



# E-Learning Acceptance among Oncology Healthcare Professionals in Europe

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## Abstract

Grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), this study investigates factors influencing oncology healthcare professionals' intentions to use e-learning within an inter-specialty training program. A cross-sectional online survey was conducted across EU/EEA/UK countries with 67 educators and 97 learners. Adapted UTAUT-based measures assessed performance expectancy, effort expectancy, facilitating conditions, attitudes toward e-learning, self-efficacy, and behavioral intention. Multiple regression analyses revealed that for educators, attitudes toward e-learning were the only significant predictor of behavioral intention to use e-learning for teaching, explaining 75.2% of the variance. For learners, attitudes toward e-learning and performance expectancy significantly predicted behavioral intention to use e-learning, explaining 60.6% of variance. These findings highlight attitudes toward e-learning as the strongest determinant of e-learning acceptance. Institutions should foster positive technology attitudes through supportive environments, awareness initiatives, and incentives to enhance digital learning adoption in oncology education.

**Keywords** Technology acceptance · Oncology education · E-learning · UTAUT · Inter-specialty training

## Introduction

Within public health, cancer is still considered a major concern, with nearly three million new cases and 1.2 million people losing their lives to the disease every year in the European Union [1]. The professionals involved in cancer care are vast, and to improve cancer care across Europe, the INTERACT-EUROPE project was established, aiming to foster stronger collaboration among cancer care professionals through an inter-specialty cancer training program (ISCTP) to be implemented in cancer centres across Europe [2]. By providing an ISCTP, the follow-up project called INTERACT-EUROPE 100 intends to break down medical silos, ensuring that professionals understand each other's roles and competencies, which leads to better-coordinated patient pathways and improved outcomes [3]. The use of

e-learning can further improve the training of healthcare professionals by providing flexible, low-cost, and user-centered activities, which are adapted to the needs of the affected professionals [4].

Building on this potential, a deeper understanding of the factors shaping healthcare professionals' acceptance of e-learning is essential for ensuring the effective and sustainable integration of digital tools into advanced oncology training programs. One of the critical frameworks that has been instrumental in understanding the acceptance and use of technology is the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT, originally proposed by Venkatesh et al. [5], aims to explain user intentions and usage behavior of an information system. The framework includes four key components: (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions.

Recent studies have shown that UTAUT is a robust framework for predicting the general acceptance of online learning platforms within medical education [6]. For healthcare professionals, the acceptance of these technologies is pivotal, as it directly impacts their continuous professional development and the quality of patient care. Studies have indicated that some variables, such as performance

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expectancy and effort expectancy, are significant predictors for e-learning adoption or intention to use among healthcare professionals and faculty in the included healthcare education settings [7, 8].

Within the INTERACT-EUROPE project, a curriculum responsive to the needs of oncology healthcare professionals needed to be developed. This curriculum was planned to be implemented and delivered through e-learning as a core component of the training program across more than 100 cancer centers throughout Europe within the follow-up INTERACT-EUROPE 100 project. Before developing the technology-enhanced learning (TEL) scenarios for the ISCTP, it was therefore pivotal to explore the acceptance of e-learning among oncology healthcare professionals in Europe. Accordingly, the primary objective of the present study was to investigate the factors influencing cancer healthcare professionals' intentions to use e-learning for teaching and learning, using the UTAUT framework as the theoretical background.

This study specifically aims to address two critical research questions:

1. To what extent do performance expectancy, effort expectancy, attitudes toward e-learning, facilitating conditions, and self-efficacy predict cancer healthcare educators' behavioral intention to use e-learning for teaching?
2. To what extent do performance expectancy, effort expectancy, attitudes toward e-learning, facilitating conditions, and self-efficacy predict cancer healthcare learners' behavioral intention to use e-learning?

## Methods

### Study Design

This study employed a cross-sectional survey design to investigate the determinants of e-learning acceptance among oncology healthcare professionals in Europe. Guided by the UTAUT [5], the study examined how constructs such as performance expectancy, effort expectancy, facilitating conditions, self-efficacy, and attitudes towards e-learning relate to behavioral intention to use e-learning in oncology education.

### Participants

The survey was open to oncology professionals across Europe, including EU member states, EEA countries, and the United Kingdom. For demographic analysis purposes, countries were grouped into five geographic regions: Central Europe (Austria, Croatia, Czech Republic, Estonia, Germany, Hungary, Latvia, Lithuania, Luxembourg, Poland,

Slovakia, Slovenia, Switzerland), Northern Europe (Denmark, Finland, Norway, Sweden), South Eastern Europe (Bulgaria, Republic of Cyprus, Greece, Romania), Southern Europe (Italy, Malta, Portugal, Spain), and Western Europe (Belgium, France, Ireland, Netherlands, United Kingdom).

