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Effect of an online training intervention on evidence-based practice in clinical nurses. #Evidencer Project

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Abstract

Background Online learning is becoming increasingly essential for health professionals, and it is necessary to understand how this modality affects clinical nurses' learning of Evidence-Based Practice (EBP). For this reason, the present study sought to assess the effectiveness of an online training program in improving nurses' EBP competence.

Methods A quasi-experimental study with a pretest–posttest design was conducted with a control group and without randomization for a period of 6 months. The intervention was an online self-learning course based on Melnyk's seven steps of Evidence-Based Practice (EBP). The course was structured into sequential modules requiring 72 h of work, with task completions and tests necessary for progression. Participants had three months to complete the course. EBP competence was measured with the EBP-COQ Prof© questionnaire. Data analysis included percentages, means, standard deviations, chi-square tests, student's t-tests, and a two-way repeated measures analysis of covariance (ANCOVA).

Results The analysis of the changes observed in each dimension and the overall EBP competence between the intervention group (IG) and the control group (CG) showed a significant group*time interaction in three of the four dimensions of the questionnaire. The results indicated that the online Evidence-Based Practice (EBP) course significantly improved knowledge, skills, and utilization three months after its completion. In the IG, the mean score was 44.04 (standard deviation (SD) = 7), compared to 37.83 (SD = 8.5) in the CG ($p < 0.001$). Regarding skills, the IG had a mean score of 24.24 (SD = 3.8), while the CG scored 23.01 (SD = 3.1) ($p = 0.008$). For utilization, the mean score in the IG was 36.77 (SD = 6.8), and the CG was 33.12 (SD = 6.3) ($p = 0.005$). Overall competence also showed a statistically significant difference, with the IG achieving a mean score of 141.22 (SD = 20.0) compared to the CG with a mean score of 130.34 (SD = 16.7) ($p < 0.001$).

Conclusions Training through an online education platform for three months (72 h) is an effective tool for improving the competence in Evidence-Based Practice (EBP) of clinical nurses. A significant increase was observed in knowledge and moderate improvements in skills and the application of EBP. These online courses, adapted to the needs of professionals, can be an efficient way to prepare nurses and improve their application of EBP in a clinical setting.

Keywords Evidence-based practice, Nurse, Competences, Distance learning, Online Education, Intervention, Attitude, Knowledge, Skills, Utilization

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Background

Healthcare quality relies on professionals utilizing evidence to care for patients and communities. While not every nurse conducts research, all must utilize research findings to support their practice, just like any other professional [1]. Evidence-based practice (EBP) is recognized internationally as a standard for making clinical decisions. It provides a framework with which to assess the quality and relevance of scientific research, allowing health professionals to choose more effective and safe interventions, considering their clinical experience and the patient's preferences as well [2].

The benefits of EBP are well known, with special emphasis on improvements in health and the quality of health systems [3–6]. However, the utilization of EBP in clinical practice has yet to reach full development. Barriers to utilizing evidence-based practices include insufficient time, resources, and skills for searching and assessing evidence, as well as resistance to change [7]. To overcome these obstacles, health systems must invest in the training and development of their professionals´ EBP competencies [8].

EBP education must start with health professionals' initial training and continue throughout their professional careers through continuous education [9]. This involves developing the skills to search for and critically appraise scientific literature and effectively apply evidence in clinical practice. To support this, governments, organizations, and international professional associations encourage and promote EBP and its teaching [9–12].

Traditionally, continuous learning by health professionals has been conducted face-to-face. However, the COVID-19 pandemic completely restricted face-to-face education, increasing online training by health services [13]. Health policies currently emphasize the importance of integrating new technologies in the training of health professionals, including all methodologies that facilitate learning without the necessity of physical presence [13]. A systematic review indicates that nurses are generally satisfied with using e-learning for ongoing education. Additionally, one of the positive outcomes highlighted is an increase in their knowledge and skills. However, it is noted that the effectiveness of e-learning interventions for nurses in the context of continuous training is still unknown, especially regarding how the learning can be transferred to change practice and affect patient outcomes; further advancements are needed in the field of e-learning in nursing education, particularly with a focus on lifelong learning [14].

More specifically for EBP, the studies on online interventions to improve the EBP competence of clinical nurses are scarce and show great variability concerning the content included in the training, the teaching modality, duration, tools utilized (online platforms, visual presentation of the contents, forums, gamification, that is the use of game-like elements in non-game contexts to engage and motivate people to achieve certain goals, use of social networks, etc.), number of hours, and EBP competence dimensions assessed [14–19]. The effectiveness of the interventions remains unclear. A meta-analysis, which included face-to-face, exclusively online, and blended training interventions, did not demonstrate positive outcomes in any of the commonly assessed dimensions: EBP attitudes, knowledge, skills, and utilization [19]. The poor outcomes may stem from several study limitations, including a small participant pool, high dropout rates, and variations in training content and duration. Additionally, the impact of different methodologies (face-to-face, blended, or online) remains unclear, as does the longevity of the intervention's effects. Therefore, it is essential to conduct rigorous research to address these critical questions.

In a context in which the transition towards online training of health professionals is crucial, there is an important need to reduce uncertainty about the impact of this training modality on the learning of EBP by clinical nurses. For this, the objective of the present study was to assess the effectiveness of an online training program to improve the EBP competence of nurses, focusing on the dimensions of EBP attitude, knowledge, skills, and utilization.

