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Development and evaluation of a blended learning training programme for pharmacy technicians' continuing education

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ABSTRACT

Objectives The role of the pharmacy technician (PT) has expanded in recent years, requiring new competencies, better communications skills and high-level knowledge about drugs. The objective of this study is to develop and evaluate a blended learning programme for PTs' continuing professional development.

Methods A blended learning programme designed to enhance knowledge, skills and attitudes was created using a six-step approach to curriculum development for medical education. The first part included three short microlearning videos to improve knowledge; the second consisted of a 1.5 hour 'edutainment' session for groups of 5–6 PTs to deepen their knowledge and practice skills. Impacts on knowledge, degree of certainty and self-perceived competence were evaluated before training (pre-test), after the microlearning (post-test 1) and after the edutainment session (post-test 2).

Results The three microlearnings were entitled 'Communication', 'Cut-crush a tablet/open a capsule' and 'Pharmacy website'. The edutainment session used team-based learning, game-based learning, peer instruction and simulation. Twenty-six PTs of mean±SD age 36±8 years participated. Pre-test and post-test 1 evaluation scores showed significant overall improvements in mean knowledge (9.1/18 vs 12.1/18, $p<0.001$), mean degree of certainty (3.4/5 vs 4.2/5, $p<0.001$) and mean self-perceived competence (58.6/100 vs 72.3/100, $p<0.001$). After post-test 2, mean knowledge (12.1/18 vs 13.1/18, $p=0.010$) and mean self-perceived competence (72.3/100 vs 81.1/100, $p=0.001$) scores had improved, but not mean degree of certainty (4.2/5 vs 4.4/5, $p=0.105$). All participants found the blended learning programme suitable for their continuing professional development.

Conclusions The present study showed the positive effects of using our blended learning programme to improve PTs' knowledge, degree of certainty and self-perceived competence, to their great satisfaction. This pedagogical format will be integrated into PTs' continuing professional development and include other educational topics.

INTRODUCTION

The profession of pharmacy technician (PT) has developed differently around the world, but their role has expanded in recent years.¹ Often present on wards to meet medication needs and manage stocks, nurses identify PTs as key resource persons

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Pharmacy technicians' expanding roles require new competencies, better communications skills and high-level knowledge about drugs.

WHAT THIS STUDY ADDS

⇒ We developed and evaluated a blended learning programme for pharmacy technicians' continuing professional development.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study shows the positive overall effects of this teaching method on competencies and student satisfaction. This pedagogical format could be used for the continuing professional development of pharmacy technicians and other healthcare professionals.

for answering questions about medications. They also link hospital pharmacy staff with frontline healthcare teams and increasingly collaborate with clinical pharmacists.^{2,3}

These new roles require new competencies, such as better communications skills and high-level knowledge about drugs.^{4,5} In Switzerland, PTs undergo a 3-year initial training course, combining internships and studies, to obtain a Federal Diploma of Vocational Education and Training. This apprenticeship aims to form PTs to work mainly in a community pharmacy under the supervision of a pharmacist.⁶ Continuing professional development (CPD) is therefore crucial for PTs in hospital, but it has to be designed and implemented.⁷

New teaching methods such as microlearning, game-based learning, team-based learning, simulations or blended learning programmes (BLP) have all created interest in the medical education field.^{8–12} Microlearnings are short targeted units of e-learning offering flexibility in terms of the time and place of training.¹³ Microlearning characteristics appear to offer a great opportunity for the CPD of healthcare professionals.^{8,14} Gamification and game-based learning are other effective educational tools that fully engage learners in meaningful, fun, motivational activities in non-threatening environments.^{10,11} On-site team-based learning and simulation are evidence-based active learning pedagogies that promote learner engagement and catalyse



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improvements in knowledge, skills and attitudes.^{10 12 15} Peer instruction is an example of team-based learning that encourages learners to reflect on the complex questions asked by instructors and to convince their peers of their chosen answers.¹⁶ Simulation creates a situation or environment as close to reality as possible that enables individuals to experience a representation of a real-life event for practice, learning, evaluation, testing or a better understanding of human systems or actions.¹⁷ A BLP is characterised by a combination of e-learning and face-to-face learning to make the most of each and optimise the overall outcome.^{9 18}

Integrating these innovative teaching methods into PTs' CPD is expected to result in improved competencies and learner satisfaction. The objectives of the present study are to create and evaluate a BLP for PTs' CPD.