Two separate surveys were distributed to educators and learners using a convenience sampling strategy. After excluding incomplete responses, out-of-scope participants, and outliers, the final sample included 67 educators and 97 learners, as shown in Table 1 (from initially 73 and 112, respectively).

The learner group ( $N=97$ ) was 56.7% female and 43.3% male, with a mean age of 38.47 years ( $SD=9.23$ ). Participants represented diverse oncology professions, most commonly pathologists (18.6%), radiation oncologists (16.5%), and surgical oncologists (14.4%). Learners were based across all regions, most frequently in Southeastern Europe (30.9%), followed by Central, Southern, and Western Europe (each 21.6%), and fewer in Northern Europe (4.1%).

The educator group ( $N=67$ ) included 52.2% female and 47.8% male participants, with an average age of 48.34 years ( $SD=10.89$ ). Educators also held various roles, most frequently as medical oncologists (20.9%) and surgical oncologists (14.9%), and were primarily located in Southern (40.3%) and Western Europe (23.9%). Full distributions are provided in Table 1.

**Table 1** Sample overview

	Educators ( $N=67$ )	Learners ( $N=97$ )
Gender		
Female	$N=35$ (52.2%)	$N=55$ (56.7%)
Male	$N=32$ (47.8%)	$N=42$ (43.3%)
Age	$M=48.34$ ( $SD=10.89$ )	$M=38.47$ ( $SD=9.23$ )
Profession		
Cancer Nurse	$N=9$ (13.4%)	$N=12$ (12.4%)
Clinical Oncologist	$N=4$ (6.0%)	$N=4$ (4.1%)
Medical Oncologist	$N=14$ (20.9%)	$N=11$ (11.3%)
Medical Physicist	$N=2$ (3.0%)	$N=1$ (1.0%)
Radiologist	-	$N=3$ (3.1%)
Radiation Oncologist	$N=5$ (7.5%)	$N=16$ (16.5%)
Radiation Therapist	$N=3$ (4.5%)	$N=2$ (2.1%)
Surgeon	$N=5$ (7.5%)	$N=8$ (8.2%)
Surgical Oncologist	$N=10$ (14.9%)	$N=14$ (14.4%)
Pathologist	$N=3$ (4.5%)	$N=18$ (18.6%)
Other	$N=12$ (17.9%)	$N=8$ (8.2%)
Region		
Central Europe	$N=13$ (19.4%)	$N=21$ (21.6%)
Northern Europe	$N=7$ (10.4%)	$N=4$ (4.1%)
Southeastern Europe	$N=4$ (6.0%)	$N=30$ (30.9%)
Southern Europe	$N=27$ (40.3%)	$N=21$ (21.6%)
Western Europe	$N=16$ (23.9%)	$N=17$ (21.6%)

## Instruments and Data Collection

The survey instrument was based on validated scales from previous studies. Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Behavioral Intention were measured using items adapted from Dečman [9] based on the UTAUT. Each construct captured beliefs about usefulness, ease of use, available support, and intention to use technology. Self-efficacy was measured using a scale adapted from Devisakti and Ramayah [10], originally designed to assess confidence in using digital learning tools. Attitudes toward e-learning were assessed using a scale from Kuliya and Usman [11], reflecting general attitudes toward e-learning. Some items were slightly reworded for the e-learning context and reviewed by three domain experts. Responses were recorded on a seven-point Likert scale (1 = strongly disagree to 7 = strongly agree).

Internal consistency was assessed using Cronbach's alpha and McDonald's omega, with all constructs demonstrating high reliability across both samples ( $\alpha > 0.80$ ;  $\omega > 0.79$ ).

Participants were recruited via email through the INTER-ACT-EUROPE project consortium, and data were collected online using LimeSurvey.

## Data analysis

Two missing values in the learners' dataset and four missing values in the educators' dataset were replaced with the item's average value. Regression analyses typically require approximately 10–15 observations per predictor variable [12]. Accordingly, with five predictors, a minimum sample size of 50–75 participants was considered adequate for the present study. Before the regression analyses, the assumptions of normality, multicollinearity, and independence of errors were examined separately for the educator and learner samples to ensure the appropriateness of applying the same analytical model to each group. Then, two separate multiple regression analyses were conducted, one for the learner sample and one for the educator sample. In both analyses, the same set of independent variables was entered simultaneously to test the proposed models within each group [12]. All statistical analyses were conducted using IBM SPSS Statistics (version 29).

## Results

This section presents the findings from the data analyses conducted to examine the factors influencing educators' and learners' behavioral intention to engage in e-learning. First, descriptive statistics were calculated for both groups, followed by multiple linear regression analyses to test the predictive power of attitudes, self-efficacy, facilitating conditions, effort expectancy, and performance expectancy.

