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Feasibility of the online educational tool about the ActiveHip + mHealth intervention in occupational therapy students

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Abstract

Background The rise of electronic learning and digital health underscores the need for occupational therapists (OTs) to be proficient in using them. Digital training enables OTs to update their skills, while the integration of digital health tools into clinical practice enhances patient care. Thus, it is crucial to explore the factors that influence the acquisition of knowledge in occupational therapists through digital training. In response, an online educational tool about the ActiveHip + mHealth intervention (*NCT04859309*) was developed to enhance students' knowledge of managing digital health tools for older adults with a hip fracture.

Objectives The primary aim of this study was to assess the feasibility of the online educational tool about the ActiveHip + mHealth intervention. The secondary aims were to explore the relationship between the knowledge after using the online educational tool and different factors (e.g., emotional status) and to inform future studies to assess the effectiveness of this tool.

Methods A feasibility study was conducted including Occupational Therapy (OT) students who completed the online educational tool about ActiveHip + mHealth intervention. The feasibility was assessed through adoption, adherence and acceptability, while learning was assessed using a questionnaire administered before and after the use of the online educational tool. The influence of different factors (i.e., emotional intelligence, previous knowledge) on knowledge after using it was also estimated.

Results The online educational tool demonstrated satisfactory feasibility results, with 83% adoption, 98% adherence and high overall acceptance (120.35 out of 141). Among the acceptance dimensions, performance expectancy, effort expectancy and facilitating conditions received the highest scores. While factors such as course year, effort expectancy and hedonic motivation showed independent correlations with knowledge after using the online educational tool, sequential regression analysis revealed that prior knowledge was the only significant predictor of the knowledge after using the online tool.

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Conclusion The online educational tool about ActiveHip + mHealth intervention is feasible to use for the occupational therapy students. However, we do not recommend its implementation in educational settings until well-randomised controlled trials confirm its effectiveness.

Significance

Integrating this type of training with in-person teaching can increase participation and improve the teaching-learning process in the university setting.

Keywords Digital education, Digital literacy, E-learning, Emotional regulation, Health literacy, Occupational therapy students, Pilot study

Background

The expansion of Information and Communications Technology (ICT) has transformed education methods, making learning more accessible through digital tools that accelerate the implementation of electronic learning (e-learning) [1]. This shift enables individuals to engage in education anytime and anywhere, with customisable tools supporting interactive learning [2]. Open online courses further expand access to education, particularly in health, by offering reliable information without geographical or time constraints [3], potentially improving health literacy [4]. However, e-learning has disadvantages, such as high drop-out rates, often linked to students' situation [2] or low digital literacy among teachers, which may limit its effectiveness [5].

The COVID-19 pandemic increased the demand of mobile health (mHealth) interventions [6], such as the ActiveHip + mHealth intervention. This multidisciplinary intervention combines occupational therapy (OT), physical exercise and health education for older adults with hip fracture and their family caregivers [7]. Given the high incidence of hip fractures [8] and their impact on health status [9], ActiveHip + is a valuable tool to face this public health problem. Delivered via an app linked to a website, ActiveHip + allows healthcare providers to overcome the barriers to provide appropriate treatment (e.g., multidisciplinary and early interventions) [10, 11] and to monitor the recovery of older adults with hip fracture supporting by their family caregivers. Regaining the pre-routine functional level is the main goal of hip fracture recovery [11, 12] and the occupational therapist plays a crucial role by designing interventions based on the patient's previous roles, assisting with the use of supportive devices, adapting activities [13] and training informal caregivers, who are often the patient's main support [14, 15]. Thus, the education of OT students in the use of digital health interventions in the hip fracture recovery is fundamental to ensure an adequate and up-to-date multidisciplinary intervention.