MATERIAL AND METHODS

An interprofessional steering committee composed of three clinical pharmacists, two pharmacists in charge of PT teams and one PT was formed within Geneva University Hospitals' Pharmacy Department. The committee used Kern's six-step approach for curriculum development for medical education to design and implement this training programme project.¹⁹

Blended learning programme development

Step 1: Problem identification and general needs assessment

New training was mandated by the hospital's Pharmacy Directorate due to PTs' increasing role in ward stock management. Interviews were conducted with the pharmacist responsible for the PTs and the pharmacist responsible for the Clinical Pharmacy Unit to refine expectations. We subsequently identified potential training topics.

Step 2: Targeted needs assessment

An online survey created using the SurveyMonkey tool was used to collect PTs' perceived training needs. Survey content was based on a retrospective analysis of questions asked by the Clinical Pharmacy Unit's PTs over the previous 3 years.

Step 3: Goal and objectives

The training programme's goal was to empower PTs to answer clinical questions from nurses that did not require the expertise of a qualified pharmacist. We selected three subjects based on the results of steps 1 and 2 above. Each subject's learning objectives were set using Bloom's Revised Taxonomy.²⁰

Step 4: Educational strategies

A blended teaching strategy was designed to enhance knowledge, skills and attitudes. The first part included three microlearnings to be completed individually to improve knowledge. These were developed as short entertaining videos using the Vyond creation tool (GoAnimate Inc). Learners could access these anytime, anywhere and from any device. The second part consisted of a 1.5-hour face-to-face 'edutainment' session composed of team-based learning involving peer instruction, game-based learning and simulations to deepen knowledge and practice skills and attitudes.

Step 5: Implementation

The three microlearnings were uploaded to the pharmacy department's Moodle platform to manage and track the learning process. To enable each PT to participate in a face-to-face session, sessions were repeated five times and led by two trainers. PT groups were randomly composed to include five or six participants each.

Step 6: Evaluation and feedback

Evaluations were based on the reaction and learning levels in Kirkpatrick's model.²¹ We evaluated the impact of the BLP on PTs' knowledge, degree of certainty, self-perceived competence and satisfaction.

The knowledge assessment consisted of 18 multiple-choice questions (six per topic) developed following the concept of constructive alignment, which ensures consistency between pedagogical objectives, content and assessment.²² Question scores were 1 if all the propositions were correct, 0.5 if $\geq 50\%$ were correct, and 0 otherwise. At the end of the study, individualised feedback with detailed results was emailed to each participant. The degree of certainty (or confidence)—i.e. "How sure am I of my answer?"—was self-assessed for each question using a 5-point scale (from 1 "not at all sure" to 5 "almost certain"). Self-perceived competence—i.e. "I feel competent to use, guide, explain, search ..."—was self-assessed at the pre-test and both post-tests using 11 statements rated on an 11-point Likert scale (from 0 to 100 in ranges of 10).²³ Satisfaction was assessed via a 25-item questionnaire evaluating a variety of aspects (format, content, overall satisfaction); 19 statements were rated on a 5-point Likert scale (from 1 "strongly disagree" to 5 "strongly agree") and six open-ended questions.

Conduct of the study

This study used a one-group pre-test–post-tests design. Training began in January 2022 with learners required to complete the pre-test (knowledge, confidence and self-perceived competence assessments). They then had a minimum of 3 weeks to complete the three microlearnings. Following this part, they received post-test 1 (identical to the pre-test) and a first microlearnings satisfaction questionnaire. After attending the scheduled 'edutainment' session, participants completed post-test 2 (identical to the pre-test) and a second satisfaction questionnaire covering that face-to-face session and the training programme overall. Voluntary study participants were recruited from among the University Hospitals of Geneva's pharmacy department PTs.