Method

Design

A quasi-experimental study utilizing a pretest–posttest design with a control group and non-randomized assignment was conducted over a 6-month period.

Setting and study participants

This study is part of the #Evidencer project, a national study conducted to assess the level of competence in EBP among Spanish nurses [20]. Participants were drawn from the sample involved in the initial phase of the project, who expressed interest in continuing with the study. Inclusion criteria included nurses working within the national health system, both in hospital and primary care settings, with a minimum of one year of clinical experience. Exclusion criteria included participation in another EBP course during the study period.

Sample selection

We based the calculation of the sample size on the estimations by Bausell and Li [21] for a two-way repeated measures analysis of variance (ANOVA) (inter-subject factor: treatment yes/no, intra-subject factor: pre and post-time points). A sample size of 190 subjects (95 + 95)

was deemed necessary to detect a difference in means between the experimental and control groups of at least 0.25 in the evidence-based practice questionnaire (EBP-COQ Prof©), and an estimated standard deviation of 0.92. This standard deviation was taken from a previous study that utilized the EBP-COQ Prof© questionnaire, conducted by the research team of the present study, with a power of 80% and a confidence of 95%. An additional 10% of participants were added due to the expected participant losses for a final 105 subjects per group.

A purposive sampling approach was conducted from September 2022 to March 2023. Nurses who expressed interest in participating in the second phase of the #Evidencer project were contacted by email and offered the opportunity to enroll in a free online course on EBP. Group allocation was non-randomized, with participants interested in taking the course forming the intervention group (IG), while those who opted not to participate in the course were given the option to join the control group (CG).

Intervention

The intervention consisted of completing an online course on EBP. Training took place on a custom-developed online platform designed for participant self-learning, featuring materials in various formats (text, video, web content), clinical scenarios, and interactive activities. Access to the online training for the intervention group (IG) was free and secured by a password to prevent potential contamination of the control group (CG).

The contents were structured considering the seven steps of EBP according to the model proposed by Melnyk [22]: 1) cultivating a spirit of inquiry, 2) asking clinical inquiry questions, 3) searching for literature, 4) appraising, 5) integrating, and 6) evaluating evidence, and 7) dissemination of EBP results. Each step of the model corresponded to a learning module of the training program (Table 1). The content of the modules was developed by the research team, which possessed teaching experience in EBP. At the end of each module, participants were required to complete an assessment test. Each module was scheduled to be completed within a specific timeframe, and progression to the next module was contingent upon the elapsed time, completion of activities, and passing the corresponding exam.

To complete this training program, the participants were given 3 months (6 h a week were estimated) for a total estimated time of 72 h. To avoid the abandonment of the training based on the online platform, reminders were sent to encourage continuing the training, and the participants obtained a certification from a public Spanish university that accredited the training received.

Table 1 Online evidence-based practice course

Modules	Hours	Contents
Module 0: Cultivate a spirit of inquiry within an Evidence-based Practice (EBP) culture and environment	6	Analysis of the evolution of science and its impact on medical and nursing practice Discussion about the concept of EBP, advantages and disadvantages Review of clinical variability examples Reflections on barriers, clinical responsibility, and ethics
Module 1: Ask the burning clinical question in PICOT format	6	Importance of asking clinical questions Formulation of clinical questions following the PICOT format Clinical domains of PICOT questions and their relationship with research designs
Module 2: Search for and collect the most relevant best evidence	18	Criteria for conducting a search of scientific evidence. Resources for scientific evidence How to conduct searches in bibliographic databases of health sciences Analysis and examples of searches for scientific evidence in PubMed
Module 3: Critically appraise the evidence	18	Reflections on why it is important to conduct critical reading of scientific evidence Understanding statistics to comprehend science Critical reading of Systematic Reviews and Clinical Practice Guidelines
Module 4: Integrate the best evidence with one's clinical expertise and patient/family preferences	12	Steps to implement practice change in an organization with examples of evidence implementation Importance of leadership for practice change in the clinical context
Module 5: Evaluate outcomes of the practice decision or change based on evidence	6	Sources of internal evidence Measurement of outcomes to evaluate the impact of changes
Module 6: Disseminate the outcomes of the EBP decision or change	6	Reflections on the importance of disseminating the results and achievements obtained Dissemination through various means: posters, oral presentations, scientific articles

Variables and instruments

The socio-demographic and professional variables of the nurses were included: age, sex, time since obtaining the Nursing degree, total professional experience, professional experience in primary care and hospital settings, whether they worked in a center implementing clinical practice guidelines through the Best Spotlight Organization (BPSO®) program [23], educational level, work setting, type of contract, training in EBP, number of articles read in the last month; mentoring of nursing students, and use of the Internet and other digital tools to access scientific information.

To evaluate competency in EBP, the Evidence-Based Practice Competency Questionnaire, Professional version (EBP-COQ-Prof©), previously validated in the Spanish context, was utilized [24]. EBP-COQ-Prof© has adequate validity and reliability and measures nurses' self-perceived EBP competence. The questionnaire includes 35 items organized into four dimensions: dimension of attitude (8 items, range 8–40); dimension of knowledge (11 items, range 11–55); dimension of skills (6 items, range 6–30); and dimension of utilization (10 items, range 10–50), and the total score of the scale that determines overall EBP competency (range 35–175). The items are scored using a Likert scale ranging from 1 to 5 (from "complete disagreement" to "complete agreement").

