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An Evidence-Based Practice Educational Intervention for Athletic Trainers: A Randomized Controlled Trial

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Context: As evidence-based practice (EBP) becomes a necessity in athletic training, Web-based modules have been developed and made available to the National Athletic Trainers' Association membership as a mechanism to educate athletic trainers (ATs) on concepts of EBP.

Objective: To assess the effect of an educational intervention on enhancing knowledge of EBP among ATs.

Design: Randomized controlled trial.

Setting: Web-based modules and knowledge assessment.

Patients or Other Participants: A total of 164 of 473 ATs (34.7% response rate), including professional athletic training students, graduate students, clinical preceptors, educators, and clinicians, were randomized into a control group (40 men, 42 women) or experimental group (33 men, 49 women).

Intervention(s): Ten Web-based modules were developed that covered concepts involved in the EBP process. Both groups completed the Evidence-Based Practice Knowledge Assessment before and after the intervention phase. During the intervention phase, the experimental group had access to the Web-based modules for 4 weeks, whereas the control group had no direct responsibilities for the investigation. The knowledge assessment consisted of 60 multiple choice questions pertaining to concepts presented in the 10 modules. Test-retest reliability was determined to be good (intraclass correlation coefficient [2,1] = 0.726, 95% confidence interval = 0.605, 0.814).

Main Outcome Measure(s): Independent variables consisted of group (control, experimental) and time (preassessment, postassessment). Knowledge scores were tabulated by awarding 1 point for each correct answer (maximum = 60). Between-group and within-group differences were calculated using a 2 × 2 repeated-measures analysis of variance ($P \leq .05$), post hoc *t* tests, and Hedges g effect size with 95% confidence intervals.

Results: We found a group × time interaction ($F_{1,162} = 26.29$, $P < .001$). No differences were identified between the control (30.12 ± 5.73) and experimental (30.65 ± 5.93) groups during the preassessment ($t_{162} = 0.58$, $P = .84$). The experimental group (36.35 ± 8.58) obtained higher scores on the postassessment than the control group (30.99 ± 6.33; $t_{162} = 4.55$, $P = .01$). No differences were identified among time instances within the control group ($t_{81} = 1.77$, $P = .08$); however, the experimental group obtained higher scores on the postassessment than the preassessment ($t_{81} = 7.07$, $P < .001$).

Conclusions: An educational intervention consisting of 10 Web-based modules was an effective mechanism to increase knowledge of foundational EBP concepts among ATs. However, it is not known whether ATs are integrating EBP into daily clinical practice. Researchers should determine whether increased knowledge of EBP affects the daily clinical decision making of ATs.

Key Words: web-based modules, implementation, education

Key Points

- A series of 10 evidence-based practice (EBP) Web-based learning modules was an effective mechanism for enhancing EBP knowledge levels among athletic trainers.
- Researchers need to identify whether increased knowledge levels of EBP concepts enhance athletic training clinical practice.

The approach to creating a culture of evidence-based practice (EBP) needs to be multifaceted,[1,2] signifying that athletic training educators, clinicians, and students must become familiar with the concepts involved in EBP. The 2011 release of the fifth edition of *Athletic Training Education Competencies*[3] from the National Athletic Trainers' Association (NATA), which includes an EBP content area, is a foundational starting point to this multifaceted approach. To foster understanding of the EBP content area, educational mechanisms must be available to effectively educate athletic trainers (ATs) in a manner that is convenient for each individual.

Researchers[4–10] in various health care professions have found numerous mechanisms of educational interventions (eg, short courses, 1-day workshops, teaching models, Web-based tutorials, weekly seminars) that effectively increase knowledge levels among health care professionals regarding EBP. However, authors of only 2 studies[6,8] have directly assessed EBP educational interventions within athletic training. Although these interventions were reported to be effective, the mechanisms varied in level of difficulty and the sample group being assessed. Welch et al[6] conducted a 5-hour, 1-day workshop geared toward athletic training educators, whereas Manspeaker et al[8] introduced an evidence-based teaching model that was developed for athletic training students and implemented in a modalities or rehabilitation course at 9 professional athletic training programs. Given that these interventions consisted of different educational techniques and focused on specific sample groups (ie, athletic training educators, professional athletic training students), it is difficult to generalize the results of these investigations to the athletic training population.

One of the most efficient ways to educate ATs about the various components of EBP may be via Web-based tutorials.[4,9–12] As society progresses through a digital era, Web-based tutorials provide a flexible option for distance learners and "hidden learners."[13,14(p50)] In the realm of athletic training, a *hidden learner* would be classified as a person who cannot attend state, district, or national conferences for continuing education. Consideration of the hidden learner will be essential in ensuring that the entire athletic training population receives the necessary foundations of EBP for efficient clinical implementation. Web-based tutorials have several advantages for the athletic training profession. To begin, such tutorials facilitate easy dissemination to a large population, such as the NATA membership, which included 32 545 ATs and 7504 athletic training students at the time of this study.[15] Given that members of a particular population are often dispersed geographically, it may be difficult for them to attend specifically designated training sessions or workshops.[16] Furthermore, providing mechanisms that target educational programs only is not sufficient for facilitating a multifaceted approach. Therefore, providing an educational tool to increase EBP knowledge via Web-based mechanisms is critical to help accommodate the various types of ATs. The ability to efficiently provide a substantial amount of information to the masses is an important feature when trying to advance a cohort of individuals.

Web-based tutorials provide learners with the opportunity to complete the material at their own speeds[16,17] and at their own convenience[16–18] and have been shown to be an effective educational strategy to enhance knowledge of a given topic.[4,19–21] Tutorials offer concise instructions and allow the learner to return as needed and to view the information numerous times to ensure comprehension.[16,22] Furthermore, Web-based tutorials are considered to be versatile training instruments that can fit into the limited time available in a busy schedule.[16] By providing EBP Web-based tutorials to the NATA membership, seminars and workshops at state, district, and national conferences can shift focus to disseminate implementation strategies for incorporating the fundamental EBP concepts into athletic training clinical practice and didactic education.