Statistical analysis

Descriptive data such as age, years of practice and hospital experience were expressed as mean \pm SD and gender was expressed using numbers and percentages. Because repeated measures were performed on the same individuals at different times (pre-test, post-test 1, post-test 2), scores, the degree of certainty and the self-perceived competence were considered dependent variables. Comparisons were made between pre-test and post-test 1, post-test 1 and post-test 2, and overall score and topic scores using a mixed-effects linear regression model (with a fixed effect on time and a random effect on intercept). Results from post-test 1 were used as reference values to express other regression coefficients (coef) and 95% confidence intervals (95% CI). Statistical significance for all analyses was set at the two-sided 0.05 level. Data analysis was performed using R software version R-4.0.2 (R Foundation, Vienna, Austria).

RESULTS

Creation of microlearnings and a face-to-face edutainment session

Twenty PTs answered the survey about their training needs. These were analysed (steps 1 and 2) and 13 topics were identified. The steering committee identified three priority topics to address because of their usefulness in daily practice: communication tools, cutting and crushing tablets or opening capsules,

Table 1 Microlearning contents

Microlearning	Pedagogical objectives	Content
Communication	<ul style="list-style-type: none"> Improve information gathering Structure the information transmitted 	<ul style="list-style-type: none"> Definition of the active listening tool Definition of the SCAR tool (Situation, Context, Assessment, Recommendation)²⁴ Concrete examples
Cutting and crushing a tablet or opening a capsule	<ul style="list-style-type: none"> Know the risks and rules to respect Find helpful online resources 	<ul style="list-style-type: none"> Concrete examples of risks associated with this practice Rules to respect for good practice Helpful documents on the pharmacy website and the internet
Pharmacy website	<ul style="list-style-type: none"> Improve knowledge of the website Optimise searches 	<ul style="list-style-type: none"> Overall presentation of the website Useful documents for PTs Tips to improve searches

PT, pharmacy technician.

and finding information on the pharmacy website. The three microlearnings were ‘Communication’ (5 min duration), ‘Cutting and crushing tablets or opening capsules’ (6 min) and ‘Pharmacy website’ (6.5 min). Table 1 shows the content of each microlearning.

The 1.5-hour edutainment session was organised as follows: a two-team speed-based game involving 11 questions to review the basic concepts seen in the three microlearnings (20 min duration); a peer instruction-based game to reflect on and solve five complex questions on the three topics and to practise searching for answers on the pharmacy website (30 min); and a simulation scenario to use the communication tools explained in the microlearning (40 min) (figure 1).

Study population

Of the 26 original participants, all completed the pre-test and 25 (96%) completed post-tests 1 and 2. One person followed the microlearnings but did not complete post-test 1, and another did not attend the face-to-face edutainment session. Most participants were female (n=25, 96%) and the mean±SD age was 36±8 years. Participants had an average of 15±8 years of practice experience including 6±5 years in a hospital setting.

Table 2 Overall results for knowledge, degree of certainty and self-perceived competence before training (pre-test), after the microlearnings (post-test 1) and after the face-to-face edutainment session (post-test 2)

	Pre-test n=26	Post-test 1 n=25	Post-test 2 n=25
Mean (SD) overall knowledge score (range 0–18)	9.1 (1.7)	12.1 (1.6) p<0.001	13.1 (1.7) p=0.010
Mean (SD) overall degree of certainty (range 0–5)	3.4 (0.5)	4.2 (0.4) p<0.001	4.4 (0.4) p=0.105
Mean (SD) overall level of self-perceived competence (range 0–100)	58.6 (15.9)	72.3 (14.6) p<0.001	81.1 (10.0) p=0.001