Among the factors influencing students' online academic performance, emotional intelligence, namely the ability to perceive, express, understand and manage emotions stands out as a key aspect [16]. Emotion management can enhance learning by regulating emotional status, which in turn modulates attention selectivity and motivates action and behaviour, both essential for learning [17–19] However, emotional intelligence encompasses more than just emotion management. It involves different skills that enable individuals to recognise, understand, regulate and use emotions effectively, both in themselves and others [20]. This implies competencies that encompasses several areas [16], including emotional awareness [21], emotional regulation [20], empathy [22], social skills [22], coping and stress management [23, 24] and self-efficacy [25]. Emotional intelligence has been previously associated with academic achievement, suggesting that enhancing emotional intelligence could lead to improved academic achievement [12].

Cognitive factors, such as prior knowledge, also significantly influence learning outcomes. Existing knowledge is widely recognised as a determining factor in learning and academic performance [26, 27]. According to Ausubel's theory of meaningful learning [28], the integration of new knowledge depends on the learner's existing cognitive structures. Existing knowledge serves as an anchor, facilitating deeper comprehension and promoting higher-order cognitive skills necessary for problem-solving and critical thinking [29]. Meaningful learning occurs when new information is connected to previous experiences [29]. Quantity and quality of existing knowledge having a significant impact both on the assimilation of new knowledge and on the development of high-level cognitive skills, which are fundamental for problem solving [30]. Thus, a holistic approach integrating both emotional and cognitive dimensions can optimise students' learning experience, particularly in online educational tools.

Offering OT students online educational tools to enhance their knowledge appears promising. However, given the scarcity of evidence on similar interventions, it is crucial to assess whether these tools are feasible, before conducting a randomised controlled trial. Feasibility studies play an important role when determining the most appropriate trial design [31]. Thus, this feasibility study may help to decide the outcomes to be included in a future randomised controlled trial considering the use

of the online educational tool. Guidelines for conducting feasibility studies recommend to include variables such as acceptance, adoption or dropout rates as key markers for successful implementation [32–34]. This has been adopted by previous studies on similar interventions [35, 36] which use the UTAUT2 as the framework for understanding the complex interplay of factors influencing technology use in various settings, including universities [40].

Thus, the primary aim of this study is to explore the feasibility of using this online educational tool. The secondary aims are: (i) to examine factors related to the knowledge after using the online educational tool and (ii) to generate insights to inform the design of future RCTs evaluating the effectiveness of this online educational tool.

Methods

This feasibility study was conducted between February and September 2023 at the University of Granada. OT students from the second- and third-year course were invited to use an online educational tool as a supplement of the formal education contents of the OT degree. The Ethics Committee of the Research Centre of Granada (CEI-GRANADA) and the University of Granada approved this study. They were invited to take part in the study on a voluntary basis, with no influence on their academic grades. Before they started their participation, it was explained to them that this study was part of a teaching innovation project, which was being carried out at the University of Granada, to evaluate the possibility of including new teaching methods such as an online educational tool in teaching practice. In addition, they were instructed on the use of the online educational tool in class and professors made sure that they had no doubts about the use of the digital tool. Both the first and final measurements were carried out during their personal study time after they were instructed in the use of the tool before starting the online educational course and after the completion of the online educational course respectively. Participation was conducted during their personal study time, rather than during scheduled class hours. They were free to use the educational tool as a complement of their formal training and there were not economic costs associated with the use of it for the students. The student recruitment process was carried out over a 10-month period, as second- and third-year students enrolled in the course were invited during separate months. All participants were informed and signed an informed consent to participate.

Online educational tool description

The online educational tool was delivered through the online learning management system of the University of Granada and it consists of three modules, including throughout the course different gamification activities, such as drag and drop options in true or false concepts or self-tests [37]. These gamification tools were included aiming at increasing student adherence, participation and motivation [38] and as a way of checking a proper knowledge of the contents. We decided to create the online educational tool about the ActiveHip + mHealth intervention because it is a novel intervention currently used by the Andalusian Public Healthcare System, where the students included in this study would perform their clinical practices during the last year of their educational training. The online educational tool about the ActiveHip + mHealth intervention provides training in telerehabilitation and health education, aiming to (i) show how the mHealth intervention works and (ii) enhance knowledge and skills of OT students regarding the recovery of older adults with hip fracture and their family caregivers. The first module, 'What is ActiveHip+?', includes six sections that explain the ActiveHip + platform. This module covers the mobile app for older adults with hip fractures and their family caregivers, as well as the website for healthcare providers. The second module, 'Why ActiveHip + is needed', comprises five sections that address the epidemiology of hip fractures and osteoporosis, highlighting the need for interventions such as ActiveHip+. The third module, 'Educational content for older adults with hip fracture and family caregivers', summarises the extensive educational material provided in the ActiveHip + mHealth intervention. This last module includes 13 sections.