Therefore, the purpose of our study was to assess whether an EBP educational intervention (ie, 10 Web-based learning modules) enhanced knowledge of EBP concepts among ATs. We hypothesized the following: (1) we would find no differences in preassessment scores achieved by participants in the experimental group and participants in the control group on the Evidence-Based Practice Knowledge Assessment, (2) we would find no differences between preassessment and postassessment scores for participants in the control group, (3) participants in the experimental group would achieve higher postassessment scores on the knowledge assessment than participants in the control group, and (4) participants in the experimental group would achieve higher postassessment than preassessment scores on the knowledge assessment.

METHODS

Participants

All members of the NATA were solicited. Of the 473 people who responded to the initial request to participate in this investigation, 175 participants completed all 3 phases of the study, for an overall initial response rate of 37.0% (Figure). Descriptions of how each participant was instructed to define his or her role as an AT are provided in Table 1. Informed consent was assumed when participants submitted their contact information on the survey Web page. The Old Dominion University Human Subjects Committee for Exempt Research approved this study, and the NATA board of directors funded the development of the Web-based modules used within this investigation.

Instrumentation

Evidence-Based Practice Web-Based Modules. Before this investigation commenced, 10 EBP Web-based learning modules were developed. These modules were designed to educate ATs about foundational concepts related to the EBP process and were made accessible to all members of the NATA after the conclusion of this study in September 2011 (http://www.nata.org/Evidence-based-Practice-in-Athletic-Training). Each module focused on a specific concept or grouping of similarly related concepts and was designed to take approximately 20 to 25 minutes to complete. The Web-based modules were developed by a development team of 5 EBP subject-matter experts (C.E.W., B.V.L., D.A.H., and 2 who were not authors) who had experience in EBP education and research.

During the module development, the development team met to outline the breakdown of the modules and how each module would be formatted and organized. Original module topics stemmed from the most commonly applied concepts relating to each of the 5 steps of the EBP process. When the primary outline of topics was developed, each member of the development team selected the topics in which she was most knowledgeable. The person assigned to a particular module was the primary content developer and responsible for all the content presented. During the module-development phase, the development team met weekly to discuss potential concerns with the modules, provide suggestions and ideas when necessary, and answer questions that may have arisen during the development of each module. During this time, each module was also specifically discussed, and the development team continually assessed whether an EBP concept should be explained in a single module or if related concepts could be discussed together.

After the development phase, 9 preliminary modules were ready for internal review. Four of the 5 members of the development team systematically examined each of the 9 modules and provided comments and suggestions related to the content area. When all members had reviewed a module, it was returned to the primary content developer for revisions. The new draft of the module was reviewed again in the same systematic approach, and the review-