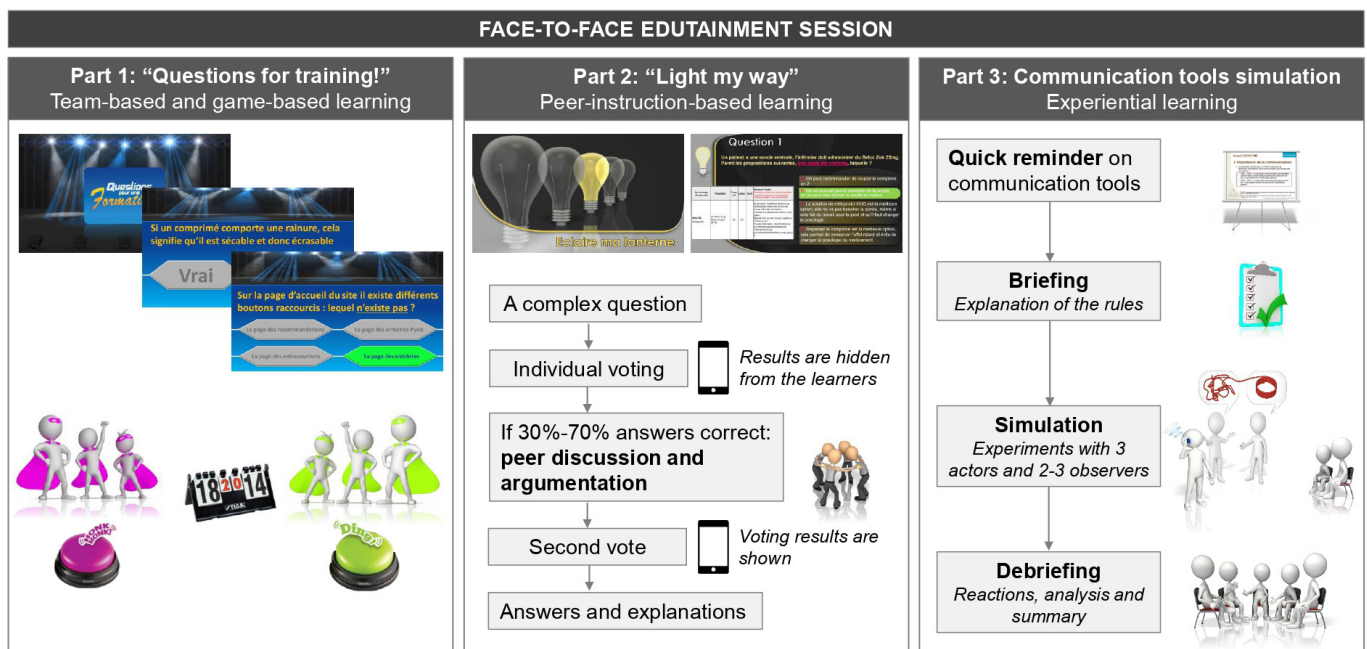
P values were calculated from a regression coefficient calculation.

Evaluation of knowledge, degree of certainty and self-perceived competence

Microlearnings had a significant impact on mean scores for knowledge (9.1/18 vs 12.1/18, coef=−3.0 (95% CI −3.7 to −2.3), p<0.001), degree of certainty (3.4/5 vs 4.2/5, coef=−0.8 (95% CI −1.0 to −0.6), p<0.001) and mean self-perceived competence level (58.6/100 vs 72.3/100, coef=−14 (95% CI −19 to −9), p<0.001) after post-test 1. Face-to-face edutainment sessions had a significant impact on mean scores for knowledge (12.1/18 vs 13.1/18, coef=1.0 (95% CI 0.2 to 1.7), p=0.010) and mean self-perceived competence levels (72.3/100 vs 81.1/100, coef=9 (95% CI 4 to 14), p=0.001). The mean degree of certainty increased, but the difference was not significant (4.2/5 vs 4.4/5, coef=0.2 (95% CI 0.0 to 0.3), p=0.105).

