers from the Finnish Institute for Health and Welfare. Responses from the two surveys waves were matched using respondents' email addresses to ensure accurate linkage across time points. Trainers and trainees were analysed as a single sample due to the limited number of respondents.

Missing responses were treated as system-missing values. For the six competence domains, missing data were randomly distributed and, at most, accounted for 25% of an individual's responses, which occurred only rarely. Therefore, composite scores for these domains were calculated as the mean of available items even when some data were missing.

Descriptive statistics were used to summarise categorical background variables and to report measures of central tendency and dispersion for continuous variables. Internal consistency of the six digital health competence domains was assessed using Cronbach's alpha. Changes in each competence domain were computed as the difference between post-survey and pre-survey sum scores for individual participants. Pre-to-post differences were tested for statistical significance using repeated-measures t-tests. Pearson and Spearman correlation coefficients were calculated to explore associations between competence domains and continuous background variables, while Spearman's rank correlation was also used for ordinal categorical variables. Due to the very small cell sizes within categorical variables, differences in competence scores across these categories were not reported. Statistical significance was set at $p \leq 0.05$. All analyses were conducted using IBM SPSS Statistics, version 30.

The open-ended responses about prior training on digital health competence and training needs before the DigiCanTrain programme were analysed qualitatively. Before analysis, each non-English response was translated into English by a member of the research team who was a native speaker of the respective language. Researchers from the Finnish Institute for Health and Welfare conducted a narrative synthesis of the qualitative data. This involved systematically reviewing the translated responses, identifying recurring themes, and grouping them into higher-level categories to capture key insights related to participants' responses.

3. Summary of findings and reporting strategy

This section provides a high-level overview of the respondent group, the main findings and their interpretation, and outlines how and where the results will be reported in greater detail.

3.1 Sample overview

Of the 333 individuals who completed the pre-survey, 212 (63.7%) went on to complete the DigiCanTrain training programme. Among these programme completers, 81 participants also completed the post-survey, yielding a response rate of 38.2% within the target population. This corresponds to a retention rate of 24.3% from baseline to post-survey and an attrition rate of 75.7% across the same period. Attrition between baseline and follow-up is substantial, which may limit the generalisability of findings, as those who remained in the study could differ systematically from those who dropped out. Nevertheless, the completion rate of 63.7% among baseline respondents indicates relatively strong engagement with the training programme.

The 81 pre-post study respondents were clinical and non-clinical cancer care professionals from all six project partner countries, with the largest representation from Estonia, Greece, and Spain. Most participants were women with an academic background at bachelor's or master's level. The majority worked as registered nurses in cancer centres or units, while others were employed in health authorities or similar organisations. Professional roles included nurses in various specialisations, medical oncologists, radiation oncologists, physicians, physicists, and dieticians. Respondents generally reported long experience in healthcare and cancer care. Digital health technologies were commonly used in both patient-related and administrative tasks but utilising digital communication methods with patients was still less frequent.

Most participants had not previously attended formal training on digital competence. Among those who had, the training varied considerably but was mostly situated within healthcare contexts. Respondents described short, practical courses organised by employers or professional bodies, focusing on office software, hospital information systems, cybersecurity, and patient safety. Others mentioned workplace-based sessions on internal platforms, social media, and general digital competences. Several respondents highlighted formal certifications in ICT, as well as accredited programmes on digital literacy. Longer and more structured programmes were also reported, including postgraduate studies and university diplomas in digital health, eHealth, and health technology, often lasting several months or academic semesters. Some participants described training on remote consultations, AI, and digital problem-solving, while others had leadership-focused courses addressing digital transformation in healthcare. Notably, some of those with previous training experience acted as trainers within the DigiCanTrain programme, where prior digital competence was an explicit requirement.Trainers were assigned the core modules *Train the Trainees* and *Interprofessional Education*, while trainees were allocated *Interprofessional Education* as part of the curriculum structure. In addition, among those who indicated which additional modules they had completed, most attended to *Cancer Nurses* module, a considerable proportion worked *Specialists (Clinical Oncology, Radiology, Surgery) and General Medicine* module, and a little over half worked through *Non-Clinical Staff Working in Health Systems, Health Authorities and/or NGOs* module.

