

Evaluating the effectiveness of digital questionnaires in improving physical therapy students' learning outcomes

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ABSTRACT

The integration of technology in healthcare education has revolutionized training, improving clinical practice and critical skills among physical therapy students. Digital learning questionnaires (DLQs) have emerged as valuable tools, enhancing self-regulated learning and personalized assessments. This study evaluates the impact of DLQs on physical therapy students' learning outcomes (LO) and their satisfaction with digital resources. An uncontrolled experimental design was used with 18 third-year physical therapy students in the Musculoskeletal System course at Andres Bello University. Four DLQs were designed based on course objectives and implemented across three units. Eight evaluations were conducted: four formative assessments (1A-4A) before DLQ use and four graded evaluations (1B-4B) after, with a 70% passing score. LO and satisfaction were the main variables, assessed through post-DLQ scores and UNE standards for digital materials. Statistically significant improvements ($p < 0.05$) were observed between pre- and post-DLQ scores, with passing rates for Evaluations 1B-4B at 88.9%, 83.3%, 94.4%, and 83.3%, respectively. High satisfaction was reported, particularly in interactivity (9.4 ± 0.2), navigation (9.2 ± 0.2), and content accessibility (9.8 ± 0.2). The integration of DLQs significantly enhanced learning outcomes and satisfaction, highlighting the importance of feedback and accessibility. Future studies should compare DLQs with other teaching methods in controlled settings.

Keywords: Education, Learning, Undergraduate, Physical therapy specialty, Clinical competence, Educational technology

Introduction

Information and communication technologies (ICTs) have significantly enhanced the education and clinical practice of healthcare professionals, particularly in physical therapy training [1, 2]. Tools such as electronic health records and interactive simulations support problem-based learning and foster the development of critical clinical skills [3, 4]. These technologies

not only aid in acquiring technical knowledge but also promote analytical thinking and informed decision-making, essential for clinical practice [1, 3].

Effective physical therapy training relies on accurate assessments for diagnosis and intervention planning [5, 6]. Clinical assessment, the first step in identifying issues, requires sound judgment and detailed analysis of body structure, function, and patient-specific factors [7, 8].

The physical therapy intervention process includes initial assessment and ongoing monitoring, requiring continuous adaptation of strategies [9, 10]. Training extends beyond technical knowledge, covering critical skills like decision-making and treatment adjustment based on patient progress [10, 11]. Integrating ICT in education enables students to develop evaluative skills in simulated settings, ensuring they acquire competencies within a patient-centered framework, and

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enhancing functionality and well-being during rehabilitation [12, 13].

ICTs have profoundly transformed education in healthcare, enabling dynamic access to learning resources [3, 14]. Technologies, including e-learning platforms and educational software, enhance teaching while promoting equity by reducing barriers to knowledge access [15, 16]. ICT use fosters autonomy, encouraging self-assessment and self-regulation and strengthening students' commitment to learning [12, 17].

Digital education is essential for training healthcare professionals, offering continuous, accessible learning that overcomes geographical and temporal constraints [12, 18, 19]. Integrating e-learning and interactive platforms optimizes the teaching process, providing access to high-quality resources like clinical simulations, virtual libraries, and databases [20, 21]. Technological advancements enable students to engage with clinical information before interacting with real patients, reinforcing practical skills and clinical reasoning [17, 21, 22]. A key pedagogical tool in this context is digital learning questionnaires (DLQs), which assess knowledge, track progress, and enable personalized learning [23-26]. Integrated into e-learning platforms, DLQs automate assessments, provide immediate feedback, and promote self-regulated learning [24, 26, 27], offering scalable, accessible, and flexible assessments tailored to each student's needs [20, 24, 26].

Multiple-choice questionnaires assess learning by providing a numerical score of acquired knowledge [25, 28] and can also reinforce learning when designed effectively. Well-constructed questions stimulate the teaching-learning process, promoting self-regulated learning, crucial for academic success [24]. Digital learning questionnaires (DLQs) help students demonstrate understanding and assist educators in identifying areas needing further support [26]. Compared to traditional strategies, DLQs offer benefits like automation and scalability, making them ideal for virtual environments [27]. Students can access them remotely, receive immediate feedback, and adjust study strategies [20, 26]. Randomized questions and multimedia resources reduce cheating and enhance the learning experience in both in-person and virtual settings [26, 27].