Outcomes

Feasibility outcomes

To measure the feasibility of the online educational tool about the ActiveHip + mHealth intervention for OT students the following outcomes were collected and analysed.

Adoption: Refers to the percentage of students who agree to use the online educational tool for the ActiveHip + mHealth intervention, out of the total number of students who were eligible to participate. It measures how many students decided to engage with the tool, indicating their initial willingness to participate. The data for this variable comes from a record of all eligible students and those who eventually joined the study.

Adherence: Represents the proportion of students who completed at least 2 of the 3 modules of the online educational tool. It reflects the degree to which students followed the educational programme, with completion of 2 modules being considered the minimum standard for a good fidelity rate, meaning that students closely followed the intended learning process.

Acceptance: Measured through the Acceptance Technology Scale, which is based on the Unified Theory of Acceptance and Use of Technology Model 2 (UTAUT2) [39]. The main constructs of the UTAUT2 considered in the present study were: (i) Performance Expectancy, refers to the perceived benefits of using a technology, (ii) Effort expectancy, defined as the degree of ease associated with consumer´s use of technology, (iii) Social influence, refers the degree to which an individual perceives that important others believe he or she should use the new system, (iv) Facilitating conditions, alludes to the amount of support and resources available, (v) Hedonic motivation, defined as entertaining element of pleasure derived from adopting technology, (vi) Habit, refers to tendency of the users to perform repeated behaviours of technology adoption and (vii) Price value, makes mention to benefit-cost balance of adopting new technology [40]. The price value domain was not considered in the present study because the use of the educational online tool was free. The Acceptance Technology Scale includes the above constructs and comprises 21 items that refers to the perceived benefits using a technology, ii are rated on a 7-point Likert-type response scale from [1] "disagree at all" to [7] "fully agree [41]. The Acceptance Technology Scale has been identified as a valid and reliable scale to measure the acceptance of ICT tools.

All these outcomes unless the acceptance, have been obtained from the online learning management system of the University of Granada, which automatically provides all this information about the users.

UTAUT2 has been reported to have satisfactory level of internal reliability (0.70) [41], as well as sound convergent and discriminant validity, according to Fornell and Larcker [42].

Age and sex were also recruited as they can be moderators of acceptance of technology according to the UTAUT2 [39].

Learning outcomes and existing knowledge

Measured through a questionnaire designed to detect changes in knowledge related to hip fracture and hip fracture recovery. This questionnaire consists of 18 single-answer questions related to aspects of epidemiology, interventions and caregiver issues, where declarative knowledge was measured. It was filled out by the students before and after they use of the online educational tool, in order to use the differences between the post scores and the pre scores. Based on Ausubel's meaningful learning theory [28], we included information regarding existing knowledge through two questions: (i) year course (second or third) and (ii) prior exposure to the subject titled "OT for Personal Autonomy: Activities of Daily Living (ADL)" offered during the second-year course. We took this approach, considering that students in higher years and those who had completed the above subject had prior experiences and knowledge related to the new content offered in our tool which could influence the learning outcomes.

Emotional factors influencing the knowledge after using the online educational tool

Emotional regulation The Emotional Regulation Questionnaire (ERQ) comprises 10 items assessing the emotional regulation strategies of cognitive reappraisal (6 items) and expressive suppression (4 items) [43]. Items are rated on a 5-point Likert-type response scale from "never [1], rarely [2], sometimes [3], fairly frequently [4], to very frequently [5]". Higher scores on each scale indicate greater use of the corresponding emotional regulation strategy. For example, an item to measure emotional regulation might ask 'When I want to feel more positive emotions, do I change what I think?' The ERQ has been reported to have high internal consistency ($r = 0.79$ for Reappraisal, 0.73 for Suppression) and 3-month test–retest reliability ($r = 0.69$ for both scales), as well as sound convergent and discriminant validity with both younger and older adults The emotional regulation questionnaire has been validated into Spanish [44].