Table 2 presents the descriptive statistics for six variables related to e-learning acceptance for both educators ( $N=67$ ) and learners ( $N=97$ ). Across all constructs, learners reported slightly higher mean scores compared to educators. Specifically, learners demonstrated greater behavioral intention ( $M=6.07$ ,  $SD=1.01$ ) and more favorable attitudes towards e-learning ( $M=6.15$ ,  $SD=1.04$ ) than educators ( $M=5.63$ ,  $SD=1.23$ ;  $M=5.71$ ,  $SD=1.26$ , respectively). Similarly, learners reported higher self-efficacy ( $M=5.78$ ,  $SD=1.02$ ) compared to educators ( $M=4.95$ ,  $SD=1.54$ ), indicating greater confidence in their ability to engage with e-learning. These differences suggest that learners may perceive e-learning environments more positively than educators.

Table 3 presents the results of multiple linear regression analyses predicting behavioral intention from five key variables for both educators and learners. The model for educators was statistically significant and explained 75.2% of the variance in behavioral intention ( $R^2 = 0.752$ ). Among the predictors, attitudes towards e-learning were a significant positive predictor ( $\beta=0.641$ ,  $p < .001$ ), indicating that more favorable attitudes toward e-learning were associated with stronger behavioral intentions to use e-learning. The other predictors, including facilitating conditions, self-efficacy, effort expectancy, and performance expectancy, did not significantly predict behavioral intention.

For learners in Table 3, the model explained 60.6% of the variance ( $R^2 = 0.606$ ). Attitudes towards e-learning ( $\beta=0.482$ ,  $p < .001$ ) and performance expectancy ( $\beta=0.285$ ,  $p = .004$ ) emerged as statistically significant variables. This suggests that learners with more favorable attitudes and stronger beliefs in the effectiveness of e-learning were more likely to intend to engage in it. Other variables, including self-efficacy, facilitating conditions, and effort expectancy, were not significant predictors of behavioral intention to use e-learning in the learners' model. Overall, attitudes toward e-learning were consistently strong predictors of behavioral intention to use e-learning in both groups, while performance expectancy appeared to play a more critical role for learners.

**Table 2** Descriptive Statistics for Educators and Learners

Variable	Educators ( $N=67$ )		Learners ( $N=97$ )	
	M	SD	M	SD
Behavioral intention	5.63	1.23	6.07	1.01
Attitudes towards e-learning	5.71	1.26	6.15	1.04
Self-efficacy	4.95	1.54	5.78	1.02
Facilitating conditions	5.00	1.28	5.58	1.02
Effort expectancy	5.05	1.43	5.64	1.04
Performance expectancy	5.22	1.35	5.56	1.14

**Table 3** Multiple Linear Regression Analysis Predicting Behavioral Intention for Educators and Learners

Predictor	Educators					Learners				
	Unstandardized Coefficients		Standardized Coefficients			Unstandardized Coefficients		Standardized Coefficients		
	B	SE	$\beta$	t	p	B	SE	$\beta$	t	p
(Constant)	0.377	0.404		0.934	0.354	1.120	0.471		2.380	0.019
Attitudes towards e-learning	0.625	0.109	0.641	5.731	<0.001	0.469	0.095	0.482	4.938	<0.001
Self-efficacy	0.010	0.100	0.012	0.099	0.922	0.082	0.101	0.083	0.812	0.419
Facilitating conditions	0.190	0.108	0.197	1.752	0.085	0.083	0.091	0.083	0.904	0.368
Effort expectancy	0.160	0.087	0.185	1.845	0.070	-0.050	0.089	-0.051	-0.557	0.579
Performance expectancy	-0.024	0.102	-0.026	-0.234	0.816	0.253	0.087	0.285	2.922	0.004
Explained variance (R <sup>2</sup> )	0.752 (75.2%)					0.606 (60.6%)				

## Discussion

This study examined factors influencing cancer healthcare professionals' intentions to adopt e-learning as educators and learners. Two key findings contribute to the existing literature and provide practical insights for digital oncology education.

Firstly, the descriptive results showed that learners demonstrated a higher interest in e-learning in oncology education across all dimensions of the acceptance model included in the study. This suggests that learners may perceive e-learning environments more positively or feel more competent in using them compared to educators. However, this discrepancy may point to a potential technological competence gap between educators and learners, which could influence the delivery and effectiveness of online training programs. Therefore, we strongly recommend that this difference be taken into account when designing and developing e-learning platforms for oncology healthcare professionals.

