Virtual Grand Rounds: A Curricular Model for Translating Evidence-Based Practice From the Classroom to the Clinic

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Background and Purpose. The physical therapy profession supports educating physical therapist graduates to use evidence-based practice (EBP) skills in the clinical environment. Educational interventions to teach EBP include a variety of formats, but most focus on changing student and clinician knowledge and skills rather than changing actual clinician behavior. The literature suggests that for clinician behavior to change, educational interventions must be integrated into clinical practice. To describe the restructuring of the ATSU research and EBP curriculum including the development of a course, Virtual Grand Rounds (VGR), that focused on EBP skills and took place during clinical experiences.

Method/Model Description and Evaluation. The curriculum and VGR course were designed for students to learn EBP skills, develop tolerance for uncertainty, implement EBP within time demands of the clinic, and use workplace supports. All physical therapy students completed both the Evidence-Based Practice Beliefs (EBPB) scale and the Evidence-Based Practice Implementation (EBPI) scale at program entry and at the end of years 1, 2, and 3 (graduation).

Outcomes. A total of 727 EBPB and 719 EBPI surveys were completed and analyzed. Using an analysis of variance with Scheffe post hoc analyses, significant differences ($P < .05$) were found between the EBPB and EBPI scores for each year of data collection with the exception of a nonsignificant change between year 1 and year 2 ($P = .998$ and $P = .702$). The overall EBPI score at graduation indicated that during the final clinical year, students performed each EBP skill somewhere between 1 and 5 times during the clinical experience. Changes in individual question scores indicated increases in students' skills, knowledge, and application throughout all years.

Discussion and Conclusion. Evidence-based practice implementation increased throughout the 3 years and was at the highest following the final clinical year when students participated in the newly developed VGR. By situating practice of EBP within the time constraints of the clinical environment, the setting where EBP takes place, students are equipped to move away from the reliance on clinical expertise to evidence-based physical therapy. The development of the VGR course described in this article shifts EBP from an academic exercise in the classroom to an activity imbedded in real clinical practice. Other programs may find this integrated course helpful in removing barriers to EBP and developing graduates equipped to integrate EBP in the clinical environment.

Key Words: Evidence-based practice, Physical therapy curriculum.

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BACKGROUND AND PURPOSE

Evidence-based practice (EBP) requires clinicians to use the best available research to guide their clinical decision making. Following a 5-step process, clinicians ask a question, find the best evidence to answer the question, evaluate and critically appraise the evidence, integrate the appraised evidence with clinical expertise and the patient's preference to make a clinical decision, and then evaluate the outcomes of that decision. The physical therapy profession supports educating physical therapist (PT) graduates to use EBP skills in the clinical environment. Specifically, the Commission on Accreditation in Physical Therapy Education requires that EBP skills and knowledge be included in the curricular requirements for PT education programs. These requirements include teaching content that develops students' skills in finding, evaluating, and using the best available research evidence along with considering the values, needs, and preferences of clients seeking care.[1] Academic programs can implement curriculum to meet these criteria in formats that align with their own missions and goals for graduates.

To help guide physical therapy programs in this endeavor, the EBP Special Interest Group of the American Physical Therapy Association's Section on Research produced *Doctor of Physical Therapy Education Evidence-Based Practice Curriculum Guidelines*[2] and published strategies for implementation.[3] The guidelines aimed at helping institutions "produce graduates who (a) are efficient, critical consumers of published evidence, (b) understand how to balance evidence with patients' preferences and their own clinical expertise, and (c) are lifelong learners who possess a common foundation of knowledge, skill sets, and tools required to keep current with the profession's ever-expanding body of knowledge."[3(p23)] The second publication provided strategies for DPT programs to apply guidelines for EBP curriculum evaluation and design and student and faculty assessment, but specific recommendations about organization of the curriculum were left open to allow for unique program design.[3]

Educational interventions to teach EBP include a variety of formats, but most focus on changing student and clinician knowledge and skills rather than changing actual clinician behavior. The literature on training programs for health providers found that although educational interventions increased participants' knowledge and skills regarding the components of EBP, limited evidence existed on the training's impact on implementing EBP in clinical practice.[4-6] Clinician behavior change occurred when educational interventions were integrated with clinical

practice.[6] Changes in clinical implementation behaviors may be due to difficulty in measuring these behaviors,[5] but more likely were due to the challenges clinicians face when attempting to integrate EBP into clinical practice.

Clinicians' inability or discomfort with searching and appraising the literature, limitations in research methodology used in the literature, and logistical factors such as time have been identified as reasons that EBP is not more effectively used in physical therapy clinical settings.[7] Several studies have explored PTs self-efficacy in the skills required for EBP performance.[8-11] In a study by Salbach et al[10], the mean confidence level was more than 85% for identifying clinical problems following patient assessment, but just at or below 50% for critically appraising psychometric properties of outcome measures, interpreting results of statistical procedures, and critically appraising the literature for reliability and validity of study designs. These findings suggest lower confidence with some key skills required for EBP. Similarly, Jette et al[9] explained that although less than 20% of the participants chose "inability to critically appraise" as one of the top 3 barriers to implementing EBP, 44% did not feel confident in their critical appraisal skills, and 34% did not feel confident in their search skills.[9] Furthermore, clinicians' inability to understand statistical data was identified as a barrier to effective use of EBP.[8-10]