Emotional intelligence Emotional intelligence was measured through the Trait Meta-Mood Scale-24 items version (TMMS-24). This scale comprises 24 items, using a five-point Likert scale from "totally disagree" to "totally agree." It encompasses three dimensions, each containing eight items. The first dimension, Emotional Attention, evaluates individuals' tendencies to recognise and prioritise their emotions. For example, an item might inquire, "Do you pay a lot of attention to your feelings?" The second dimension, Emotional Clarity, assesses individuals' ability to understand and articulate their emotions clearly, as opposed to feeling confused about them. An example item could be, "Can you often define your feelings?" Lastly, the third dimension, Emotional Repair, examines how individuals employ positive thinking to address negative moods. An item might ask, "Do you typically maintain an optimistic outlook even when feeling sad?" [45] This assessment tool has been validated into Spanish [46].

Emotional regulation and emotional intelligence of OT students were measured before they used the online educational tool.

Statistical analysis

Based on previous studies reporting the feasibility of online educational tools [47, 48], we did not calculate a formal sample size for this feasibility study [49]. This approach was chosen due to the fact that we wanted to explore the feasibility of our tool in a real educational

setting. This was the reason for offering our intervention in a volunteer-basis. Thus, we aimed to train all the aforementioned OT students from the University of Granada as part of our intervention. The normal distribution of the data was checked with the Kolmogorov-Smirnov test. Descriptive characteristics of the sample are presented as mean and standard deviation (SD) or frequency and percentage when appropriate.

A paired samples t-test was used to assess if there was a statistically significant difference in TO students' knowledge levels before and after the intervention. We estimated the correlation between the knowledge after using the online educational tool related to the ActiveHip + mHealth intervention and the following factors: Age, sex, year course (second or third), prior exposure to the subject titled "OT for Personal Autonomy: ADL" and the prior knowledge, each of the two dimensions of emotional regulation (i.e., cognitive reappraisal and expressive suppression), each of the three dimensions of Emotional intelligence (i.e., attention, clarity and repair) and the six acceptance dimensions based on the UTAUT2 (i.e., performance expectancy, effort expectancy, social influence, facilitating condition, hedonic motivation, habit) were estimated using Pearson and spearman correlation coefficients. A hierarchical multiple regression was then performed with the significant predictors, entered in three steps based on theoretical and empirical considerations. First, age and sex were added as confounders. Second variables related to knowledge were added including year course (2nd or 3rd) and knowledge prior to the educational online tool given the evidence of the association with educational performance. Finally, in the 3rd step, Acceptance dimensions were added (i.e., Performance Expectancy and Hedonic Motivation) as these factors are theoretically important but less studied. The validity of the regression analyses was checked through the Durbin-Watson test for self-Correlation and the tolerance index for non-collinearity. All analyses were performed using Statistical Package for Social Sciences (SPSS, IBM Corporation version 25.0; Armonk, NY) and the level of significance was set at $p < 0.05$.

Results

Between September 1st, 2022 and June 30th, 2023, 113 OT students in the University of Granada (Spain) were invited to participate in this innovative educational approach. Out of these 113 students, 94 accepted to participate in this study and use the online educational tool about the ActiveHip + mHealth intervention. Out of these 94, 77 (82%) were women, with an average age of near to 22 years. Table 1 shows the sociodemographic characteristics of the participants.

Regarding the feasibility outcomes

Adoption

The adoption rate of the online educational tool about the ActiveHip + mHealth intervention was 83% in the OT students from the University of Granada, meaning that 94 out of 113 students who were invited to participate accepted.