Despite advancements in education, many traditional strategies struggle to engage students and continuously assess progress. This study evaluated DLQs' impact on physical therapy students' learning outcomes (LOs) and satisfaction with digital materials, determining whether DLQs enhance LOs and foster a more active, personalized, clinically oriented learning experience.

Materials and Methods

Design

The study is a non-controlled trial with an experimental design.

Participants

The study population included third-year physical therapy students from Andres Bello University, Santiago, Chile, enrolled

in the Musculoskeletal System Evaluation (MSE) course during the second academic semester of 2024. This mandatory course, part of the Physical Therapy program, totals 208 hours, including 6 hours of face-to-face instruction and 7 hours of autonomous study weekly, equivalent to 5 semester credits. The MSE course develops students' ability to diagnose movement and functional alterations through kinesiological analysis and the biopsychosocial model, incorporating health conditions and environmental factors. Upon completion, students gain skills to assess and identify musculoskeletal health issues while promoting inclusivity and a rights-based approach in their practice.

The course includes three key LOs: LO1: *Assess health conditions using the biopsychosocial model, focusing on musculoskeletal health and social inclusion*; LO2: *Interpret kinesiological assessment results across the life cycle*; LO3: *Develop a physical therapy diagnosis within the biopsychosocial model across contexts*.

Four assessments structure the course: three theoretical-practical tests (75%), clinical practice (10%), and summative evaluations (25%). The summative evaluations comprise five components, which may include multiple-choice questionnaires, short-answer response quizzes, assignment submissions, and practical work assessments conducted in class.

Selection criteria

Participants were selected based on the following criteria: students enrolled in the MSE course in 2024 who provided informed consent for the use of their evaluation scores related to DLQ, corresponding to summative assessments. Students who (i) did not sign the informed consent form, (ii) did not agree to the use of their pre-and post-exam scores from tests taken before and after using DLQ in independent work, (iii) missed either the pre- or post-exam because they did not attend the two chosen thematic units, or (iv) officially dropped out of the course were not included. The final sample included 18 students for four pre-and post-evaluations associated with DLQ use.

Digital questionnaire

A DLQ strategy aligned with the LOs of the MS course was introduced. The implementation followed four stages: design, validation, application, and feedback. In the design stage, four questionnaires (DLQ1-4) were created to support the study of three-course units. These units covered: I) general principles of examination; II) analytical musculoskeletal examination and physical therapy assessment; and III) cervical spine examination. The questionnaires were developed using Office365® [28]; this platform is provided by the institution for course instructors. Each DLQ consisted of three types of items: (a) single or multiple-choice questions on course content, (b) clinical case questions, and (c) video-based questions. The number of questions varied between 18 and 32 per unit. DLQs allowed multiple attempts, with time limits and feedback provided.

The validation process involved peer review by three-course instructors. Three-course instructors evaluated the DLQs for clarity, relevance, and coherence across content-related items, clinical case question items, and video-related items. Clarity

ensured that items were understandable and free from ambiguity, enabling accurate interpretation by respondents. Relevance confirmed that the items aligned with the objectives and content under assessment, making the evaluation meaningful and centered on key LOs. Coherence ensured logical consistency between items and the overall context, preventing contradictions. Each criterion was rated on a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5).

The DLQs were used in the MSE course. Students were informed that the DLQs would contribute to their summative assessments. They completed a pre-DLQ evaluation (evaluation A) following the face-to-face class before engaging with the DLQs. We did not grade this formative test, which was based on an independent study. Afterward, students worked autonomously on the DLQs without additional content delivery. A post-DLQ evaluation (evaluation B) on the same topics was then conducted. The students' scores from the pre-DLQ (1A to 4A) and post-DLQ evaluations (1B to 4B) were compared. Both evaluations included a total score of 18 points, with a passing score set at 12 points (70%). The post-DLQ evaluations contributed 25% to the student's final course grades. In the feedback stage, the questions from each DLQ were reviewed to clarify any doubts. The effectiveness of the DLQs as a resource for autonomous learning was evaluated by comparing the students' pre- and post-evaluation scores after completing the independent work activities.

After completing the DLQs and the pre-and post-DLQ evaluations (A and B), students provided written consent for the use of their scores for further analysis.