Respondents estimated that they used an average of around 58 hours to complete the programme. This overall figure reflects both trainers and trainees combined, although the planned workload differed between roles: approximately 140 hours for trainers and 80 hours for trainees. Some participants reported completing the modules in only a few hours, whereas others invested a significant amount of time. This reflects variation in module selection, learning pace, and effort invested. The spread suggests that the programme offered

flexibility to accommodate diverse professional roles and schedules. The lower overall average compared to planned hours may indicate that some participants completed only part of the allocated content or approached the learning tasks differently.

3.2 Main observations and interpretation

Before the DigiCanTrain programme, participants' confidence in digital health competence varied across domains. ICT skills and attitudes towards digital solutions as part of work were already relatively strong, whereas competences related to remote consultations and cancer-specific digital care were clearly less developed. Open-ended responses reinforced this pattern, as participants expressed a strong need for practical, context-specific training to better support patients and integrate digital health technologies into care pathways. Commonly mentioned needs included guidance on new platforms and applications, structured and unhurried interaction to ensure safe and efficient use, and strategies to overcome challenges such as fragmented digital infrastructure and reliance on multiple disconnected tools,. While some participants expressed confidence with basic digital tools in their open-ended responses, many acknowledged gaps in advanced competences and emphasised the importance of continuous learning for professional growth and quality care.When comparing participants' self-assessed digital health competence before and after the DigiCanTrain programme, we identified statistically significant improvements in five of the six competence dimensions: *human-centred remote consultation competence*, *digital solutions as part of work*, *competence in utilising and evaluating digital solutions*, *ethical competence related to digital solutions*, and *digital competence in cancer care*. The most pronounced changes were observed in competences requiring both technical and interpersonal skills. No significant change was observed in *ICT competence*. However, developing this competence was not included in the content of the training programme, and it was assumed that participants already possessed basic ICT skills due to the online delivery format, which required navigation and operational capabilities from the outset.

Human-centred remote consultation competence

The largest improvement was seen in remote consultation competence. Participants reported feeling more capable of guiding patients through video or chat consultations, maintaining trust, and adapting communication to virtual settings. This domain also includes competence in assessing patients' readiness for remote care and supporting them through digital channels, and improvements in this area can be seen as particularly important for reducing the risk of digital exclusion. Our programme had targeted modules, such as communication training in digital care environments and remote monitoring practices, which likely contributed to these gains by combining theoretical principles with practical exercises.

Competence in utilising and evaluating digital solutions

Competence in utilising and critically evaluating digital solutions also advanced considerably. Participants appeared to move from a cautious approach to a more analytical and purposeful use of digital tools, including assessing their relevance, appropriateness, and ethical implications. This shift aligns with the programme's emphasis on structured reflection and case-based learning. Such improvements are essential for ensuring that digital tools are not adopted uncritically but integrated in ways that enhance individual patient care.

Digital competence in cancer care

Digital competence specific to cancer care strengthened notably. This domain addresses the unique challenges of cancer care in digital settings, such as providing emotional support, managing sensitive conversations, and delivering difficult news remotely. These skills are important in cancer care, where conversations often involve sensitive topics and clear, empathetic communication can be more challenging in remote formats. The programme's curriculum was designed with these needs in mind, ensuring that cancer-specific aspects of digital competence were embedded throughout the training. The improvements in participants' competence suggests that tailoring digital health education to the realities of specific clinical contexts is essential for meaningful impact.

Ethical competence related to digital solutions

Ethical competence improved moderately and with already higher baseline scores, it appeared that there was existing awareness of privacy, data security, and patient autonomy in digital care. The ability to recognise ethical risks and apply principles of fairness and choice is critical as digital health evolves, and periodic reinforcement helps maintain competence. Training content should continue to be updated to reflect emerging ethical challenges.