Data collection

The data were collected through an online form that included the variables described above. The IG nurses took part in the online training program, and three measurements were taken: before the course, i.e., baseline measurement (Time 1); after 3 months, i.e., after the end of the course (Time 2); and 6 months after the baseline (Time 3). The CG was also measured at these three time points using the online questionnaire after accepting to participate: baseline (Time 1), after 3 months (Time 2), and after 6 months (Time 3).

Data analysis

Descriptive statistics, including means and standard deviations, were calculated for quantitative variables, while frequencies and percentages were determined for qualitative variables. Depending on the nature of the variables being compared, the ANOVA, Student's t-test, and Chi-square tests were employed to analyze the differences between the control and experimental groups. If significant differences were found in any of the analyzed variables, they were included in the multivariant statistical analysis to prevent potential confounding bias.

To calculate the effectiveness of the intervention, a two-way, repeated-measures analysis of covariance (ANCOVA) was performed, using the T1, T2, and T3 measurements as the intra-subject factor, and the taking of the online training program as an inter-subject factor (intervention: yes/no). This analysis also allowed comparing the adjusted mean scores obtained in each dimension of the EBP-COQ Prof© for each group at each of the three time points of the study.

To assess the effect of the changes observed in the two groups compared (IG and CG), the variation rate was calculated from T1 to T2 and from T1 to T3 to evaluate the real increase in each of the dimensions of the EBP competence in each group. This rate was computed using the following formula: Variation rate of variation at 3 months $\frac{T2-T1}{T1}x100$, and Variation rate of variation at 6 months $\frac{T3-T1}{T1}x100$ [25].

The effectiveness analysis was conducted by blinding the participants' membership to each group studied (intervention or control). In the statistical analysis, a significance level of 5% ($p \leq 0.05$) was utilized. The data were analyzed using the SPSS v.26.0 program.

Ethical compliance

This research received approval from the Ethics Committee of the University of Murcia (ID: 2540/2019). All procedures adhered to the ethical guidelines outlined in the Declaration of Helsinki. Participation by nursing professionals was voluntary, following a detailed explanation of the study's objectives and the ethical assurances provided. The anonymity of the participants was preserved, and the confidentiality of the collected data was assured through the assignment of a personal code.

Results

The final sample consisted of 194 nurses. In the IG, 102 nurses completed the three measurements, while 92 nurses in the CG did the same. The socio-demographic and professional characteristics are shown in Table 2. About 80% of the participants were middle-aged women, with an average age ranging from 44 to 49 years. The total professional experience of the participants averaged between 20 and 25 years, with about 13 years of experience in hospital settings. Between 54 and 61% of the professionals held a master's degree, and about 8 to 11% had a PhD. Statistically significant differences were observed between the groups regarding age, work experience, type of contract, work setting, EBP training, reading of articles, and working in a BPSO® center (Table 2). These variables were considered in the analysis of the effect of the intervention on EBP competence and included in the covariance (ANCOVA) analysis as co-factors.

The analysis of the changes observed in each dimension and the overall EBP competence between the IG and the CG at three different time points (Fig. 1: a, b, c, d, and e)

Table 2 Characteristics of the participants

		Intervention group	Control group	*P value*
Age (M; SD)		**43.38 (9.48)**	**49.51 (8.43)**	**< 0.0001**
Sex %(N)	Female	79.4% (81)	76.1% (70)	0.578
	Male	20.6% (21)	23.9% (22)	
Professional experience (years) (M; SD)		19.59 (9.47)	25.55 (8.73)	< 0.0001
Professional experience in Primary Care (years) (M; SD)		11.15 (12.51)	4.56 (7.08)	< 0.0001
Professional experience in Hospital (years) (M; SD)		12.68 (10.78)	14.25 (10.25)	0.303
Specialist Nurse % (N)	Yes	20.6 (21)	17.4 (16)	0.571
Master's degree % (N)	Yes	61.8 (63)	54.3 (50)	0.296
Doctoral Degree % (N)	Yes	7.8 (8)	10.9 (10)	0.468
Other bachelor's degree % (N)	Yes	16.7 (17)	16.3 (15)	0.946
Employment status	Temporary work	16.7 (17)	4.3 (4)	< 0.0001
	Interim	27.5 (28)	8.7 (8)	
	Permanent	55.9 (57)	87 (80)	
Work setting % (N)	Urban (> 50,000 inhabitants)	73.5 (75)	60.9 (56)	0.080
	Suburban (10,000–50,000 inhabitants)	16.7 (17)	18.5 (17)	
	Rural (< 10,000 inhabitants)	9.8 (10)	20.7 (19)	
Context of care % (N)	Hospital care	70.6 (72)	45.7 (42)	< 0.0001
	Primary Care	29.4 (30)	54.3 (50)	
Training on EBP % (N)	None	27.5 (28)	8.7 (8)	< 0.0001
	< 40 h	25 (24.5)	29.3 (27)	
	40 – 150 h	36.3 (37)	28.3 (26)	
	> 150 h	11.8 (12)	33.7 (31)	
Reading of articles per month % (N)	0	30.4 (31)	16.3 (15)	0.006
	1 to 3	46.1 (47)	40.2 (37)	
	> 3	23.5 (24)	43.5 (40)	
Working at a BPSO® center % (N)	Yes	53.9 (55)	25 (23)	< 0.0001
Nursing Student´s Mentor % (N)	Yes	50 (51)	38 (35)	0.094
Use of the Internet and digital tools to access scientific information % (N)	Yes	77.5 (79)	64.1 (59)	0.041
Place where access the Internet most frequently to consult information % (N)	Home	73.5 (75)	67.4 (62)	0.349
	Work	26.5 (27)	32.6(30)	