DLQs quality

The UNE 71362 standards provided the framework for evaluating students' perceptions of the digital DLQs' quality [27, 28]. UNE, the Spanish Association for Standardization, is responsible for developing technical standards to enhance quality, safety, and interoperability across various sectors. Specifically, the UNE 71362 standards assess digital educational materials, focusing on usability, accessibility, and pedagogical effectiveness. In this study, the version of the UNE standard adapted to the student profile was used, considering students as non-expert users of digital educational materials [29, 30].

The evaluation included specific criteria such as content value and coherence (3 items), content quality (3-items), learning generation capacity (4-items), adaptability (2-items), interactivity (5-items), motivation (5-items), format and design (6-items), portability (2-items), technical stability (3-items), navigation (4-items), operability (3-items), audiovisual content accessibility (3-items), textual content accessibility (4-items), and competencies (with the number of items varying according to the intended LOs). A 10-point scale (0, lowest score; 10, highest score) was used to assess all UNE criteria. The questionnaire was distributed via institutional email, ensuring anonymity and voluntary participation.

Statistical analysis

The statistical analysis involved a detailed examination of data from the peer validation process, evaluation scores, and the quality perception questionnaire. Data were tabulated and coded for processing using Microsoft Excel 2016® software.

To assess inter-rater agreement, the Fleiss kappa statistic (kappa coefficient) was applied, with a significance threshold set at $\alpha=0.05$ [30]. The Landis and Koch scale interpreted the kappa coefficient: values of 0 indicate poor agreement, 0.1–0.2 signify slight agreement, 0.21–0.4 represent low agreement, 0.41–0.60 denote moderate agreement, 0.61–0.80 reflect substantial agreement, and 0.81–1.0 indicate almost perfect agreement [31].

Scores from evaluations A (1A to 4A) and B (1B to 4B) were summarized using measures of central tendency, including means and medians, alongside dispersion metrics such as standard deviations, minimum and maximum values, and the 25th and 75th percentiles. The normality of the data distribution was evaluated using the Shapiro-Wilk test [32]. Given the non-normal distribution of scores, bivariate analysis was conducted using the Wilcoxon matched-pairs signed rank test to determine differences between pre- and post-DLQ evaluation scores. Box plots are used to present results between pre and post-DLQ evaluations.

The students's scores on the UNE standards questionnaire were presented as mean scores with their respective standard deviations for each item and overall criterion. All statistical analyses were conducted using SPSS version 26.0 (Software for Sociologists: Statistical Analysis on the IBM PC), with a significance level set at $p<0.05$.

Results and Discussion

The DLQs were administered to one section of the 2024 MSE course, which had 18 enrolled students (11 men, 7 women; mean age: 21.3 years (1.4)). All students completed the four evaluations before (1A–4A) and after (1B–4B) the implementation of the DLQs and provided consent for the use of their scores in the study. No students were excluded due to absence or formal course withdrawal, resulting in the analysis of all 18 participants.

Instrument

Three course instructors validated the four DLQs [29]. The DLQ items were categorized into three sections: content, clinical cases, and video-related items. Experts assessed the clarity, relevance, and coherence of the items in each section using a 5-point Likert scale (1:strongly disagree, 5:strongly agree).

Table 1 presents the average scores for each item, categorized by content, video, or clinical cases, evaluated according to each criterion. Overall, the average scores of four points indicate general agreement among experts regarding clarity, relevance, and appropriateness for the DLQs. The evaluators' scores for all

three criteria showed moderate and statistically significant agreement [31].

Table 2 presents the DLQs applied in the MSE course and their characteristics following the peer-validation process. The questionnaires contained items related to content, videos, or clinical cases, which were distributed as follows: DLQ-1 contained 17 content items, 13 clinical case items, and 2 video-related items; DLQ-2 included 12 content items and 6 clinical case items; DLQ-3 comprised 15 content items and 3 video-related items; and DLQ-4 had 20 content items and 4 video-related items.

The DLQs were designed to address at least two of the course's LOs and covered three units. DLQ1 focused on physical therapy examination models, therapeutic objectives, and physical therapy diagnosis. DLQ2 addressed physical therapy diagnosis, determination of deficiencies, severity of clinical conditions, and analytical examination in physical therapy. DLQ3 covered fracture classification, movement examination, strength examination, and neurosensory examination, while DLQ4 focused on cervical spine examination. The questionnaires took between 40 and 60 minutes to complete. All DLQs allowed multiple attempts and provided feedback at the end of the assessment.