Table 1 Baseline characteristics of the students of occupational therapy

Variable	*n* = 94
Age, (years)	21.56 (3.8)
Sex, *n* (%)	
Women	77 (82)
Men	17 (18)
Course of Occupational Therapy they are, *n* (%)	
Second	47 (50)
Third	47 (50)
Have they previously taken the subject of ADL? *n* (%)	
Yes	46 (49)
No	48 (51)
Emotional Regulation, (ERQ, 10–70)	44.83 (6.7)
Cognitive reappraisal (ERQ, 6–42) *	30.46 (4.60)
Expressive suppression (ERQ 4–28) **	14.37 (4.81)
Emotional Intelligence, (TMMS-24, 24–120)	72.33 (12.3)
Attention (TMMS-24, 8–40) ***	25.78 (5.43)
Clarity (TMMS-24, 8–40) ****	22.88 (6.68)
Repair (TMMS-24, 8–40) *****	23.85 (5.40)
Knowledge prior the educational online tool	6.97 (2.0)

Values are Mean (SD) unless otherwise indicated. ADL: Activities of Daily Living; ERQ: Emotional Regulation Questionnaire; SD: Standard Deviation; TMMS-24: Trait Meta-Mood Scale-24 items version. * Cognitive reappraisal was calculated using the items 1,3,5,7,8 and 10 of ERQ. ** Expressive suppression was calculated using the items 2,4,6 and 9 of ERQ. *** Attention was calculated using the items 1–8 of TMMS-24. **** Clarity was calculated using the items 9–16 of TMMS-24. ***** Repair was calculated using the items 17–24 of TMMS-24

Table 2 Feasibility outcomes of the online educational about the ActiveHip + mHealth intervention

Variable	*n* = 94
Adoption	83%
Adherence	98%
Acceptance	120.35 (13.48)
Performance expectancy (7–28)	23.46 (3.51)
Effort expectancy (7–28)	24.80 (2.58)
Social influence (7–28)	14.80 (3.64)
Facilitating condition (7–28)	24.89 (2.63)
Hedonic motivation (7–21)	16.41 (3.04)
Habit, (7–21)	16.00 (3.02)

Values are Mean (SD) unless otherwise indicated

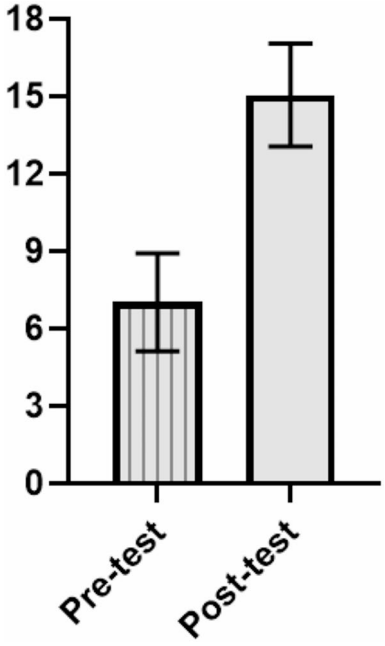

Fig. 1 Average score of knowledge about the hip fracture management in each one of the 2 assessments conducted (i.e., pre-test and post-test)

Adherence

The adherence to the online educational tool about the ActiveHip + mHealth intervention was 98%, meaning that 92 out of 96 students complete a minimum of 2 out of the 3 modules of the online training course on ActiveHip + intervention.

Acceptance

The average acceptance was 120.35 (13.48) out of 147 points of the Acceptance Technology scale. Regarding each one of the different dimensions comprising this item, we found a performance expectancy of 23.46 (3.51) out of 28 points, an effort expectancy of 24.80 (2.58) out of 28 points, a social influence of 14.80 (3.64) out of 21 points, a facilitating condition of 24.89 (2.63) out of 28 points, a hedonic motivation of 16.41 (3.04) of 21 points and a habit of 16.00 (3.02) out of 21 points. These results are presented in Table 2.

The average knowledge prior the educational online tool of the students (pre-test) had a score of 6.97 (SD = 0.21) points out of 18, meanwhile the average knowledge after using the educational online tool (post-test) increased to 15.12 (SD = 0.21). The average difference between the post-test and the pre-test was 8.15 (3.4) ($\boldsymbol{p} < 0.001$; $t = 23.50$) in favour of the post-test assessment. The 95% confidence interval for the mean difference ranged from 7.46 to 8.84. These differences are shown in Fig. 1.