Digital solutions as part of work

Competence reflecting motivation and attitudes toward digital solutions showed only modest gains, likely due to high baseline scores and participants' pre-existing positive views possibly influenced by voluntary enrolment. The training programme included the latest scientific evidence demonstrating the benefits of digital tools in cancer care for organisations, professionals, and patients, which may have helped transform positive expectations of digital health technologies into evidence-based enthusiasm.

Thus, the results indicate that the programme primarily addressed areas where professionals perceived the greatest need for improvement. The overall

improvements in digital health competence domains are particularly noteworthy given the diversity of professional roles and health systems represented in the programme. Strengthening these competences is critical for ensuring safe and patient-centred cancer care while digitalisation is increasingly shaping its organisation, delivery, and processes.

3.3 Limitations

However, some limitations of the study must be acknowledged. The absence of a control group restricts causal inference; observed changes cannot be fully attributed to the training programme, as external factors or concurrent organisational developments may have influenced the outcomes. The reliance on self-reported competence introduces potential response and social desirably bias, and these perceptions may not accurately reflect actual performance. Additionally, the attrition between the pre- and post-surveys reduced the sample size, which was also smaller than anticipated, and limited meaningful subgroup analyses. As a result, it was not possible to draw generalisable conclusions about whether the DigiCanTrain programme was more beneficial for certain groups.

It should also be noted that participation in the pilot programme and this pre-post study was voluntary, which may have attracted professionals who were already positively inclined toward digitalisation. This could partly explain the relatively high baseline scores in the domain reflecting motivation and attitudes toward digital solutions. In a broader target population of cancer care professionals, where digital readiness and motivation can vary more widely, the programme's potential to strengthen these aspects might be even greater than observed in this study.

3.4 Conclusion

Despite the methodological constraints, the study provides valuable insights. Our findings suggest that the DigiCanTrain programme has a positive impact on strengthening self-assessed digital health competences that are directly relevant to clinical and non-clinical cancer care practice. The most notable improvements were observed in domains requiring a combination of technical and interpersonal skills, particularly the ability to conduct remote consultations, critically evaluate digital health technologies and apply them effectively in cancer care. These findings highlight the value of training approaches that integrate theory with opportunities to apply practical skills in realistic scenarios, as demonstrated in DigiCanTrain. Participants' experience of improvement in these areas may have a meaningful impact on the quality of cancer care delivered through digital platforms, and future research could examine how the effects of such training translate into patient outcomes.

Motivation and the ability to use digital health technologies ethically and securely improved only modestly in our study; however, these competences remain essential to maintain. Thus, a limited measurable change or stability in these areas should not be considered an unsuccessful outcome, especially when baseline levels are already high, as was the case in our sample. Ensuring that such skills are periodically reinforced is important for sustaining professional confidence and safeguarding quality of care.

A key challenge for future programmes like DigiCanTrain will be to keep training content regularly updated to reflect evolving competence requirements in an increasingly digitalised healthcare environment. However, the materials developed during this project provide a strong foundation for future updates. Importantly, this project demonstrates that a training programme built on shared core principles and adapted to local contexts can deliver positive outcomes across European countries, even when participating professionals work in health systems with markedly different levels of digitalisation and organisational structures for cancer care.

3.5 Publication status

The study findings will be published in full, including detailed statistical analyses and comprehensive discussion, in an open-access scientific journal. The DigiCanTrain research team collaboratively prepared a manuscript, which was submitted on 31 October 2025 to *BMC Medical Education* for peer review:

Kaihlanen, A.-M., Virtanen, L., Kuusisto, H., Mikkonen, H., Hernon, O., Madrid, C., Talvik, M., Katsaragakis, S., Curcean, S., & Sulosaari, V. (submitted). Evaluating the impact of the DigiCanTrain programme on cancer care professionals' digital health competence: A pre-post study.

As this deliverable report is a public document, it presented only a high-level summary of results to avoid duplication and comply with journal publication requirements. The forthcoming article will provide complete analyses and interpretation. A link to the open access publication will be added to the project documentation once available.

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