Furthermore, in the learner sample, attitudes toward e-learning were also the highest values, while performance expectancy and facilitating conditions were the lowest values. These results indicate that oncology healthcare professionals hold positive attitudes toward using e-learning, despite limited institutional support or expectation of improving learning experiences with such technologies. Similarly, in the educator sample, attitudes toward e-learning and behavioral intention to use e-learning were the highest scores among the measured variables, whereas self-efficacy and facilitating conditions were the lowest scores. This suggests that, although oncology healthcare educators are positively inclined toward using e-learning for teaching, they may perceive limitations in their own digital competencies and in the institutional support available to effectively implement e-learning technologies. Jobst et al. [13] similarly reported that older age groups demonstrate lower levels of digital competence and reduced openness toward

using digital technologies for teaching, as well as a greater need for digital skills development within the context of nursing education. Considering that there is an approximate ten-year age difference between the learner and educator samples in this study, these findings may be partially explained by generational differences in digital habits, experiences, and tendencies.

Secondly, the multiple linear regression analyses showed that attitudes toward e-learning were the only significant predictor of educators' behavioral intention to use e-learning for teaching. For learners, both attitudes toward e-learning and performance expectancy significantly predicted behavioral intention. Other factors, including effort expectancy, facilitating conditions, and self-efficacy, were not significant in either group. These findings suggest that, in the context of online oncology education, motivational and value-related factors may outweigh usability and/or support-related considerations when explaining e-learning adoption. This pattern is partially consistent with previous research. Studies in education healthcare settings have similarly reported attitudes and performance expectancy as key predictors of technology acceptance [9, 14, 15], while others have identified additional influential factors such as effort expectancy and facilitating conditions [6–8, 16]. The absence of these effects in the present study may be attributed to contextual characteristics and domain-specific requirements [16] of oncology education, such as high professional motivation, prior experience with digital learning, and institutional conditions that reduce the perceived relevance of effort expectancy and facilitating conditions. Therefore, these findings highlight the context-dependent nature of e-learning acceptance and offer insights for designing targeted digital education initiatives in oncology.

To meet the growing need for flexible, accessible, yet effective multi-disciplinary oncology training, TEL scenarios for the ISCTP were developed as part of the INTERACT-EUROPE project. The development of TEL scenarios was informed by the concept of "proximal implementation"

[17], which involves determining the degree of innovation that can be accomplished by educators and learners of the ISCTP and succeeds in incrementally bridging from the current situation to the desired state of oncology training [18]. Rather than assuming that all acceptance-related factors equally inform design decisions, the present study specifically contributed by identifying attitudes toward e-learning and performance expectancy as the key drivers of behavioral intention among oncology educators and/or learners. These findings informed TEL scenario development by prioritizing tools and learning activities that clearly demonstrate pedagogical value and relevance to clinical practice, thereby enhancing perceived usefulness and sustaining positive attitudes toward e-learning. By aligning design decisions with empirically supported acceptance factors and the current use of educational technology in the oncology domain [18, 19], TEL scenarios were designed to support engagement and motivation without introducing unnecessary complexity. Overall, these findings provide a grounded basis for cancer centers to design and implement e-learning environments that reflect oncology professionals' needs, ultimately supporting effective training and quality patient care.

In order to increase e-learning acceptance and adoption for the digital training programs in the context of oncology education, we recommend promoting a culture of technology acceptance and motivation (e.g., awareness campaigns, incentives for early adopters, and feedback mechanisms) by

- providing hands-on training and ongoing support for trainers,
- showcasing successful online learning and teaching experiences,
- demonstrating pedagogical value,
- involving learners and educators in decision-making,
- integrating online learning and teaching components into conventional training,
- ensuring accessibility and inclusivity,
- creating a culture of experimentation,
- and measuring and sharing impact with stakeholders.

## Conclusion

Attitudes toward e-learning and performance expectancy emerged as key predictors for behavioral intentions to use e-learning. Fostering technology acceptance and emphasizing the practical benefits of TEL are crucial for encouraging cancer healthcare professionals to adopt e-learning technologies effectively. Implementing tailored, supportive strategies that address both contextual and individual factors will be essential to enhance engagement, improve learning outcomes, and ultimately contribute to better patient care.

## Limitations

Several limitations need to be reported. Following a convenience sampling strategy and low sample size, the generalizability of our results is limited. As a consequence, although all constructs revealed a high internal consistency across both samples, future studies need larger and stratified samples (e.g., by professions and regions) to validate our findings. Furthermore, the scales applied in English, which might be a foreign language for most of the participants in this study, might have affected the accuracy of the answers of the individuals. Future studies may consider applying scales in the native languages of participants.

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

## Declaration

**Ethics Approval and Consent to Participate** Ethical approval for this study was granted by the Joint Ethics Committee of the Heidelberg University of Education and the SRH University Heidelberg. All procedures involving human participants were in accordance with the provisions of the Declaration of Helsinki. Informed consent was obtained from the participants prior to the study.

**Competing Interest** The authors declare no competing interests.

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