Table 1. Scores obtained by peer evaluation for the different sections of the DLQs

Section	DQ-1			DQ-2			DQ-3			DQ-4		
	Clarity mean (SD)	Relevance mean (SD)	Coherence mean (SD)	Clarity mean (SD)	Relevance mean (SD)	Coherence mean (SD)	Clarity mean (SD)	Relevance mean (SD)	Coherence mean (SD)	Clarity mean (SD)	Relevance mean (SD)	Coherence mean (SD)
Single- or multiple-choice questions	17-items 4.2 (0.2)	17-items 4.0 (0.0)	17-items 4.0 (0.1)	12-items 4.1 (0.1)	12-items 4.0 (0.2)	12-items 4.1 (0.2)	15-items 4.0 (0.0)	15-items 4.1 (0.1)	15-items 4.0 (0.1)	20-items 4.3 (0.3)	20-items 4.1 (0.1)	20-items 4.0 (0.1)
Clinical case	13-items 4.0 (0.2)	13-items 3.8 (0.0)	14-items 4.4 (0.3)	6-items 3.7 (0.3)	6-items 3.9 (0.0)	6-items 4.1 (0.2)		NA			NA	
Video	2-items 4.7 (0.3)	2-items 3.34 (0.3)	3-items 4.3 (0.3)	5-items 4.6 (0.2)	5-items 4.0 (0.2)	5-items 4.2 (0.4)	3-items 4.7 (0.3)	3-items 4.3 (0.6)	3-items 4.3 (0.6)	4-items 4.4 (0.1)	4-items 3.8 (0.1)	4-items 4.3 (0.5)
kappa Agreement	0.31* Low	0.43* Moderate	0.48* Moderate	0.41* Moderate	0.41* Moderate	0.46* Moderate	0.43* Moderate	0.37* Low	0.44* Moderate	0.47* Moderate	0.43* Moderate	0.42* Moderate

Abbreviations: DLQ-digital learning questionnaire, NA-not apply Agreement assessed with Fleiss's kappa. *p<0.05

Table 2. Characteristics and contents of the DLQs

Digital resource	Platform	IO*	Items	Activity (items)	Course units	Contents	Time	Feedback at the end of the attempt	Link
DLQ-1	Office 365®	LO1 LO2	32	- Single- or multiple-choice questions (17) - Clinical case (13) - Video-related questions (2)	I	- PT examination models - Setting therapeutic objectives - PT diagnosis	60'	Yes	https://forms.office.com/r/iQmXRvEhsv
DLQ-2		LO1 LO2	23	- Single- or multiple-choice questions (12) - Clinical case (6) - Video-related questions (5)	II and III	- PT diagnosis - Assessing clinical deficiencies and severities - Analytical examination in PT	50'	Yes	https://forms.office.com/r/flKqh2HDJi
DLQ-3			18	- Single- or multiple-choice questions (15) - Video-related questions (3)	I-III	- Fracture classification - Movement examination - Strength examination - Neural examination	40'	Yes	https://forms.office.com/r/gTplaVkdAb
DLQ-4		LO1 LO2 LO3	24	- Single- or multiple-choice questions (20) - Video-related questions (4)	I-III	- Cervical spine examination	50'	Yes	https://forms.office.com/r/jvyPsahmkd

Abbreviations: DLQ-digital questionnaire, LO-learning outcome, PT- physical therapy

Unit I. Evaluation of the musculoskeletal system in context throughout the life cycle; Unit II. Interpretation of the Results of the MSE; Unit III. Diagnostic statements and functioning problems.

Evaluations scores

Table 3 summarizes the evaluation results obtained by students before and after using the DLQs. The Shapiro-Wilk test showed normal distribution for six evaluations, except for tests 1A and 4B [31]. Average scores ranged from 8.9 (2.5) before using

DLQs to 14.2 (2.5) after their implementation, with median score differences between 4 and 7 points. The second set of evaluations indicated that students achieved scores above the passing threshold.