Regarding the correlations with the knowledge after using the education online tool, the Pearson correlation coefficient was estimated for variables conforming to a normal distribution, revealing the following associations: The dimension cognitive reappraisal of emotional regulation (ERQ) showed a correlation of 0.085 ($p = 0.42$) and the dimension social influence of the acceptance scale (UTAUT2) demonstrated a correlation of 0.121 ($p = 0.28$). The dimensions of the scale emotional intelligence (TMMS-24) showed correlations of -0.079 ($p = 0.46$) for attention, 0.43 ($p = 0.69$) for clarity and 0.164 ($p = 0.12$) for repair. Conversely, for variables deviating from a normal distribution, Spearman's Rho was applied, revealing the following relationships: Age displayed a correlation of 0.160 ($p = 0.13$), while Sex exhibited a correlation of 0.12 ($p = 0.25$), year course (second or third) demonstrated a significant correlation of 0.379 ($\boldsymbol{p < 0.001}$), prior exposure to the subject titled "OT for Personal Autonomy: ADL" indicated a correlation of -0.353 ($\boldsymbol{p < 0.001}$), the knowledge prior to the course exhibited a correlation of -0.356 ($\boldsymbol{p < 0.001}$) and the dimension expressive of emotional regulation (ERQ) suppression showed a correlation of -0159 ($p = 0.13$). Finally, the rest of dimensions of the acceptance scale (UTAUT2) demonstrated correlations of 0.316 ($\boldsymbol{p = 0.004}$) for performance expectancy, 0.202 ($p = 0.69$) for effort expectancy, 0.068 ($p = 0.54$) for facilitating condition, 0.242 ($\boldsymbol{p = 0.028}$) for hedonic motivation and 0.094 ($p = 0.40$) for habit. Table 3 provides a visual description of the correlations.

Sequential linear model revealed that prior knowledge (B = -0.28, SE = 0.10, β = -0.301, $p = 0.007$) were significant predictor of knowledge after using the ActiveHip + mHealth educational tool. In contrast, performance expectancy and hedonic motivation were not significant at the final step ($p > 0.05$). The final model explained 21.0% of the variance in the outcome (adjusted $R^2 = 0.21$, $p = 0.067$). The role of potential confounders, namely age and sex, was tested in Step 1, but neither showed significant associations ($p > 0.05$). In Step 2, predictors related to prior knowledge (i.e., knowledge prior the educational online tool and year of course) were included and prior knowledge ($p = 0.007$) and year course ($p = 0.034$) were

Table 3 Correlations of variables related to knowledge after using the educational online tool in occupational therapy students

Variable	Correlation coefficient	*P*
Pearson Correlation Coefficients (Normal Distribution)		
Cognitive Reappraisal (ERQ)	0.085	0.42
Attention (TMMS-24)	-0.079	0.46
Clarity (TMMS-24)	0.43	0.69
Repair (TMMS-24)	0.164	0.12
Social Influence (UTAUT2)	0.121	0.28
Spearman's Rho (Non-Normal Distribution)		
Age	0.160	0.13
Sex	0.12	0.25
Year Course (Second or Third)	0.379	**< 0.001**
Prior Exposure to "Occupational Therapy for Personal Autonomy: ADL"	-0.353	**< 0.001**
Knowledge prior the course	-0.356	**< 0.001**
Expressive Suppression (ERQ)	-0.159	0.13
Performance Expectancy (UTAUT2)	0.316	**0.004**
Effort Expectancy (UTAUT2)	0.202	0.69
Facilitating Conditions (UTAUT2)	0.068	0.54
Hedonic Motivation (UTAUT2)	0.242	**0.028**
Habit (UTAUT2)	0.094	0.40

ADL: Activities of Daily Living; ERQ: Emotional Regulation Questionnaire; TMMS-24: Trait Meta-Mood Scale-24 items version

found to be significant. Lastly, Step 3 included dimensions of Acceptance (i.e., performance expectancy and hedonic motivation), but these variables did not contribute significantly to the model ($p > 0.05$), while prior knowledge ($p = 0.007$) was the only significant variable. Durbin-Watson test indicated that the residuals were not significantly autocorrelated (DW = 1.851). Further information is detailed in Table 4.