M Mean, *SD* Standard Deviation

shows a significant group*time interaction in three of the four dimensions of the questionnaire, indicating that the online course increases EBP knowledge (F = 29.256; p = < 0.001; $\eta 2 = 0.242$); in second place, skills (F = 11.269; p = < 0.001; $\eta 2 = 0.109$), and lastly, utilization (F = 9.908; p = < 0.001; $\eta 2 = 0.097$). Concerning the overall competence, a statistically significant effect was observed (F = 21.491; p = < 0.001; $\eta 2 = 0.189$). A statistically significant effect was not observed only in the dimension of attitude (F = 1.324; p = 0.269; $\eta 2$ = 0,014).

The comparison of the adjusted mean scores obtained by the IG and the CG in the four dimensions and the overall EBP competence shows no statistically significant differences in the baseline measurements (T1). In the latter measurements at 3 (T2) and 6 months (T3), statistically significant differences were observed, with higher scores in the IG, which had taken the course, in all the dimensions and the overall competence, except for the dimension of attitude (Table 3). At T2, the intervention group (IG) demonstrated a significantly higher mean score in the dimension of knowledge at 46.04 (SD: 6.7) compared to the control group (CG), with a mean of 37.84 (SD: 8.3), p-value < 0.001. This difference slightly decreased by T3, with the IG scoring a mean of 44.02 (SD: 7.0) and the CG at 37.83 (SD: 8.5), p-value < 0.001.

In the dimension of skills, the intervention group (IG) scored a mean of 25.16 (SD: 3.5) at T2, compared to the control group (CG), which had a mean of 22.39 (SD: 3.7), with a p-value < 0.001. At T3, the IG had a slightly lower