The mean overall knowledge score increased significantly by three points between pre-test and post-test 1 and by one point between post-tests 1 and 2 (table 2).

Analysis by topic showed that the microlearnings increased mean knowledge scores, degree of certainty and self-perceived competence levels for all three (figures 2–4). The face-to-face edutainment sessions had significant additional impacts on mean knowledge scores for the ‘Cutting and crushing a tablet’ topic and on the mean degree of certainty for the ‘Communication’

**Figure 1** Presentation of the three parts of the face-to-face edutainment session: a team-based and game-based activity, a peer-teaching activity and a simulation.

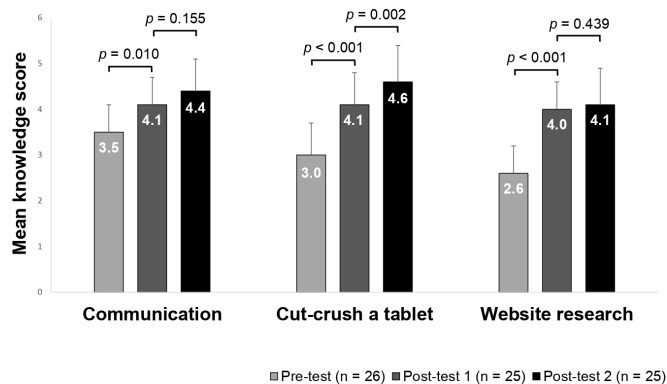


Figure 2 Mean (SD) knowledge score (range 0–6) before training (pre-test), after microlearnings (post-test 1) and after the face-to-face edutainment session (post-test 2). P values were calculated from a regression coefficient calculation.

topic. Furthermore, face-to-face sessions had significant impacts on self-perceived competence levels for all three topics.

Analysis by topic also showed that the overall BLP significantly improved the mean knowledge score for the ‘Cutting and crushing a tablet’ topic. Mean knowledge scores increased significantly after the ‘Communication’ and ‘Pharmacy website’ microlearnings, but those improvements were no longer statistically significant after the face-to-face edutainment session. The overall BLP significantly improved self-perceived competence levels for all three topics.

Satisfaction

All 26 participants completed the satisfaction questionnaire about microlearnings, and 25 completed it for the face-to-face session and the overall BLP.

All participants (n=26) agreed or strongly agreed that microlearnings were a suitable format for their CPD. One participant had difficulties with the online training technological aspects (Moodle, online questionnaires).

All the participants (n=25) enjoyed each part of the face-to-face sessions (game-based learning, peer instruction and simulation) and agreed or strongly agreed that group interactions and the entertaining style optimised learning. All 25 participants agreed or strongly agreed that the contents of the microlearnings and the face-to-face session were relevant to their training needs

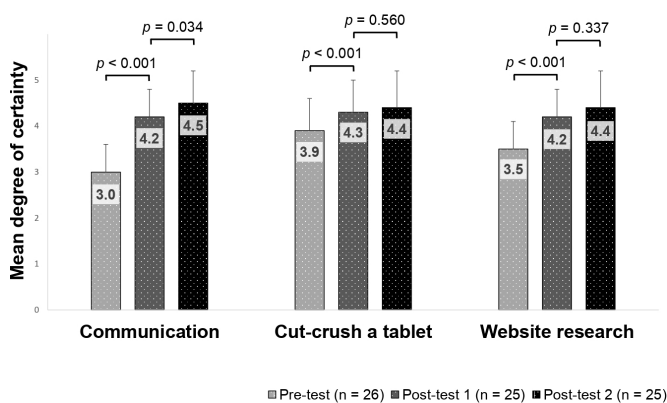


Figure 3 Mean (SD) degree of certainty (range 0–5) before training (pre-test), after microlearnings (post-test 1) and after the face-to-face edutainment sessions (post-test 2). P values were calculated from a regression coefficient calculation.

and useful for their daily practice. They strongly agreed that the microlearnings and edutainment sessions were complementary and asked for more BLPs as part of their CPD.