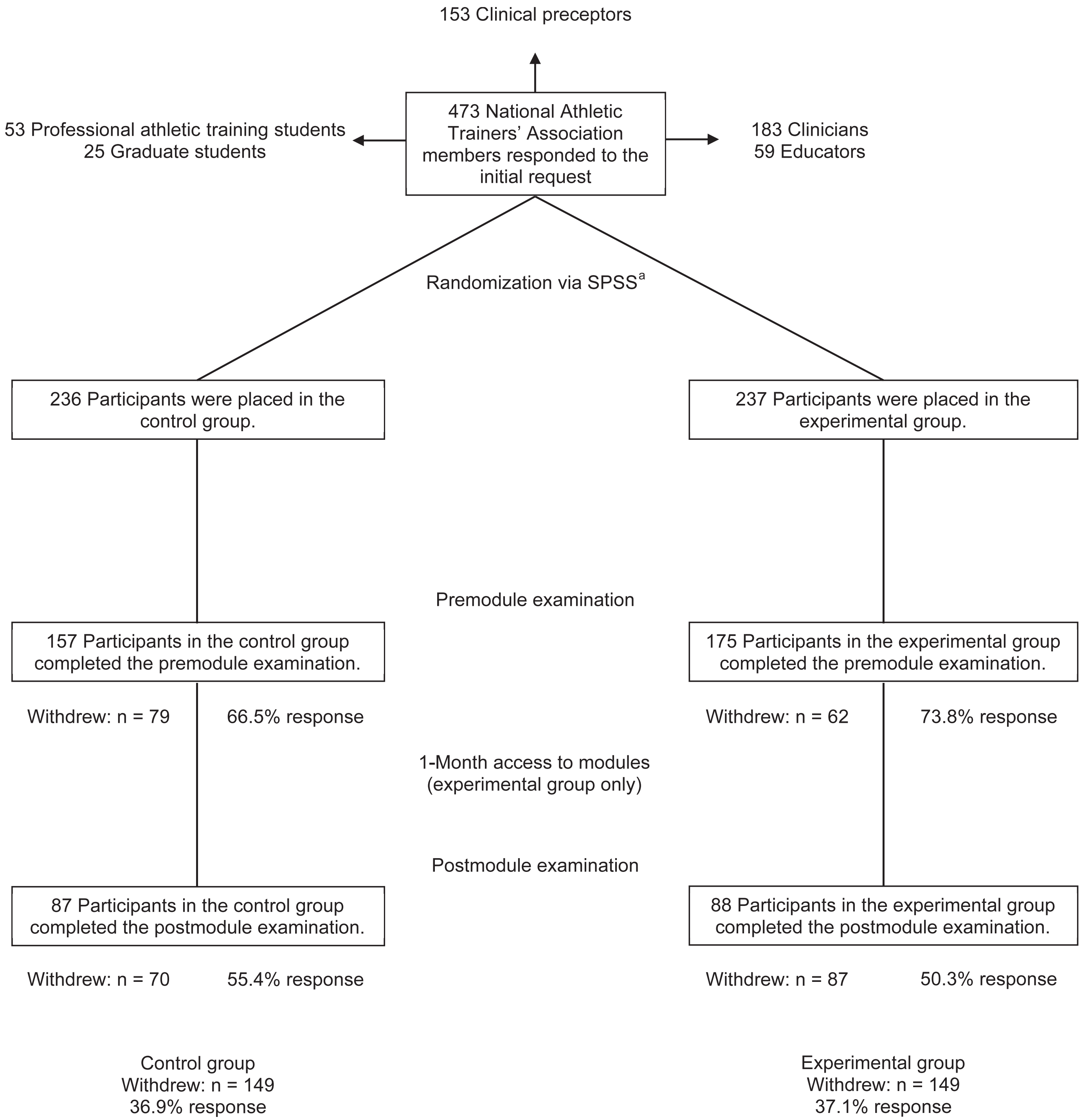

Figure. Investigation withdrawal and response rates. [a] Version 16.0 for MacIntosh; SPSS Inc, Chicago, IL.

revision process continued until all members of the development team approved each module. Simultaneously during the review process, face validity of the Web-based modules was determined via a sample group ($n = 11$) of postprofessional athletic training students who had no experience with EBP concepts. The sample group was given 1 module per week, and each student completed the module and then provided the primary content developer with specific feedback. Most student feedback identified areas that were confusing and unclear, as well as instances where more examples would have been beneficial. Student feedback was considered during the revision process.

When the internal review was completed, the modules were sent to a team of external reviewers to assess the content validity. The external reviewers consisted of 3 additional EBP subject-matter experts who also had experience in EBP education and research. Each expert was assigned 3 modules to review. After examination, the modules were returned to the primary content developer for revisions. When all revisions were completed, all 9

Table 1. Definitions of Primary Athletic Training Role

Athletic Training Role	Definition
Professional athletic training student	Enrolled in a professional undergraduate or professional entry-level athletic training program; recently became certified or recently graduated from an athletic training program but had not begun employment in an athletic training setting
Graduate student	A graduate student in a master's or doctoral program and certified by the Board of Certification; recently graduated from a graduate program but had not begun employment in an athletic training setting; a graduate student and also had clinical supervision responsibilities (ie, clinical preceptor)
Clinical preceptor	Currently acting as a clinical preceptor affiliated with an athletic training program; held a dual role (didactic and clinical supervision responsibilities)
Full-time educator and researcher	Currently a full-time educator in an athletic training program with no clinical responsibilities, full-time researcher affiliated with an athletic training program, or an educator in a program other than athletic training as long as he or she had no clinical responsibilities
Full-time clinician	A practicing clinician with no current affiliation to an athletic training program or no clinical supervision responsibilities; practice in and teach within a high school setting

modules were sent to 1 of the external reviewers. This reviewer examined the content of each module for a final time, but more importantly, checked the modules as a whole for clarity, consistency, and accuracy.

During the final review process, 1 content-heavy module was divided into 2 modules. Thus, the final result of the module development process was 10 EBP Web-based learning modules (Table 2). After the completion of module development and review, 1 member of the research team (C.E.W.) worked directly with the Web design team at the NATA office to transfer the modules to a Web-based mechanism: eLearning (version 3.6.8; Epignosis, Ltd, Athens, Greece).

Evidence-Based Practice Knowledge Assessment. Given the lack of a preexisting knowledge assessment tool to accurately represent the material covered in the EBP Web-based modules, the development team created a Web-based assessment using Inquisite 8.0 Corporate Survey Builder (Catapult System Corporation, Austin, TX). The Evidence-Based Practice Knowledge Assessment was developed while the Web-based modules underwent external review. During this time, each primary content developer was instructed to write pertinent questions based on the information presented within each module. The questions were reviewed in the same systematic way as the Web-based modules. After the development team agreed on the questions from the assessment, the same external subject-matter expert who reviewed all 10 modules was instructed to assess the face and content validity of the examination, and minor revisions were made based on the external reviewer's feedback. A test-retest reliability assessment was conducted on the preassessment and postassessment knowledge scores that the control-group participants achieved. Test-retest reliability of the knowledge assessment was assessed with intraclass correlation coefficient (ICC) (2,1) values and was determined to be good (ICC [2,1] = 0.726, 95% confidence interval [CI] = 0.605, 0.814).

The Evidence-Based Practice Knowledge Assessment included 2 subsections: knowledge and demographics. The knowledge section consisted of 60 multiple choice questions involving the EBP concepts discussed within the 10 modules. The assessment included approximately 3 to 8 questions related to each module. Each question had 1 correct response, and composite scores of participants were tabulated by awarding 1 point for a correct response and zero points for an incorrect response. Therefore, a higher knowledge composite score (maximum = 60) indicated a higher level of knowledge pertaining to EBP concepts. Along with the knowledge section, participants were instructed to complete a demographic questionnaire. The questionnaire instructed each participant to select a predetermined group that most accurately represented his or her primary role as an AT and then guided the participant to answer specific demographic questions relating to the athletic training role selected.

Procedures

When the research investigation commenced and after approval from the NATA board of directors, all NATA members were sent an e-mail by the administrative staff at the NATA office requesting participation in the study. However, members of the NATA can refuse e-mails from the NATA office. Therefore, it is difficult to assess how many members received the participation request. The participation e-mail contained a description of the overall purpose and importance of the research study, a timeline of the 3 phases of the investigation, general information regarding the Web-based learning modules, and a URL hyperlink directing them to the Web page to provide consent. The Web page instructed respondents to provide their full name, e-mail address, current status as an NATA member (ie, student or certified), primary role as AT (Table 1), and current job setting. The Web page also informed respondents that their name and e-mail would be kept confidential and that this information was necessary to gain

Table 2. Final Module Breakdown by Evidence-Based Practice Step

Steps of Evidence-Based Practice	Module Order	Module Topic
1. Developing a clinical question	1	Developing clinical questions
2. Literature searching	2	Literature searching
	3	Types of research
3. Critical appraisal	4	Levels of evidence and strength of recommendation
	5	Appraisal scales
	6	Statistics terminology
	7	Reliability coefficients
	8	Critically appraised papers and topics
4. Applying the evidence	9	Patient-reported outcomes
5. Assessing outcomes	10	Disablement models

access for the modules. When all responses to participation requests were received, participants were stratified by primary role as an AT and current job setting; they were then randomized into the control or experimental group. The randomization process was conducted using a random number generator (SPSS version 16.0 for Macintosh; SPSS Inc, Chicago, IL).