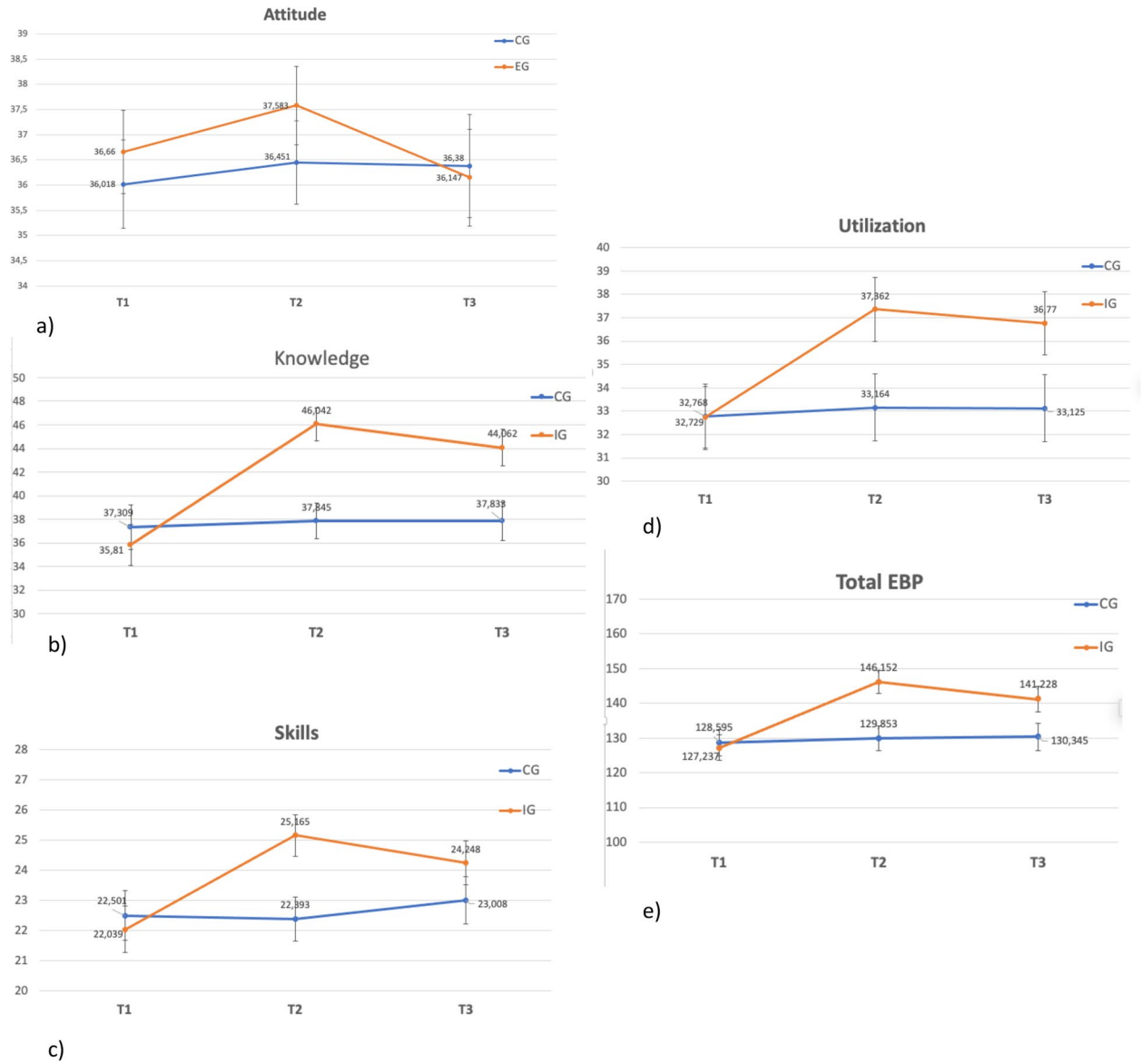

Fig. 1 Comparison of the adjusted means scores of the EBP´s dimensions and the overall EBP competence

mean of 24.24 (SD: 3.8), while the CG mean was 23.01 (SD: 3.1), p-value < 0.05.

For the dimension of utilization, at T2, the intervention group (IG) achieved a mean score of 37.36 (SD: 6.1), while the control group (CG) had a mean of 33.16 (SD: 7.4), with a p-value < 0.001. At T3, the IG mean was 36.77 (SD: 6.8), compared to 33.12 (SD: 6.3) for the CG, again with a p-value < 0.001. For overall competence in EBP at T2, the IG obtained a mean score of 146.15 (SD: 16.9), while the CG scored 129.85 (SD: 18.0), with a p-value < 0.001. This difference slightly decreased at T3, with the IG showing a mean of 141.22 (SD: 20.0) compared to 130.34 (SD: 16.7) in the CG, p-value < 0.001.

The analysis of the change between T1, T2, and T3 (intra-subject change) shows a statistically significant effect only in the IG, in the dimensions of knowledge, skills, utilization, and overall competence, with a significant change between T1-T2 and T1-T3. As for the magnitude of the effect, the variation rates showed a higher increase in the dimension EBP knowledge, with a rate of variation of 36.7% between T1-T2, and 32% between T1-T3, followed by skills, with a variation of 15.6% (T1-T2), and 12% (T1-T3), and utilization, with values of 15.2% (T1-T2) and 13.3% (T1-T3) (Table 3).

Table 3 Comparison of the scores of the EBP dimensions and the global competence adjusted by covariables

	T1	T2	T3	Variation Rate (T1-T2)	Variation Rate (T1-T3)	Within subjects			Between subjects AxB (T1-T2-T3)		
Attitude	**M (SD)**	**M (SD)**	**M (SD)**	**%**	**%**	**F**	**P**	***η2***	***F***	***p***	***η2***
IG	36.66 (2.7)	37.58[a] (4.3)	36.14 (5.6)	1.74	-1.92	4.003	0.020	0.041	1.065	0.303	0.006
CG	36.01 (4.9)	36.45 (2.8)	36.38 (2.9)	7.49	6.90	0.396	0.674	0.004			
Knowledge											
IG	35.81[b,c] (9.4)	46.04[a] (6.7)	44.02 (7.0)	36.7	31.9	80.323	< 0.001	0.465	17.471	< 0.001	0.086
CG	37.30 (9.4)	37.84 (8.3)	37.83 (8.5)	5.2	4.8	0.211	0.810	0.002			
Skills											
IG	22.04[b,c] (4.1)	25.16 (3.5)	24.24 (3.8)	15.6	11.98	26.282	< 0.001	0.221	7.274	0.008	0.038
CG	22.50 (3.7)	22.39 (3.7)	23.01 (3.1)	4.7	6.8	1.144	0.321	0.012			
Utilization											
IG	32.72[b,c] (6.6)	37.36 (6.1)	36.77 (6.8)	15.2	13.3	28.889	< 0.001	0.238	8.192	0.005	0.042
CG	32.76 (6.7)	33.16 (7.4)	33.12 (6.3)	4.2	5.4	0.190	0.827	0.002			
GLobal Competence											
IG	127.23 [b,c] (18.0)	146.15[a*] (16.9)	141.22* (20.0)	15.0	11.6	60.240	< 0.001	0.394	14.033	< 0.001	0.070
CG	128.59 (20.0)	129.85 (18.0)	130.34 (16.7)	3.9	4.2	0.354	0.702	0.004			

M Mean, *SD* Standard Deviation, *η2* eta square, *IG* Intervention Group, *CG* Control Group, *T1* Time 1, *T2* Time 2, *T3* Time 3

a: comparison T2 y T3 $p < 0.05$; b: comparison T1 y T2 $p < 0.001$; c: comparison T1 y T3 $p < 0.001$

Covariables: Context of care, years of work experience, work in a BPSO, EBP training, article reading, and employment status

Discussion

The study's main findings show that an exclusively online EBP training course, based on self-learning and without tutoring, lasting 3 months (72 h) improved the EBP knowledge, skills, and utilization, as well as overall EBP competence, of clinical nurses. The dimension of attitude was not significantly modified, as observed in most of the studies on nurse training, independently of the type of intervention performed [16, 19, 20, 26]. In our case, this dimension showed very high scores from the baseline measurement, which limits its potential for improvement and explains the lack of significant changes.