DISCUSSION

Summary of results

We developed a BLP for PTs that included three microlearnings and a face-to-face edutainment session. The topics covered were ‘Communication’ (a major part of avoiding serious adverse events), ‘Cutting and crushing tablets or opening capsules’ (a major theme among nurses’ questions within our institution) and our ‘Pharmacy website’ (which contains more than 200 reference documents for healthcare professionals).^{24 25}

The BLP significantly improved overall knowledge, confidence and self-perceived competence for all the participants. After the microlearnings, mean knowledge scores, the degree of certainty and the self-perceived competence levels increased significantly. The programme offered a flexible format for becoming proficient. The face-to-face sessions reinforced these results. Group work and practice seemed particularly useful for developing self-perceived competence in knowledge, skills and attitudes. All the PTs were satisfied with the BLP format and found it relevant and useful for their practice. Participants enjoyed all the teaching methods (microlearning, game-based learning, peer instruction and simulation) and wanted to see this type of training repeated as part of their CPD.

Comparison with the relevant literature

Our results showing improved knowledge and confidence among PTs following microlearnings were consistent with those of a review that evaluated their effects on other healthcare students. We concluded that microlearnings were a useful training method for busy healthcare professionals.⁸

To the best of our knowledge, no previous studies have been conducted to develop and evaluate a BLP for PTs. A recent meta-analysis showed that BLP had consistently better effects on knowledge outcomes than did traditional learning methods in health education (eg, with doctors, nurses, pharmacists, etc).¹⁸ One randomised controlled trial concluded that BLPs seem to provide better pedagogical value than online learning alone in terms of teaching undergraduate nurses clinical supervision skills.²⁶ Another study with a design similar to ours showed the effectiveness of using blended learning approaches to improve nursing students’ communication skills and self-efficacy during clinical transfers.²⁷

Furthermore, a recent study assessing PTs’ learning preferences using a VARK (visual, auditory, reading/writing, kinaesthetic) questionnaire concluded that their training should be multimodal and include experiential learning.²⁸ Our results indicating high satisfaction with the BLP reinforced these findings. Participants enjoyed the entertainment aspect, which was also a factor recently described in the literature as one that might improve learning outcomes among healthcare professionals.¹¹

We used self-perceived competence to obtain more information about self-confidence and detect erroneous beliefs.²⁹ Indeed, at pre-test, participants perceived themselves as less competent in ‘Communication’, even though they had a better mean score, and as quite competent in ‘Cutting and crushing tablets or opening capsules’, even though their mean score was fairly median. After training, self-perceived competence levels were more consistent with knowledge scores. However, a study with medical students reported varying degrees of agreement between self-perceived and objectively measured