Phases of the Investigation. The first phase of the study involved the Evidence-Based Practice Knowledge Assessment. Participants were sent an individualized e-mail informing them of the group into which they had been randomized. The e-mail also contained information regarding the first phase of the study and the URL hyperlink directing them to the Web page of the survey. Additionally, participants were informed that their survey responses could not be matched to their name. Participants were given 7 days to complete the Evidence-Based Practice Knowledge Assessment and were instructed to answer all questions honestly without the use of external materials. A reminder e-mail was sent to participants on the fourth day to thank those who had completed the survey assessment and to remind those who had not responded. When participants indicated that they had completed the survey by clicking "submit," the information was sent automatically to the university database system. Individual responses to specified questions were generated in SPSS and then matched with a file-coding system to maintain participant confidentiality. On the first page of the survey assessment, each participant was instructed to create a personalized participant identification code. The code was required during the first and third phases of the study. It could not be matched to the participant in any way but allowed the research team to accurately match phase 1 and phase 3 responses.

The second phase of the study began immediately after phase 1 ended. In phase 2, the experimental group was provided access to the EBP Web-based learning modules. Each participant was sent an e-mail from the NATA office that contained a unique user name, password, and URL hyperlink directing him or her to the Web-based modules. Additionally, participants in the experimental group were sent an e-mail from the research team that included the timeline to complete the modules and helpful hints to navigate through the module Web page. Participants were allotted 4 weeks to complete the 10 EBP Web-based learning modules at their own pace, and e-mails were sent weekly to remind participants of the module timeline. The research team also sent control-group members an individualized e-mail at the beginning of the phase 2 that informed them of the 4-week timeline in which they would not have any direct responsibilities for the investigation and highlighted the specific date in which the next phase of the study would begin. Control-group members were instructed not to use outside resources to educate themselves on the concepts of EBP during this 4-week period; participants were granted access to the Web-based modules after the investigation ended.

Phase 3 of the research investigation began immediately after phase 2 ended. In this final phase of the study, participants in both the experimental and control groups were instructed to complete the Evidence-Based Practice Knowledge Assessment for a second time and again were instructed to answer all questions honestly without the use of external materials. In addition, participants in both groups were instructed to report descriptive information pertaining to any use of external resources to educate themselves on components related to EBP and whether they had attended or completed any type of educational intervention (eg, class, workshop, short course, Webinar) during the 4-week period between assessments. In addition to the questions assessing external resources and educational interventions, participants in the experimental group were instructed to rate their perceptions of the Web-based modules. Before the assessment was distributed, access to the Web-based modules was revoked from all experimental-group participants so they could not access the information while completing the assessment. Participants were allotted 7 days to complete the assessment, and a reminder e-mail was sent on the fourth day. Similarly to phase 1, participant responses were sent automatically to the university database system and were generated in SPSS. After completion of the final phase of the study, participants in both groups were sent individual e-mails thanking them for their time and effort to complete this investigation.

Data Analysis

Preassessment data from 5 participants in the control group and 6 participants in the experimental group could not be accurately matched to the postassessment data. Therefore, data analyses were conducted on the responses from 164 participants (34.7% final response rate): 13 professional athletic training students, 23 graduate students, 29 clinical preceptors, 35 educators, and 64 clinicians (Table 3).

Descriptive statistics were used to calculate the means, standard deviations, CIs, and frequencies of the data. A representative analysis was conducted to determine if the balance between the control and experimental groups (ie, responders) that was achieved after stratification and randomization was maintained despite the persons who withdrew from the investigation (ie, nonresponders).[23] This type of analysis allowed researchers to confirm that no bias existed between the groups before the intervention phase. It included the following demographic variables: age, sex, ethnicity, athletic training role, and previous EBP instruction. Analyses consisted of χ^2 logistic regression tests and Mann-Whitney U tests, which were appropriate to the nature of the data. A 2-tailed α level of .05 was used to determine differences. Between-group (control, experimental) and within-group (preassessment, postassessment) differences were calculated using a 2×2 repeated-measures analysis of variance with an α level set a priori at .05. In the presence of an interaction, post hoc *t* tests and Hedges g effect sizes with 95% CIs were calculated. We used SPSS to calculate the statistical components.

RESULTS

Withdrawal and response rates for each phase of the study among the control and experimental groups are displayed in the Figure. The representative analysis revealed no differences between responders and nonresponders. It also showed that the sample included in this investigation was representative of the real population, and participants who withdrew after the first phase of the investigation did not affect the homogeneity between