The learning behavior in the IG showed significant improvement across all three dimensions and overall competence in EBP. Specifically, using the national standardized norms [20], our results show a significant increase in percentiles, indicating a substantial effect of the intervention. In the IG, the dimension of knowledge changed from the 50th percentile to the 80th percentile (P80) after the training, remaining between P70-P75 after three months. In the dimension of skills, a change was observed from P40 to P60 in T2, decreasing to P50 after three months. Concerning EBP utilization, the IG started at P50 at baseline, increasing to P75 after the course and decreasing to P70 at T3. Globally, the EBP competence of the professionals changed from P40 at baseline to P75 at T2 and P70 at T3. Therefore, an important increase was observed in EBP after the training, which decreased moderately after 3 months.

The international literature has shown that EBP knowledge is the facet of learning on which an effect of EBP training of nurses is clearly observed, independently of the teaching method utilized [19, 27, 28]. In line with this evidence, our findings showed the greatest effect of the intervention in the dimension of knowledge, with a rate of variation of almost 37%, which remained at 32% at the end of the study. Similarly, other studies conducted with blended EBP courses for nurses in Spain [16], as well as other countries [29, 30], showed positive changes in knowledge. Other distance learning initiatives, such as online nursing journal clubs, observed a significant increase in EBP knowledge up to 3 months after the intervention [31].

Our findings provide new evidence regarding the other learning dimensions, such as EBP skills and utilization of EBP. On one hand, a positive effect was observed in the dimension of skills throughout the study, with variation rates slightly lower than those observed in knowledge. In this case, the changes observed were between 15% after the intervention (T2) and 12% after 3 months (T3). This dimension has been less studied in the specialized literature. When research has been conducted, it has not shown significant results in favor of training, such as in

an e-mentoring study lasting 12 weeks [32], or in another study in which an EBP online 3-week training course was compared [33]. It is not known if the lack of effectiveness of these studies was due to the duration of the training and its characteristics or to methodological aspects such as the small sample size.

The effect of the training on the utilization of EBP in nurses is more controversial. On the one hand, previous studies on online training experiences have not shown changes in the utilization of EBP [16, 33]. Conversely, our results show that following the training, an improvement in the utilization of EBP was produced, with a 15% increase (T2) compared to the baseline measurement, which remained at 13% (T3). These findings raise several questions regarding the long-term durability of this effect and whether conducting maintenance sessions could contribute to the sustainability of the learning.

Our study allows us to address some methodological and practical matters that have yet to be resolved. The content of our EBP online training course encompassed the seven steps of the model proposed by Melnyk in 2010 [22], including aspects related to the promotion of a culture that values and practices the use of evidence in the making of decisions, the analysis of the results of the changes observed, the process of implementation of evidence, and the dissemination of the findings obtained. Previous educational interventions did not incorporate these specific contents, regardless of the methodology applied [19].

Also, it is necessary to address alternative modes of education based on new technologies to increase the EBP competence of nurses, which facilitates the learning of professionals and adapts to their schedules and pace of work. In this sense, the methodology used in our study suggests that this type of training, in which the participants access the learning platform to independently read and answer the self-reflection tasks without the support of tutors or peer groups, is a successful approach to improving the EBP competence of nurses. This finding is particularly promising at a time when health organizations have increasingly adopted online training methods [13].

Lastly, knowing the ideal duration of the training for it to have a positive effect is a much-discussed subject. Different factors, such as the duration or intensity of the training, the type of tasks, and the characteristics of the subjects, influence the duration of the training. The specialized literature coincides in that the training periods of longer duration lead to better retention [34]. Our results are consistent with this evidence, showing that training that lasts 3 months, with a teaching load of 72 h, is enough for obtaining a positive impact at least 3 months after the intervention in improving EBP knowledge, as well as EBP skills and utilization. It could be interpreted, as shown by the #EvidencerMUSEBP, which describes the comprehensive relationship of diverse determinant factors on nurse's EBP competence, that EBP training, independently of the methodology applied, requires a large number of hours to have an impact at least on the EBP knowledge of nurses [35].

Healthcare organizations worldwide strive to enhance the implementation of EBP among nursing personnel to reduce variability, increase the quality of care, and improve patient outcomes. This is one of the few research studies with a quasi-experimental design with two groups that assessed the impact of the online EBP education program on clinical nurses' learning to acquire EBP competencies. The results suggest that this type of intervention can be sustainable and cost-effective for other target populations across different work environments, healthcare specialties, and cultures.

Limitations of the study

Some limitations of the present study must be pointed out. On the one hand, the study's design was not random, so the group of nurses that participated showed differences in variables such as age, professional experience, area of work, EBP training, and whether their center of employment was implementing the BPSO® program. However, these variables were considered in all the statistical analyses performed, which helped to control for a possible confounding bias in the results compared.

On the other hand, the study participants expressed their interest in collaborating when answering a national poll on EBP competence. Similarly, it was ensured that professionals interested in EBP were used to obtain high participation and adherence to the training and study follow-up, considering that the professionals' high workloads made it very complex to conduct a study of these characteristics. However, this implies that the participants' answers were more favorable than those from the general population of nurses [36].