Table 3. Scores for assessments before and after the use of DLQ

Evaluations	Students (n)	Distribution*	Mean (SD)	CI (95%)	Median	P ₂₅	P ₇₅	Minimum	Maximum	Range
1A		No	10.2 (1.9)	9.3-11.1	10	9	12	7	13	6
1B		Yes	14.0 (2.5)	12.7-15.3	14	12.8	16.3	8	17	9
2A		Yes	8.4 (2.2)	7.4-9.5	8	6	10.3	5	12	7
2B	18	Yes	13.9 (1.9)	12.9-14.9	14	12.8	15	11	17	6
3A	♂ (11) ♀ (7)	Yes	8.2 (2.3)	7.0-9.3	8	6	8.5	6	13	7
3B		Yes	15.1 (2.4)	13.9-16.3	15.5	13	17.3	10	18	8
4A		Yes	10.1 (3.6)	8.3-11.9	8.5	7	14	6	16	10
4B		No	13.6 (3.5)	11.9-15.3	13	11	17	7	18	11

Distribution of scores obtained with the Shapiro Wilk test (significance level 0.05)*

CI: Confidence interval

SD: Standard deviation

Table 4 shows the results of the Wilcoxon matched-pairs signed rank test used to compare the median scores between evaluations A and B. A statistically significant improvement ($p < 0.05$) was observed for all evaluations, indicated by the positive rankings obtained for the B evaluations. In terms of positive rankings, a 100% improvement was observed for evaluation 1B (18 students), 94.4% for evaluation 2B (17 students), 100% for evaluation 3B (18 students), and 83.3% for evaluation 4B (15

students). Three negative rankings were recorded—one for evaluation 2B and two for evaluation 4B.

The results also show a passing score (scores equal to or above 12 points) of 88.9% for evaluation 1, 83.3% for evaluation 2, and 94.4% for evaluation 3. These outcomes are graphically presented in **Figure 1**, which displays box plots comparing the results of the evaluations before and after using the DLQs.

Table 4. Statistical Differences Between Pre- and Post-DLQ Evaluations

Evaluations	Sample	Median	Median difference	Differences between evaluations**	Ranks sum**	Mean of ranks	p-value	Evaluation ^o Pass (n, %) Not approved (n, %)
1A		10						
1B ^o	18	14	4	Positive ranks (18) Negative-ranks (0) Ties (0)	Positive ranks = 171.0 Negative ranks = 0.0	Positive ranks = 0.0 Negative ranks = 9.5	<0.01*	16 (88.9%) 2 (11.2%)
2A		8						
2B ^o	18	14	6	Positive ranks (17) Negative-ranks (1) Ties (0)	Positive ranks = 169.5 Negative ranks = 1.5	Positive ranks = 1.5 Negative ranks = 9.97	<0.01*	15 (83.3%) 3 (11.2%)
3A		8						
3B ^o	18	15.5	7	Positive ranks (18) Negative-ranks (0) Ties (0)	Positive ranks = 171.0 Negative ranks = 0.0	Positive ranks = 0.0 Negative ranks = 9.5	<0.01*	17 (94.4%) 1 (5.6%)
4A		8.5						
4B ^o	18	13	4	Positive ranks (15) Negative ranks (2) Ties (1)	Positive ranks = 146.0 Negative ranks = 7.0	Positive ranks = 3.5 Negative ranks = 9.7	<0.01*	15 (83.3%) 3 (11.2%)

Statistically significant differences ($p < 0.05$)*

Comparison of assessments before and after DLQ use using the Wilcoxon rank test**