Discussion

The aim of the present study was to assess the feasibility of an online educational tool about the ActiveHip + mHealth intervention designed to increase the knowledge of OT students about this intervention and the management of older adults with hip fracture and their family caregivers. We found that our intervention is feasible in occupational therapy students. Our findings also suggest that the prior knowledge influenced the knowledge after using it. The online educational tool about the ActiveHip + mHealth intervention may improve students' knowledge of the hip fracture recovery process, which should be confirmed through well-designed randomised controlled trials.

The adoption rate of the present study was 83%, which is a bit lower than in previous studies where the adoption of educational digital tools was higher [50, 51]. The difference may be explained by the fact that the limited literature focusing on adoption rate includes, to our knowledge, administered tools implemented on a mandatory basis, while online educational tool about the ActiveHip + mHealth intervention was a supplement to traditional training for OT students. We found a very high adherence (98%) to the online educational tool about the ActiveHip + mHealth intervention. This can be attributed firstly to the previous experience of students with digital educational tools due to COVID-19 confinements, where e-learning ensured continuity of learning and prevented contagion among students in the university environment [52]. This previous competence likely facilitated their engagement with the online educational tool about the ActiveHip + mHealth intervention, as they were already used to using similar tools. Furthermore, the high adherence can be related to the fact that the tool was offered by teachers known to the students. Finally, our results about the acceptance are similar to previous studies where the acceptance to educational digital tools have been very high [53, 54]. The domains of the UTAUT2 with higher scores in our study were effort expectancy, facilitating condition and performance expectancy. The high acceptance could be explained by: (i) the online tool was easy to use, (ii) it was completely free, (iii) the benefits of the online tool were highlighted by known teachers of the students and (iv) this population were used to use new technologies to improve their knowledge.

Our preliminary results regarding the knowledge increase after using the online educational tool about the ActiveHip + mHealth intervention were promising, which is consistent with previous studies [55–57]. The pre-test shows an average 6.97, indicating that the previous knowledge was not very high. The post-test shows an average of 15.12, a promising score representing a statistically significant increase over 8 points in the test knowledge about the hip fracture recovery process. This

Table 4 Sequential linear regression analysis of factors influencing the knowledge after using the online educational tool about ActiveHip + mHealth intervention

Factor	B (SE)	β	*P*	Tolerance	VIF
Step 1					
Intercept	14.19 (1.22)	-	< 0.001		
Age	0.03 (0.05)	0.07	0.543	0.99	1.01
Sex	0.43 (0.55)	0.09	0.441	0.99	1.01
Adj. R^2	-0.012		0.586		
Step 2					
Intercept	10.24 (5.58)	-	0.070		
Age	0.01 (0.05)	0.02	0.851	0.97	1.03
Sex	0.46 (0.50)	0.09	0.360	0.99	1.01
Prior knowledge	-0.28 (0.10)	-0.31	**.007**	0.85	1.18
Year Course (Second or Third)	0.90 (0.42)	0.23	**.034**	0.87	1.15
Adj. R^2	0.167				
Δ Adj. R^2	0.183		< 0.001		
Step 3					
Intercept	9.11 (5.51)	-	0.103		
Age	0.00 (0.05)	0.00	0.989	0.96	1.04
Sex	0.48 (0.49)	0.10	0.331	0.99	1.01
Prior knowledge	-0.28 (0.10)	-0.30	**0.007**	0.84	1.19
Year Course (Second or Third)	0.68 (0.42)	0.18	0.112	0.81	1.23
Performance Expectancy	0.10 (0.07)	0.18	0.160	0.65	1.53
Hedonic motivation	0.06 (0.08)	0.09	0.450	0.96	1.04
Adj. R^2	0.200				
Δ Adj. R^2	0.037		0.081		

B = unstandardised regression coefficients; β = standardised regression coefficients; SE standard error; Δ Adj. R2: change in adjusted R2

support the idea that digital tools contribute significantly to increasing knowledge, as they are highly effective tools in terms of knowledge acquisition and motivation [56]. Furthermore, they provide an interactive way of structuring and linking teaching material, which enhances the learning process. Although this underscores the need of developing feasible digital tools to complement the practical training of OT students, it also highlights the scarcity of studies with regard to implementing online educational tools for healthcare providers students. In particular, the results of this study enhance the possibilities of designing studies to compare the effectiveness of online training with that of face-to-face training.