In future studies, it would be advisable to use experimental designs, include nurses from other practice areas, and conduct follow-ups longer than 3 months after the intervention. It would also be interesting to include variables that impact the patient results.

Conclusions

It has been demonstrated that training through an online learning platform lasting 3 months (72 h) is an efficient and desirable tool for improving the EBP competence of clinical nurses. The greatest effect was produced in the dimension of knowledge, with an increase

higher than a third of the baseline value. Significant increases were also found in the dimensions of EBP skills and utilization, with a more moderate impact. The performance of these online courses, which can be adapted to the characteristics and availability of professionals, can be an efficient resource for preparing nurses for EBP competence and improving its applicability in a clinical setting.

Abbreviations

ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
BPSO	Best Practice Spotlight Organization
EBP	Evidence-based Practice
EBP-COQ Prof©	Evidence-based Practice Competence Questionnaire for registered nurses
IG	Intervention group
CG	Control group
COVID-19	Coronavirus Disease 2019
F	Snedecor's F-distribution
M	Mean
P	Probability
P40	40Th percentile
P50	50Th percentile
P70	70Th percentile
P75	75Th percentile
P80	80Th percentile
SD	Standard deviation
SPSS	Statistical Package for the Social Sciences
T1	Time 1
T2	Time 2
T3	Time 3
η2	Eta square

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Authors' contributions
AJRM performed conceptualization, methodology, investigation, data curation, software, resources, funding acquisition, project administration, validation, writing-original draft, and visualization. SFS performed methodology, investigation, data curation, writing review and editing, and visualization. CLC performed methodology, formal analysis, and data curation. MRM performed conceptualization, methodology, funding acquisition, validation, formal analysis, writing-original draft, and supervision. All authors approved the final version.

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

Declarations

Ethics approval and consent to participate
The study was approved by the Ethics Committee of the University of Murcia (ID: 2540 /2019). The nurses were invited to participate voluntarily through the online survey. They were informed about the objectives of the study, clarifying that their participation was completely anonymous, that they could withdraw from the study at any time, and that by submitting the questionnaires, they were giving their consent to participate in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. McKenna L, Copnell B. Fundamentals of nursing and midwifery research: a practical guide for evidence-based practice. London: Routledge; 2024.
2. Levin RF, Feldman HR, editors. Teaching evidence-based practice in nursing. 2nd ed. New York: Springer; 2013.
3. Coster S, Watkins M, Norman IJ. What is the impact of professional nursing on patients' outcomes globally? An overview of research evidence. Int J Nurs Stud. 2018;78:76–83.
4. Melnyk BM, Gallagher-Ford L, Long LE, Fineout-Overholt E. The establishment of evidence-based practice competencies for practicing registered nurses and advanced practice nurses in real-world clinical settings: proficiencies to improve healthcare quality, reliability, patient outcomes, and costs. Worldviews Evid Based Nurs. 2014;11:5–15.
5. Ylimäki S, Oikarinen A, Kääriäinen M, Pölkki T, Mikkonen K, Holopainen A, et al. Advanced practice nurses' evidence-based healthcare competence and associated factors: a systematic review. J Clin Nurs. 2024;33:2069–83.
6. Connor L, Dean J, McNett M, Tydings DM, Shrout A, Gorsuch PF, et al. Evidence-based practice improves patient outcomes and healthcare system return on investment: findings from a scoping review. Worldviews Evid Based Nurs. 2023;20:6–15.
7. Sánchez-García I, López-Medina IM, Pancorbo-Hidalgo PL. Obstáculos percibidos por las enfermeras para la práctica basada en evidencias: Un estudio cualitativo. Enferm Clin. 2013;23:279–83.
8. Fernández-Castro M, López M, Martín-Gil B, Rodríguez-Soberado P, Rivas-González N, Muñoz-Alvaredo L, et al. Nurses' evidence-based practice competence and hospital practice environment after specific training under the Best Practice Spotlight Organization® Programme. a cross sectional study. Nurse Educ Today. 2023;126:105808.
9. WHO. Regional Office for Europe. European strategic directions for strengthening nursing and midwifery towards Health 2020 goals. Geneva: World Health Organization (WHO); 2015. https://iris.who.int/handle/10665/353555.
10. Institute of Medicine (US) Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine. The Future of Nursing: Leading Change, Advancing Health. Washington (DC): National Academies Press (US); 2011.
11. International Council of Nurses. Closing the Gap: From Evidence to Action. Geneva: International Council of Nurses; 2012.
12. Registered Nurses' Association of Ontario. Promoting evidence-based practice and healthy work environments. RNAO Vision backgrounder; 2014. https://rnao.ca/sites/rnao-ca/files/vision-docs/RNAO-Vision-Nurturing-Evidenced-Based-Practice-and-HWE.pdf.
13. Frenk J, Chen LC, Chandran L, Groff EOH, King R, Meleis A, et al. Challenges and opportunities for educating health professionals after the COVID-19 pandemic. The Lancet. 2022;400:1539–56.
14. Rouleau G, Gagnon M-P, Côté J, Payne-Gagnon J, Hudson E, Dubois C-A, et al. Effects of E-Learning in a Continuing Education Context on Nursing Care: Systematic Review of Systematic Qualitative, Quantitative, and Mixed-Studies Reviews. J Med Internet Res. 2019;21:e15118.
15. D'Souza P, George A, Nair S, Noronha J, Renjith V. Effectiveness of an Evidence-Based Practice Training Program for Nurse Educators: A Cluster-Randomized Controlled Trial. Worldviews Ev Based Nurs. 2021;18:261–71.
16. Ramos-Morcillo AJ, Fernández-Salazar S, Ruzafa-Martínez M, Del-Pino-Casado R. Effectiveness of a brief, basic evidence-based practice course for clinical nurses. Worldviews Evid Based Nurs. 2015;12:199–207.