Results for the post-DQ evaluation^o

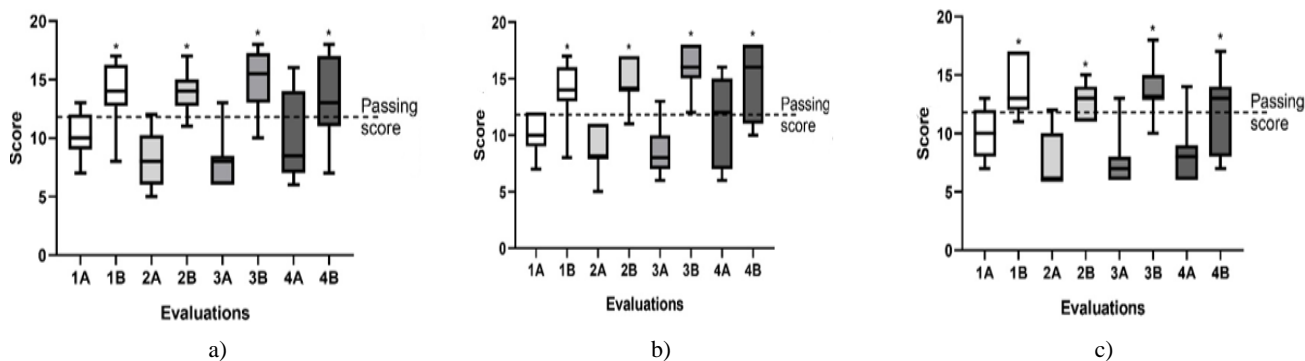


Figure 1. Box plot showing scores from evaluations before and after DLQ use (a), separated by gender (b and c). a) Differences between summative evaluations (total), b) Differences between summative evaluations (men), c) Differences between summative evaluations (women)

In **Figure 1**, a subgroup analysis by gender showed that there were no statistically significant differences in the scores of male and female students on any of the tests before and after the DLQs. For example, on Test B, both male (**Figure 1b**) and female (**Figure 1c**) students got median scores above the passing mark.

Student satisfaction

Table 5 presents the results of the quality standards questionnaire for digital materials, completed by the students in the course. The data shows that all items and criteria received an average score above 8 on a scale from 0 to 10 (0, lowest score;

10, highest score), indicating overall satisfaction with the material. The highest-rated criteria included interactivity (9.4), navigation (9.2), and accessibility of textual content (9.8). The lowest-rated criterion, though still highly scored, was portability (9.0).

Regarding the LOs (criterion 14), the students rated LO1 and LO2 the highest, with average scores of 9.3 (0.5) and 9.1 (0.9), respectively. While LO3 also received scores above 8, it had a slightly lower average of 8.6 (0.9).

Figure 2 presents the average scores for each criterion across all items, with an overall average close to 9 points for all criteria. These findings indicate a high level of student satisfaction with both the material and the LOs achieved in the course.

Table 5. Results for the UNE standards criteria (student profile)

Criterion	Question	Average score per item (SD)	Average score per criterion (SD)	Median score per criterion p50
1. Didactic value and coherence	1.1 I understand the objectives to be achieved with this material.	8.7 (0.9)	9.13 (0.3)	9.0
	1.2 I can achieve the proposed didactic objectives.	9.6 (0.7)		
	1.3 I am clear about which competencies or skills I will develop with this material.	9.5 (0.9)		
	1.4 I understand the instructions for the material (in the classroom with a teacher or self-learning).	9.0 (1.2)		
	1.5 I can estimate the time needed to complete the work with the digital material.	9.1 (1.1)		
	1.6 I am aware if I need prior knowledge for the activity's development.	9.0 (1.9)		
2. Content quality	2.1 The content includes all learning objectives and is appropriate for my level of knowledge.	9.1 (0.8)	9.3 (0.2)	9.3
	2.2 The content is clear, and I understand the key ideas I need to learn.	9.3 (0.9)		
	2.3 The content is presented in an objective, respectful manner, without ideological bias.	9.50 (0.6)		
3. Ability to generate learning	3.1 This material helps me relate new knowledge to my prior knowledge.	9.3 (0.6)	9.2 (0.3)	9.2
	3.2 The material helps me be critical and to ask questions.	8.8 (1.1)		
	3.3 This material helps me generate new knowledge.	9.2 (1.0)		
	3.4 I can apply this material in practice.	9.5 (2.8)		