Table 3. **Participant Demographics**

	Professional Athletic Training Students		Graduate Students		Clinical Preceptors		Full-Time Educators and Researchers		Full-Time Clinicians	
	Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group
No.	7	6	10	13	13	16	20	15	32	32
Age, y, mean ± SD	23.7 ± 3.90	27.5 ± 13.1	25.80 ± 2.66	29.0 ± 7.10	35.15 ± 11.39	33.69 ± 5.59	38.75 ± 8.28	41.40 ± 9.25	36.69 ± 11.36	34.59 ± 10.34
Sex, No. (%)										
Female	5 (71.4)	4 (66.7)	6 (60)	7 (53.8)	7 (53.8)	9 (56.3)	9 (45)	8 (53.3)	15 (46.9)	21 (65.6)
Male	2 (28.6)	2 (33.3)	4 (40)	6 (46.2)	6 (46.2)	7 (43.7)	11 (55)	7 (46.7)	17 (53.1)	11 (34.4)
Experience as an athletic trainer, y, mean ± SD	Not applicable	Not applicable	3.20 ± 2.04	6.12 ± 5.97	9.38 ± 7.09	10.97 ± 5.15	16.05 ± 8.08	19.13 ± 8.94	13.02 ± 10.64	10.63 ± 8.87
Previous evidence- based practice instruction? No. (%)[a]										
Yes	4 (57.1)	3 (50)	10 (100)	9 (69.2)	6 (46.2)	5 (31.3)	11 (55)	11 (73.3)	6 (18.8)	12 (37.5)
No	3 (42.9)	3 (50)	0 (0)	4 (30.8)	7 (53.8)	11 (68.7)	9 (45)	4 (26.7)	26 (81.2)	20 (62.5)

[a] *Previous evidence-based practice instruction* was defined to the participants as having attended a workshop, tutorial, or conference (eg, Athletic Training Educators' Conference).

groups after stratification and randomization. That is, those who withdrew and did not complete all phases of the study did not bias our findings.

We found a group × time interaction ($F_{1,162} = 26.29$, $P < .001$). For the experimental group, time (ie, the intervention) led to higher knowledge scores, with a mean score increase of 5.71 ($F_{1,162} = 73.08$, $P \leq .001$). However, knowledge scores of the control group were not dependent on time ($F_{1,162} = 1.68$, $P = .20$). No differences were identified between the control (30.12 ± 5.73) and experimental (30.65 ± 5.93) groups during the preassessment ($t_{162} = 0.58$, $P = .84$, Hedges g = 0.09, 95% CI = –0.22, 0.40); however, the experimental group (36.35 ± 8.58) obtained higher scores on the postassessment than the control group (30.99 ± 6.33, $t_{162} = 4.55$, $P = .01$, Hedges g = 0.71, 95% CI = 0.39, 1.02). No differences were identified among time instances within the control group ($t_{81} = 1.77$, $P = .08$, Hedges g = –0.14, 95% CI = –0.45, 0.16); however, the experimental group obtained higher scores on the postassessment than the preassessment ($t_{81} = 7.07$, $P < .001$, Hedges g = 0.77, 95% CI = 0.45, 1.09). Preassessment and postassessment composite scores by athletic training role are reported in Table 4.

During phase 3, participants reported any use of external resources during the 4-week phase 2 period. A total of 88% (n = 72) of the participants in the experimental group and 87% (n = 71) of the participants in the control group indicated that they had not used any external resources to educate themselves on EBP concepts, whereas the other 13% (n = 11) in the experimental and 12% (n = 10) in the control groups indicated using a combination of textbooks, journals, or Web sites. Regarding completion of another EBP educational intervention, 95% (n = 78) of the experimental group and 96% (n = 79) of the control group reported they did not attend any form of an educational session. Four (0.05%) participants in the experimental group and 3 (0.04%) participants in the control group attended an educational class, professional presentation, or Webinar. The experimental groups' perceptions of the Web-based modules are shown in Table 5.

DISCUSSION

As EBP emerges throughout the athletic training profession, the membership must be educated properly and provided with the necessary tools to efficiently implement EBP. Our results indicated that a series of Web-based modules regarding various EBP concepts is an effective mechanism to enhance knowledge among a wide variety of ATs. Before the implementation of the educational intervention, we found no differences in preassessment scores between the experimental and control groups, indicating that the 2 groups were homogeneous in regard to their knowledge levels of EBP concepts. Homogeneity between groups at the start of the investigation minimized variance of extraneous variables specific to participant characteristics that may have affected the results.[24] Results from this investigation confirmed our hypothesis that we would find no differences between preassessment and postassessment scores within the control group. These findings also

Table 4. **Group Means by Primary Athletic Training Role**

Primary Athletic Training Role	Group					
	Control			Experimental		
	Preassessment	Postassessment	Mean Difference	Preassessment	Postassessment	Mean Difference
Professional athletic training students	28.71 ± 2.56	26.43 ± 7.50	–2.28	28.33 ± 5.82	36.00 ± 6.10	+7.67
Graduate students	35.50 ± 4.14	38.10 ± 5.34	+2.60	36.85 ± 6.63	36.62 ± 8.14	+1.92
Clinical preceptors	28.92 ± 5.97	29.69 ± 6.02	+0.77	29.06 ± 4.82	36.62 ± 8.14	+7.56
Full-time educators and researchers	32.80 ± 5.00	33.35 ± 5.20	+0.55	31.00 ± 4.72	39.87 ± 9.70	+8.87
Full-time clinicians	27.56 ± 5.35	28.81 ± 4.98	+1.25	29.19 ± 5.23	33.66 ± 7.88	+4.47

corroborated that improvement due to knowingly being evaluated (ie, Hawthorne effect[25]) did not influence the control group. Our findings also confirmed that the experimental group achieved higher scores on the post-assessment assessment when between-groups scores were compared. Furthermore, the experimental group also achieved higher scores on the postassessment when within-group preassessment-postassessment scores were compared.

Other investigators[4,19–21] assessing the effectiveness of Web-based tutorials have noted similar knowledge gains. Kerfoot et al[20] found that knowledge of urology increased among medical students (34%) after Web-based teaching compared with a control group (7%) that did not have access to the tutorials. Comparably, Pusic et al[12] also reported increases in knowledge among students (25%) after implementing a series of Web-based tutorials regarding pertinent topics in emergency medicine compared with a control group (16.7%). Thus, regardless of the topic being presented, Web-based learning via tutorials has been shown to successfully accomplish knowledge gains.