The sequential linear model identified an association between the knowledge after using the online tool and both the year course and the prior knowledge, but when we included all significant variables in the adjusted model (i.e. performance expectancy and hedonic motivation), the only factor influencing the knowledge after using the online educational tool was the prior knowledge. Based on Ausubel's meaningful learning theory [58], students in higher years have a more solid knowledge to connect with the new material and are better prepared to handle complex learning tasks and retain new information [63]. Thus, students in higher grades could experience greater benefit from using online educational tools. Conversely, prior knowledge was negatively associated with the knowledge after using it, suggesting that those who had more knowledge before using the tool did not experience as much increase in the knowledge after using the online tool. Previous research in learning theory supports the idea that prior knowledge can sometimes hinder the learning process. When individuals have a solid framework, new information may not be perceived as useful, as they already possess established methods for interpreting it [59], consequently, prior knowledge may reduce the perceived need for further learning [60]. These results are significant, as it suggest that students with more limited prior knowledge prior to implementation will be the ones who can most benefit from this type of online educational tool in the acquisition of new knowledge after using the online tool. This aligns with theories as the expertise reversal effect [61] and cognitive load theory [62], which suggest that instructional support is more beneficial for novices students than for advanced students.

This study is no exempt of limitations. First, only OT students from the University of Granada were included in this study, limiting the reproducibility of the data. Second, the absence of a control group makes it impossible to compare adherence to different forms of teaching this type of content. Third, the study design does not allow for an exploration of the effect on variables such as emotional regulation [58]. Fourth, we assessed changes in the knowledge after using the online educational tool but not in skills development. Fifth, only a few variables that can be related to learning were included based on previous studies and resources available for the present feasibility study. Lastly, a possible limitation of our online educational tool is the reliance on log data from the learning management system (LMS) to measure adoption and adherence. While logs provide useful data on usage patterns, they may not fully distinguish between mandatory and voluntary participation, as students had to use the tool to complete the course. Simply calculating the proportion of users or task completion may not provide a deeper insight into adoption. In addition, the lack of control and experimental groups limits our ability to assess the impact of the tool on voluntary participation. Accordingly, future studies are guaranteed with an appropriate design (i.e., well-designed randomised controlled trials including both experimental and control

group) to confirm the effectiveness of the tool once its feasibility to be implemented has been confirmed.

Conclusion

This study showed that an online educational tool about the ActiveHip + mHealth intervention may be a feasible option to increase the knowledge about hip fracture recovery of older adults among OT students. Lower level of prior knowledge was associated with greater knowledge after using the online educational tool. While our results in the increase of knowledge seem to be promising, they should be carefully interpreted due to the limitations of the present feasibility study. Accordingly, we do not recommend the implementation of our online educational tool about the ActiveHip + mHealth intervention in OT students unless well-designed studies demonstrate its effectiveness.

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Author contributions
PA-V led the development of this study. MM-T and LM-M recruited the sample. RP-M, was responsible of data collection, monitoring and curation. RP-M and PA-V were responsible for data analysis. RP-M, MM-T, MPM-R, LM-M, DR-and PA-V collaborated in the development of the research protocol. RP-M, MM-T, MPM-R, LM-M, DR-and PA-V designed the methodology of this study. RP-M wrote the original draft, supervised by MM-T, MPM-R, LM-M, DR-and PA-V reviewed and edited the manuscript. All authors had full access to all the data and final responsibility for the decision to submit for publication.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
Not applicable.

Consent to publish
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Competing interests
The authors declare no competing interests.

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