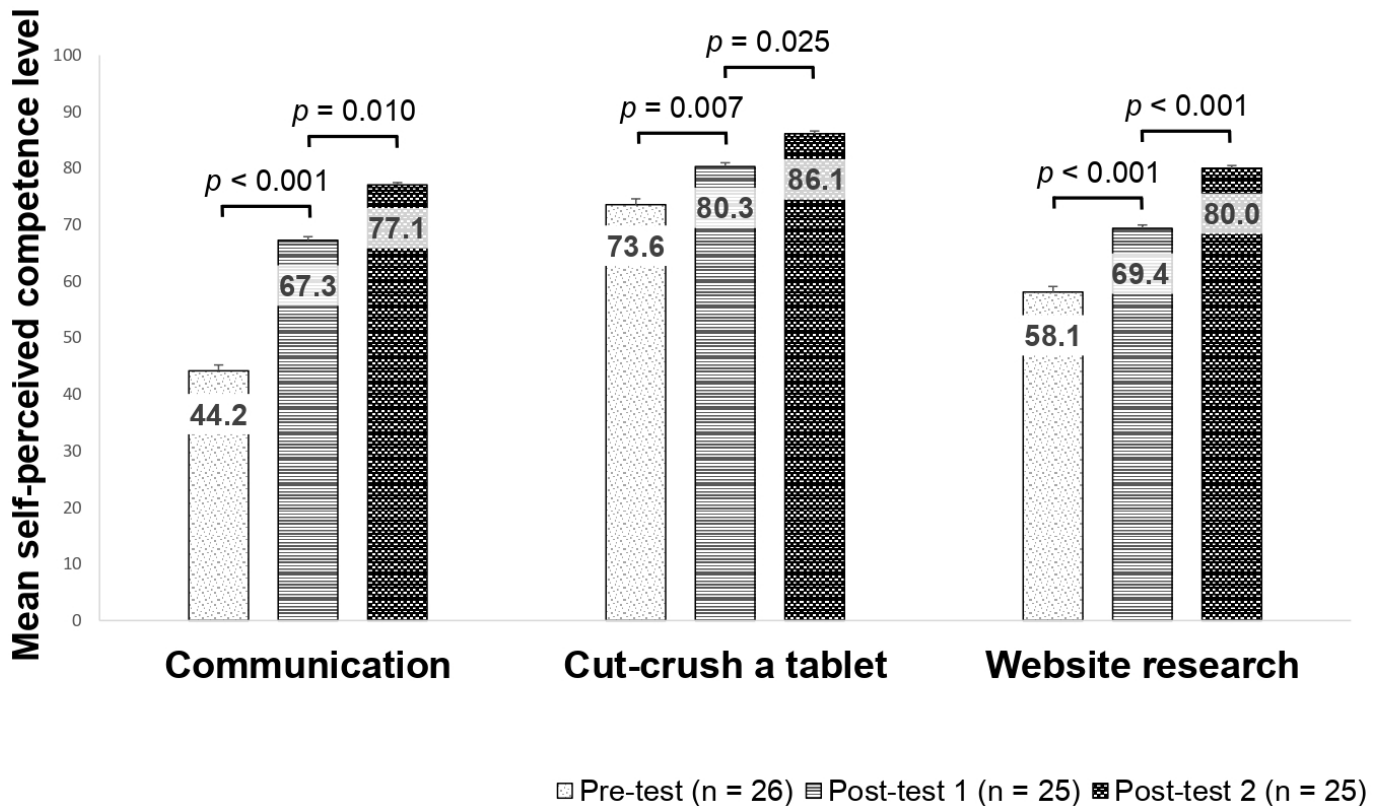


Figure 4 Mean (SD) self-perceived competence level (range 0–100) before training (pre-test), after microlearnings (post-test 1) and after the face-to-face edutainment sessions (post-test 2). P values were calculated from a regression coefficient calculation.

competences. Self-perceived competence must be interpreted cautiously.³⁰

Study limitations

Our study had some limitations, including the lack of a control group (eg, no intervention, just microlearning or just face-to-face learning groups) and the relatively low number of participants. Regarding teaching impact, we limited our evaluation to the first two levels of Kirkpatrick's model (user satisfaction and knowledge) and did not evaluate levels 3 and 4 (transposition into professional practice and impact for patients).²¹ Moreover, we performed the assessments directly after the microlearnings and the face-to-face sessions, so the duration of the impact is therefore unknown.

Future research

To address some of the study's limitations, more PTs could be included from other hospitals, with other topics evaluated. It would be interesting to retest participants' knowledge a few months after their training to measure retention over time and evaluate the need to reinforce their knowledge regularly. To evaluate level 3 in Kirkpatrick's evaluation model for training programmes, field audits could be conducted to observe changes in participants' behaviour and practice. Self-perceived and objectively measured competencies could also be compared in working environments.

CONCLUSIONS

The present study demonstrated the positive overall impact of BLPs on improving knowledge, degrees of certainty and self-perceived competence levels for three topics important for pharmacy technicians. Participant satisfaction with this pedagogical

format was high. It could be used for PTs' CPD and is probably similarly applicable to other healthcare professionals.

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