The Web-based learning modules developed for ATs, which were released to the NATA membership in September 2011, encompass numerous concepts involved in the EBP process. The first module introduces the learner to the EBP process and then presents the foundations of developing a solid clinical question. From there, each module introduces new concepts that build on one another and progress the learner through the 5 steps of EBP. The 10 EBP modules discussed in this investigation (ie, level 1 modules) are available via the NATA Web page (http://www.nata.org/Evidence-based-Practice-in-Athletic-Training). Numerous examples are provided throughout the modules that pertain to real-life athletic training clinical practice, and NATA members may access each module as many times as they choose at no cost. Additionally, 2 knowledge assessments approved by the Board of Certification are available for those interested in acquiring level 1 EBP category continuing education units. A second cohort of Web-based modules (ie, level 2 modules), including information pertaining to sensitivity, specificity, likelihood ratios, predictive values, epidemiologic measures, health care informatics, and clinical prediction rules, was made available to the NATA membership in September 2012.

Whereas it is difficult to directly compare the Web-based learning modules with previous EBP educational interventions that have been assessed within athletic training,[6,8] some of the key distinctions that make each intervention unique need to be highlighted. Welch et al[6] assessed the effectiveness of a 5-hour, 1-day workshop detailing 3 presentations on EBP fundamentals, implementing systematic reviews, and using clinical predication rules. Results indicated that postworkshop knowledge slightly increased from 66.0% to 69.5%. However, a key limitation to that investigation was the nature of the workshop in relation to the content included within the survey because the instrument included information pertaining to only 1 of the 3 presentations in the workshop.[6] Using a short-course mechanism, Manspeaker et al[8] developed an evidence-based teaching model (EBTM) consisting of lecture materials, class assignments, and guided discussion for clinical preceptors and students during a clinical experience. Post-EBTM knowledge scores (66%) increased from scores achieved on the assessment before implementation (50%) of the EBTM, and 23% of participants increased their scores by 3 or more points.[8]

Table 5. **Experimental-Group Perceptions of the Evidence-Based Practice Web-Based Learning Modules**

Perception Statement	Response Choice	Response, No. (%)
Overall, the evidence-based practice modules were__________	Extremely easy to understand	9 (11.0)
	Mostly easy to understand	57 (69.5)
	Somewhat easy to understand	13 (15.9)
	Extremely difficult to understand	3 (3.7)
Overall, the information provided within the evidence-based practice online modules was ___________ in enhancing my knowledge of evidence-based practice.	Extremely helpful	29 (35.3)
	Moderately helpful	35 (42.7)
	Mildly helpful	18 (22.0)
	Extremely unhelpful	0 (0)
I would recommend these online modules to my peers, colleagues, and fellow clinicians to further enhance their own knowledge of evidence-based practice concepts.	Agree	74 (90.2)
	Disagree	8 (9.8)
I am interested in continuing to enhance my knowledge of additional evidence-based practice concepts, such as sensitivity, specificity, epidemiological measures, and clinical prediction rules.	Agree	72 (87.8)
	Disagree	10 (12.2)

Although both of these EBP mechanisms successfully enhanced knowledge levels, each intervention focused only on a small sample group of ATs (ie, athletic training educators, professional athletic training students). On the other hand, the Web-based modules were developed to be available to the entire NATA membership, including athletic training students and ATs who hold various positions in numerous diverse clinical settings. Furthermore, the Web-based modules aimed to combat some of the barriers perceived to affect EBP implementation.[26–28] Researchers have identified several barriers ATs perceive as issues about EBP; knowledge[26,27] and insufficient time[26–28] are the 2 most frequently reported barriers. The most convenient aspect of the Web-based modules is that this learning medium can be used anywhere Internet or WiFi access is available. The EBP Web-based modules effectively increased knowledge scores among participants. The average effect size of a computer-based learning mechanism has been reported to be 0.42,[29] indicating that Web-based tutorials have a small to medium effect for increasing short-term knowledge.[30] However, results from our investigation revealed a large effect size (0.77),[30,31] which indicated that this Web-based mechanism is a credible option for knowledge gain among ATs.

After the 4-week implementation phase, most participants in the experimental group ($n = 64$, 78%) perceived the Web-based modules to be moderately to extremely helpful in enhancing knowledge of EBP concepts. Furthermore, most participants reported that the modules were moderately to extremely easy to understand, and nearly all participants would recommend them to their peers, colleagues, and fellow clinicians. Pusic et al[12] also reported favorable results and found that 54% of medical students preferred Web-based tutorials over face-to-face learning. Interestingly, York et al[32] reported that although students achieved higher knowledge scores after the implementation of Web-based tutorials, 78% of participants preferred to have live lectures in conjunction with the availability of Web-based learning. Thus, although our participants had satisfactory perceptions of the EBP Web-based modules, Web-based learning is not the most effective mechanism for every type of learner, and additional mechanisms would possibly benefit this group.

Although Web-based tutorials provide a mechanism to educate a large group of people at times that are most suitable to their distinct schedules, this training mode presents challenges that must be considered. First, use of Web-based tutorials requires self-regulation from the participants.[16] Participants in the experimental group of our investigation were instructed to complete all 10 Web-based modules in a 4-week period. However, we did not specify how many times they should review each module to ensure full comprehension of the information. Unlike a classroom setting, where an instructor is available, no one other than the participant was available to ensure that he or she fully comprehended the given material. Furthermore, it is the participants' responsibility to ensure that they sought answers to questions that arose during the tutorial session. Thus, self-regulation requires students to be self-motivated, active, goal-oriented learners.[16] Participation in a Web-based tutorial creates a large challenge, particularly when the participant is not directly interested in the material being presented. Additionally, when a tutorial is required, a person may not take it seriously or may miss the full potential that the tutorial offers.