	4.1 This material meets my expectations and learning needs.	9.0 (0.9)		
4. Adaptability	4.2 I feel comfortable with this material as it provides various content levels that support my learning.	9.0 (1.0)	9.0 (0.1)	9.0
	5.1 The material is interactive (I learn actively).	9.2 (0.7)		
5. Interactivity	5.2 The material contains interactive activities for the key ideas.	9.5 (0.9)	9.4 (0.2)	9.5
	5.3 The material allows me to control and manage my learning.	9.53 (0.7)		
	5.4 I can check my progress (feedback).	9.1 (0.9)		
	6.1 I feel that what I have learned with this material is important for my education.	9.6 (0.5)		
	6.2 I feel that this material encourages me to learn independently.	9.1 (0.9)		
6. Motivation	6.3 The estimated learning time is suitable for meeting my expectations.	9.0 (0.7)	9.0 (0.2)	9.0
	6.4 The content is engaging.	8.8 (1.2)		
	6.5 The material promotes communication and collaboration between students and teachers (feedback).	8.9 (0.9)		
	7.1 The material has an easy, clear, and organized design.	9.3 (0.6)		
	7.2 The texts, images, audio, and videos are of good quality.	9.0 (1.2)		
7. Format and design	7.3 The audiovisual content facilitates and reinforces my learning.	8.9 (0.9)	9.1 (0.2)	9.0
	7.4 Different multimedia formats are included.	9.1 (0.8)		
	7.5 The material is easy to use.	9.2 (0.9)		
8. Portability	8.1 I can access and use the materials on all my devices (computer, tablet, mobile, etc.).	9.3 (0.7)	9.0 (0.4)	8.4
	8.2 The material can be used on any device with or without an internet connection.	8.8 (0.9)		
9. Robustness; technical stability	9.1 The material does not fail during its operation.	8.6 (1.2)		
	9.2 The material responds quickly when I interact with it.	8.1 (1.5)	9.2 (0.3)	9.1
	9.3 El profesor está disponible para ayuda si tengo algún problema	9.5 (0.9)		
	10. 1 The names of the links indicate where they will lead.	8.9 (1.3)		
	10. 2 The links work properly.	9.1 (1.0)		
10. Navigation	10.3 I am always clear about which part of the material I am in, how much I have completed, and how much is left.	9.0 (1.2)	9.2 (0.2)	9.2
	10.4 It is possible to exit and re-enter the material at any time.	9.1 (0.7)		
	11.1 The material is compatible with keyboard and mouse and also functions with touchscreens and other assistive devices.	9.3 (0.9)		
11. Usability	11.2 I have no problems seeing and moving the cursor	9.5 (0.6)	9.1 (0.2)	9.0
	11.3 I have enough time to read and complete the activities.	9.3 (0.9)		
12. Accessibility of audiovisual content	12.1 Accessibility of audiovisual content	8.94 (1.3)		
	12.2 I can see or read the description of the images	9.1 (0.9)	9.2 (0.2)	9.1
	12.3 I can see, hear, and read the content of the videos	9.0 (1.1)		
	13.1 I can read the text well and adjust its size.	9.1 (0.7)		
13. Accessibility of textual content	13.2 If there are forms, they are easy to fill out.	9.3 (0.9)	9.8 (0.2)	9.8
	13.3 If there are tables, they are easy to read and understand.	9.6 (0.5)		
	13.4 If there are lists, they are easy to read and understand.	9.9 (0.3)		
14. Course LO	LO1	9.3 (0.5)		
	LO2	9.1 (0.9)	9.0 (0.4)	9.0
	LO3	8.6 (0.9)		

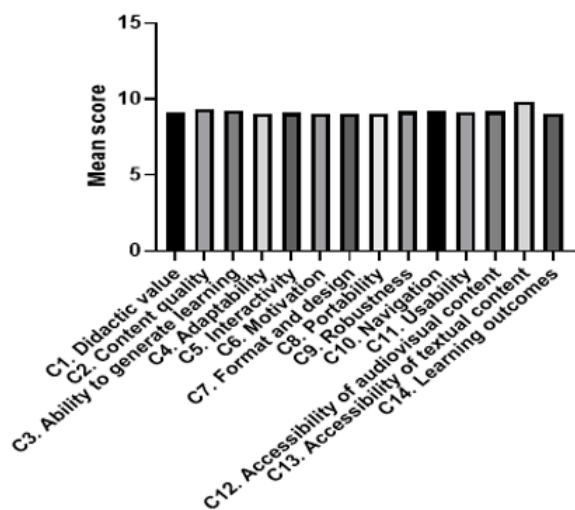


Figure 2. Average scores obtained for each criterion of the UNE standards.

This study aimed to evaluate the effectiveness of DLQs on the LOs of physical therapy students and their satisfaction with this digital resource. The results revealed statistically significant improvements in students' LOs, indicating that DLQs positively impact performance. Additionally, positive feedback from the UNE standards questionnaire confirmed high student satisfaction with the digital materials.