17. Smith SB, Kennedy S. Authentic Teaching to Promote Active Learning: Redesign of an Online RN to BSN Evidence-Based Practice Nursing Course. J Prof Nurs. 2020;36:56–61.
18. Song CE, Park H. Active Learning in E-Learning Programs for Evidence-Based Nursing in Academic Settings: A Scoping Review. J Contin Educ Nurs. 2021;52:407–12.
19. Sapri ND, Ng YT, Wu VX, Klainin-Yobas P. Effectiveness of educational interventions on evidence-based practice for nurses in clinical settings: A systematic review and meta-analysis. Nurse Educ Today. 2022;111:105295.
20. Ramos-Morcillo AJ, Fernández-Salazar S, Leal-Costa C, Ruzafa-Martinez M. Evidence-based practice nurses' competency: Spanish national survey and establishment of a scale of the EBP-COQ-Prof©. J Nurs Manag. 2021;29:794–804.
21. Bausell RB, Li Y-F. Power analysis for experimental research: a practical guide for the biological, medical, and social sciences. Cambridge; New York: Cambridge University Press; 2002.
22. Melnyk BM, Fineout-Overholt E, Stillwell SB, Williamson KM. Evidence-based practice: step by step: the seven steps of evidence-based practice. Am J Nurs. 2010;110:51–3.
23. González-María E, Moreno-Casbas MT, Albornos-Muñoz L, Grinspun D. The implementation of Best Practice Guidelines in Spain through the Programme of the Best Practice Spotlight Organizations®. Enfermeria Clinica. 2020;30:136–44.
24. Ruzafa-Martínez M, Fernández-Salazar S, Leal-Costa C, Ramos-Morcillo AJ. Questionnaire to evaluate the competency in evidence-based practice of registered nurses (EBP-COQ Prof©): development and psychometric validation. Worldviews Evid Based Nurs. 2020;17:366–75.
25. Daniel WW, Cross CL. Biostatistics: a foundation for analysis in the health sciences. Eleventh. Hoboken, NJ: Wiley; 2019.
26. Kim S, Jeong HW. Developing and evaluating an evidence-based practice research competency enhancement program for clinical nurses in Korea: a pilot study. BMC Nurs. 2024;23:111.
27. Farokhzadian J, Jouparinejad S, Fatehi F, Falahati-Marvast F. Improving nurses' readiness for evidence-based practice in critical care units: results of an information literacy training program. BMC Nurs. 2021;20:79.
28. Nandaprakash P, Lingaraju M, Shakuntala BS. A Study to Assess the Effectiveness of Self Instructional Module on Knowledge Regarding Evidence Based Nursing Practice among Staff Nurses Working in Selected Hospitals at Mysore. Inter Jour of Nurs Educ. 2019;11:36.
29. Saunders H, Vehviläinen-Julkunen K, Stevens KR. Effectiveness of an education intervention to strengthen nurses' readiness for evidence-based practice: A single-blind randomized controlled study. Appl Nurs Res. 2016;31:175–85.
30. Allen N, Lubejko B, Thompson J, Turner B. Evaluation of a Web Course to Increase Evidence-Based Practice Knowledge Among Nurses. CJON. 2015;19:623–7.
31. DuGan JE. "Keeping You in the Know": The Effect of an Online Nursing Journal Club on Evidence-Based Knowledge Among Rural Registered Nurses. Computers Informatics Nursing. 2019;37:190–5.
32. Hooge N, Allen DH, McKenzie R, Pandian V. Engaging advanced practice nurses in evidence-based practice: An e-mentoring program. Worldviews Ev Based Nurs. 2022;19:235–44.
33. Moore L. Effectiveness of an Online Educational Module in Improving Evidence-Based Practice Skills of Practicing Registered Nurses. Worldviews Ev Based Nurs 2017;14:358–66.
34. Alhussein L, Hosseini EA, Nguyen KP, Smith MA, Joiner WM. Dissociating effects of error size, training duration, and amount of adaptation on the ability to retain motor memories. J Neurophysiol. 2019;122:2027–42.
35. Ruzafa-Martínez M, Fernández-Salazar S, Leal-Costa C, Ramos-Morcillo AJ. Determinants of Evidence Implementation by Nurses: #Evidencer Model for the Use of Evidence-Based Practice (#EvidencerMUSEBP)—A Structural Equation Model. J Nurs Manag. 2024;2024:1–13.
36. Moore ER, Watters R, Wallston KA. Effect of evidence-based practice (EBP) courses on MSN and DNP students' use of EBP. Worldviews Evid Based Nurs. 2019;16:319–26.

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