One of the largest challenges of Web-based tutorials is distinguishing ways to disseminate the material in an engaging way to various types of learners.[33] Incorporating numerous instructional strategies that require active learning is one way to overcome this barrier.[34,35] Techniques for active learning can include ideas ranging from simulations and frequent quizzes to any activity that promotes critical thinking and problem solving.[34] Furthermore, incorporating active learning techniques throughout a tutorial and requiring students to make choices will help them to stay engaged with the materials they need to learn.[36] Using examples and scenarios that directly relate to situations the learners may experience is a critical component to help them apply this information directly to their real-life practice.[37] Although the EBP Web-based modules currently do not offer features that provide immediate feedback, several examples and scenarios that include critical thinking are included. Participants are encouraged to actively challenge themselves by exploring the various scenarios provided throughout the modules. The Web-based modules also contain numerous additional hyperlinks, which allow interested students to acquire further information.

Whereas the EBP Web-based modules presented in our study provided a solid foundation of concepts relating to EBP, this educational intervention is not all-inclusive. These modules provide ATs with an effective mechanism to enhance knowledge of EBP. However, although the Web-based modules were an effective mechanism to increase knowledge of EBP among ATs, average scores after the intervention (60.6%) were still low. Therefore, it may be beneficial to combine this Web-based learning tool with other media to create a multifaceted approach for maximizing knowledge acquisition and to effect change throughout clinical practice. Authors of most studies conducted to assess clinical practice changes after an intervention have indicated that most interventions are effective under some circumstances but that no single intervention is effective for all circumstances.[38–40] Interventions, including interactive small-group meetings, computerized learning, mass-media campaigns, and combined interventions, have been shown to be most effective.[38,40] Thus, ATs who are interested in using the EBP learning modules should determine if Web-based learning is an effective mechanism for their learning styles and should consider which other information-delivery methods (eg, workshops, face-to-face lectures, reading supplements, peer discussions) may complement the modules to augment knowledge acquisition.

Limitations

Certain limitations may have affected the results of our investigation. All phases of this study (ie, recruitment, premodule and postmodule assessment, educational invention) and all communication with the primary researcher (C.E.W.) were conducted via the Internet, which promoted the inherent risk of technological error. Internet malfunctions may have prevented NATA members from receiving the initial e-mail requesting voluntary participation in this study, thereby preventing them from participating. Furthermore, specific Internet domains may have prevented potential participants from accessing the initial participation Web page, barring them from providing consent to participate in the study. To combat any initial technological concerns, the NATA office sent 2 e-mails within a 1-week period requesting participation. The second e-mail specifically provided an e-mail address and directions for those having difficulty accessing the participation Web page.

Given the Web-based nature of this investigation, several external factors could not be controlled. The amount of time participants in the experimental group spent on each Web-based module could not be controlled. Generally, one of the benefits of Web-based learning is that participants can review the material as many times as necessary to ensure knowledge comprehension. However, because access to the Web-based modules was disabled after the 4-week intervention phase, participants may not have used the Web-based modules as much as they would have under normal circumstances. In addition, the ability of participants in the experimental group to share their personal access codes to the Web-based modules with other people could not be controlled. Finally, we could not prevent participants in the control group from using external resources to educate themselves about EBP concepts during the 4-week intervention phase. However, recommendations were made to participants, and during the postmodule assessment, they were instructed to report any uses of external resources during the 4-week period. Participants were also informed that they would gain full access to the modules after the investigation concluded.

Finally, this investigation required involvement from participants over a 6-week period. Although persons in the control group did not have any direct responsibilities during the middle 4 weeks of the investigation, participants in the experimental group were instructed to complete the 10 Web-based modules. The response rate of this study aligns with the average response rate of Web-based surveys,[41] but the duration of this study may have influenced the decision of participants to withdraw from the investigation after the premodule assessment, which could have affected the overall response rate. To diminish the potential number of participants who withdrew throughout the phases of the investigation, we provided participants with a detailed timeline identifying the specific dates of each phase of the study, as well as an estimated time to complete each phase.

CONCLUSIONS

A series of EBP Web-based learning modules was an effective mechanism for enhancing EBP knowledge levels among ATs. The Web-based modules provided a versatile approach to comprehending the concepts involved in EBP through a medium that is easily accessible and regulated by each learner. However, to maximize the learning potential for the various types of learners, researchers need to continue to assess the most successful mechanisms to combine this educational intervention with other learning mediums. Whereas the development of the Web-based learning modules has created a solid learning foundation for the NATA membership, our investigation assessed only short-term learning. Researchers should progress toward identifying whether increased knowledge levels of EBP concepts affect clinical behavior within athletic training practice. Focus also should be placed on effective EBP implementation strategies that can be applied in didactic and clinical practice settings.