Digital technology

Integrating digital technology into education is essential in today's digital world, reshaping traditional teaching and learning methodologies [1, 15]. Technological tools enhance instructional quality and engage students more effectively [21, 22]. Resources such as digital questionnaires, interactive simulations, and online platforms foster active learning and self-regulation, allowing students to personalize their educational experiences to suit individual needs [22, 33].

Digital technology also provides access to a broad range of information, addressing gaps in conventional education [15, 33]. This accessibility encourages students to take charge of their learning, developing critical thinking and problem-solving skills crucial for today's workforce. Additionally, technology facilitates collaboration between students and educators, creating a dynamic, inclusive learning environment [34].

By embedding technology in the curriculum, educators prepare students for an evolving job market, equipping them with digital literacy skills needed for success in an interconnected world [11, 18, 33].

DLQs in education

The use of questionnaires as educational tools has proven effective by enabling students to self-assess through digital material [26]. Key benefits include promoting self-assessment, providing immediate feedback, and highlighting areas needing improvement. These elements are essential for active learning and self-regulation skills, both critical to academic success [24, 26].

Compared to traditional paper questionnaires, DLQs offer significant advantages, particularly in accessibility. DLQs enable students to access assessments anytime and anywhere, catering to the needs of digital-native students [22]. This flexibility allows students to complete assessments at their own pace, enhancing their learning experience and empowering them to take ownership of their education.

DLQs also incorporate interactive elements, such as multimedia resources, enriching the learning experience compared to paper formats. Videos, images, and links to additional materials make the content more engaging, facilitating the understanding of complex concepts. This interactivity fosters deeper participation, improving retention and comprehension.

Another advantage of DLQs is their capacity to collect and analyze data efficiently. Educators can access immediate performance statistics, enabling real-time monitoring of LOs. This feature helps identify trends, assess educational material effectiveness, and adapt teaching strategies, promoting continuous quality improvement.

Several factors contribute to the positive outcomes associated with DLQs in this study. Immediate feedback allows students to quickly assess their comprehension and focus on knowledge gaps. This timely feedback promotes active learning and self-regulation, helping students adjust their study strategies effectively. DLQs foster self-assessment, encouraging responsibility in the learning process, and boosting motivation for better academic performance. DLQs also enable instructors to align assessments with specific LOs, ensuring students focus on relevant content and thereby improving assessment performance. Additionally, group feedback sessions following evaluations fostered peer discussions, enhancing comprehension and critical thinking skills in a collaborative learning environment.

Students' satisfaction

This study's findings reveal several factors influencing students' positive perception of DLQs as an educational tool. DLQs significantly boosted students' confidence in their learning by providing immediate feedback, allowing real-time assessment of comprehension, and pinpointing areas needing improvement [35]. This instant feedback empowered students to adjust study strategies promptly, enhancing LOs and fostering self-regulated learning through greater accountability.

The accessibility and flexibility of DLQs were key to student satisfaction. Students' preferences aligned with the completion of assessments on various devices at convenient times, which enhanced their autonomy and created a more personalized, engaging learning experience [36-39].

Students found DLQs to be interactive, particularly when they incorporated multimedia elements like videos and images. These resources helped make complex concepts more understandable and engaging, encouraging active participation that improved retention and comprehension. Additionally, DLQs supported both independent and collaborative work, with many students

engaging in peer discussions, which enriched understanding and fostered critical thinking.

Aligning DLQs with course LOs ensured students focused on relevant content, positively affecting performance in assessments. Students felt more satisfied when they saw a clear connection between assessments and LOs. These findings suggest that DLQs, with their feedback, interactivity, collaboration, and alignment with LOs, enhance student engagement and performance in digital learning.

Strengths and limitations

This study had strengths and limitations. A key strength was the peer validation process, enhancing credibility and ensuring alignment with educational standards. Multiple assessments provided a comprehensive view of student learning. However, the lack of a control group and small sample size limit generalizability. Additionally, reliance on self-reported data may introduce response bias, as students might provide socially desirable answers.

Conclusion

Research shows that integrating DLQs into education improves LOs and student satisfaction. High pass rates across four assessments indicate DLQs effectively supported students in meeting course objectives. Instant feedback, accessibility, content-specific assessments, and collaboration contributed to these outcomes. These findings highlight the value of DLQs in enhancing engagement and performance. Future studies should include controlled trials to compare DLQs with other instructional methods.

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