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REFERENCES

1. Manspeaker SA, Van Lunen BL. Implementation of evidence-based practice concepts in undergraduate athletic training education: experiences of select educators. *Athl Train Educ J*. 2010;5(2):51–60.
2. Welch CE, Van Lunen BL. Athletic training clinicians knowledge and confidence of evidence-based concepts for clinical decision-making [abstract]. *J Athl Train*. 2011;46(3 suppl):S59–S60.
3. National Athletic Trainers' Association. *Athletic Training Education Competencies*. 5th ed. Dallas, TX: National Athletic Trainers' Association; 2011:1–32.
4. Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: sound educational method or hype: a review of the evaluation literature. *Acad Med*. 2002;77(10 suppl):S86–S93.
5. Fritsche L, Greenhalgh T, Falck-Ytter Y, Neumayer HH, Kunz R. Do short courses in evidence based medicine improve knowledge and skills? Validation of Berlin questionnaire and before and after study of courses in evidence based medicine. *BMJ*. 2002;325(7376):1338–1341.
6. Welch CE, Van Lunen BL, Walker SE, et al. Effectiveness of a single-day evidence-based concepts pilot workshop for athletic training educators [abstract]. *Athl Train Educ J*. 2011;6(1 suppl): S28–S29.
7. Nicholson LJ, Warde CM, Boker JR. Faculty training in evidence-based medicine: improving evidence acquisition and critical appraisal. *J Contin Educ Health Prof*. 2007;27(1):28–33.
8. Manspeaker SA, Van Lunen BL, Turocy P, Pribesh S, Hankemeier DA. Student knowledge, attitudes and use of evidence-based concepts following an educational intervention. *Athl Train Educ J*. 2011;6(2):88–98.
9. Wilkes M. Changing clinical practice. *Med Educ*. 2001;35(10):924.
10. Williams C, Aubin S, Harkin P, Cottrell D. A randomized, controlled, single-blind trial of teaching provided by a computer-based multimedia package versus lecture. *Med Educ*. 2001;35(9): 847–854.
11. Osman LM, Muir AL. Computer skills and attitudes to computer-aided learning among medical students. *Med Educ*. 1994;28(5):381–385.
12. Pusic MV, Pachev GS, MacDonald WA. Embedding medical student computer tutorials into a busy emergency department. *Acad Emerg Med*. 2007;14(2):138–148.
13. Blummer BA, Kritskaya O. Best practices for creating an online tutorial: a literature review. *J Web Librariansh*. 2009;3(3):199–216.
14. Viggiano RG. Online tutorials as instruction for distance students. *Internet Ref Serv Q*. 2004;9(1–2):37–54.
15. About the NATA. National Athletic Trainers' Association Web site. http://www.nata.org/aboutNATA. Accessed March 6, 2012.
16. Ardis S. Creating Internet-based tutorials. *Info Outlook*. 1998;2(10): 17–20.
17. Jacoby CG, Smith WL, Albanese MA. An evaluation of computer-assisted instruction in radiology. *AJR Am J Roentgenol*. 1984;143(3): 675–677.

18. Bassano JM. The development of an on-line self guided diagnostic imaging tutorial and its impact on course performance. *J Chiropr Educ*. 2005;19(2):81–84.
19. Greenhalgh T. Computer assisted learning in undergraduate medical education. *BMJ*. 2001;322(7277):40–44.
20. Kerfoot BP, Baker H, Jackson TL, et al. A multi-institutional randomized controlled trial of adjuvant web-based teaching to medical students. *Acad Med*. 2006;81(3):224–230.
21. Letterie GS. Medical education as a science: the quality of evidence for computer-assisted instruction. *Am J Obstet Gynecol*. 2003;188(3): 849–853.
22. Rose KA. Development of an on-line advanced clinical topics course. *J Chiropr Educ*. 2002;16(2):122–127.
23. Kaambwa B, Bryan S, Billingham L. Do the methods used to analyse missing data really matter? An examination of data from an observational study of intermediate care patients. *BMC Res Notes*. 2012;5:330.
24. Portney L, Watkins M. *Foundations of Clinical Research: Applications to Practice*. 3rd ed. Upper Saddle River, NJ: Prentice Hall Health; 2008.
25. Festinger L, Katz D. *Research Methods in the Behavioral Sciences*. New York, NY: Holt, Rinehart, and Winston; 1953.
26. Hankemeier DA, Van Lunen BL. Perceptions of approved clinical instructors: strategies for overcoming barriers in the implementation of evidence-based practice [abstract]. *J Athl Train*. 2011;46(3 suppl): S37–S38.
27. Manspeaker S, Van Lunen B. Overcoming barriers to implementation of evidence-based practice concepts in athletic training education: perceptions of select educators. *J Athl Train*. 2011; 46(5):514–522.
28. Welch CE, Van Lunen BL. Accessibility and barriers to evidence for clinical decision-making. *Med Sci Sports Exerc*. 2011;43(5):545–546.
29. Kulik CL, Kulik JA. Effectiveness of computer-based instruction: an updated analysis. *Comput Human Behav*. 1991;7(1–2):75–94.
30. Cohen J. Quantitative methods in psychology: a power primer. *Psychol Bull*. 1992;112(1):155–159.
31. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. *Introduction to Meta-Analysis*. San Francisco, CA: Wiley; 2009.
32. York AM, Nordengren FR, Stumbo T. Teaching evidence-based medicine with an asynchronous web module: measuring student preferences and outcomes. *J Physician Assist Educ*. 2009;20(1):44–50.
33. Dent VF. Innovation on a shoestring: an all-virtual model for self-paced library orientation on an urban campus. *Coll Undergrad Libr*. 2003;10(2):29–43.
34. Hegarty N, Quinlan N, Lynch T. A portrait of Olas as a young information literacy tutorial. *Libr Rev*. 2004;53(9):442–450.
35. Zhang L. Effectively incorporating instructional media in web-based information literacy. *Electronic Libr*. 2006;24(3):294–306.
36. Clay ST, Harlan S, Swanson J. Mystery to mastery: the CSU competency information project. *Res Strategies*. 2008;17(2–3):157–166.
37. Association of College and Research Libraries (ACRL). Information literacy competency standards for higher education. http://www.ala.org/acrl/standards/informationliteracycompetency. Accessed March 6, 2012.
38. Grimshaw JM, Shirran L, Thomas R, et al. Changing provider behavior: an overview of systematic reviews of interventions. *Med Care*. 2001;39(8 suppl 2):II2–II45.
39. Grimshaw JM, Eccles MP, Walker AE, Thomas RE. Changing physicians' behavior: what works and thoughts on getting more things to work. *J Contin Educ Health Prof*. 2002;22(4):237–243.
40. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet*. 2003;362(9391): 1225–1230.
41. Sheehan KB. E-mail survey response rates: a review. *J Comput Mediat Commun*. 2001;6(2). http://onlinelibrary.wiley.com/doi/10.1111/j.1083–6101.2001.tb00117.x/full. Accessed August 28, 2012.

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