The research methods used in physical therapy studies may also be at odds with approaches used in clinical practice, limiting clinicians' comfort with incorporating findings into practice. The demand for EBP has led to a push for the use of randomized controlled trials (RCTs) in physical therapy interventions. However, the use of RCTs in clinical decision making is problematic because controls on the patient population are unlike the heterogeneous patient populations clinicians see in clinical practice. This difference in patient populations requires practitioners to interpret the literature and then to modify interventions when applying the results in clinical practice.[7] In fact, the "poor generalizability" of findings is a significant barrier to implementing EBP in real-world settings.[8,12,13] However, medical residents who were more comfortable with uncertainty in the clinical environment were more confident in generalizing the findings from research studies to patient situations and were more likely to engage in EBP.[14]

Another challenge to implementing EBP practices in clinical settings is time constraints faced by clinicians with full patient caseloads, limited staffing, and other work expectations.[8,13] Across several studies, staffing and workload issues were identified as contributing to the shortage of time to implement EBP,[10,12,15,16] with 1 author suggesting that evidence needs to be accessible at the point of care to make it practical.[17] Harding et al[18] reported that allied health professionals in a large metropolitan hospital system felt "guilty" when they engaged in EBP activities because the organization perceived EBP as an activity clinicians should do outside their work day.

Workplace supports, such as constant involvement by colleagues in daily practice, staff and management support to learn and apply EBP in daily clinical practice, structural promotion and facilitation of EBP activities by the management, and clear and easily accessible sources of evidence, protocols, and guidelines have been shown to support EBP use.[19] However, research findings are inconclusive as to the most effective methods to promote EBP use in the workplace.[19] Many researchers reporting successful knowledge translation (KT) interventions have also attributed aspects of their success to workplace supports.[20-22] Menon et al[20] reported strong evidence in their systematic review that active multicomponent KT interventions, including working groups and change leaders, encouraged evidence-based behaviors. Tilson et al[21] found that the collaborative nature of their KT intervention was engaging and motivating for participants, and Perry et al[22] found that the use of reminders, role modeling, ongoing discussion, and clinical consultation were key to success. Together, the evidence suggests that aspects of workplace leadership and culture are essential to the process of implementing EBP[19] and should be incorporated into both educational programs and organizational structure for ultimate success.[23]

In an effort to better prepare graduates to become evidence-based practitioners, the faculty of the professional-level doctor of physical therapy program at ATSU reviewed its research and EBP curriculum. Following the model provided by McKimm and Barrow,[24] ATSU faculty engaged in a cyclical process of curriculum review that began with an assessment of the needs of the relevant stakeholders including students, faculty, and the profession overall. Following this step, the curriculum was developed applying appropriate teaching and assessment methods. Finally, implementation of the new curriculum was monitored and evaluated.

The purpose of this article was to describe the restructuring of the ATSU research and EBP curriculum including the subsequent development of a course that focused on EBP skills and took place during clinical experiences. This new course, Virtual Grand Rounds (VGR), addressed curricular needs identified in the literature including developing a tolerance for uncertainty, recognizing time demands in the clinic, providing appropriate workplace supports, and allowing for assessment and reflection.

METHOD/MODEL DESCRIPTION AND EVALUATION

Development of Research and Evidence-Based Practice Curriculum

A.T. Still University (ATSU) is a private nonprofit university with campuses located in Kirksville, Missouri and Mesa, Arizona. The Department of Physical Therapy, located in Mesa, Arizona, consists of professional (entry-level), postprofessional, and residency programs. The professional Physical Therapy Program currently offers a 3-year curriculum comprising 142 credits. The curriculum is a hybrid model with students building on their prerequisite coursework, progressing from simple to more complex courses that require integration and a holistic approach to patient care. The research and EBP courses are embedded throughout the curriculum, with coursework starting during the second semester and continuing through the final clinical experiences. Table 1 provides additional details regarding content covered and activities embedded in the courses during the first 2 years of the curriculum.

ATSU physical therapy faculty review the current curriculum annually. During the curriculum review in 2009, faculty members recognized the need for changes within the research and EBP curriculum. At the time, students chose between a research tract and an EBP tract. All students were required to take classes in research design and statistics, but from there, they elected to take courses related to development of a research project or courses that highlighted skills needed for the EBP process. Before the curriculum review, informal assessments of student performance in EBP had determined that students who chose the research tract were less competent with specific EBP skills, including developing clinical questions and searching for and critically appraising the literature on relevant physical therapy topics.

As a result, faculty identified core competencies in EBP, as well as the research skills needed for all graduates, and decided to eliminate the tracts, requiring all students take the same courses. In addition, faculty developed a common language to be used when implementing EBP in classroom activities. Faculty also agreed that EBP concepts must be introduced early in the Physical Therapy program and then culminate with students

Table 1. Content and Activities in Research and EBP Courses During the First 2 Years of the Curriculum

Course Name and Place in the Curriculum		Content Covered	Assignments/Activities
Critical inquiry 1	Year 1, Winter Quarter	Research design and statistics	• IRB certifications • Analysis of data sets • Selection of appropriate research designs and statistics • Exams
Critical inquiry 2	Year 1, Spring Quarter	Analysis of the literature in EBP	• Critical appraisal of different types of studies • Developing clinical questions • Searching the literature • Application of evidence to paper patient cases
Critical inquiry 3	Year 1, Summer Quarter	EBP application	• Searching the literature • Real-time critical appraisals • Application of evidence to "real" patient cases
Critical inquiry 4	Year 2, Winter Quarter	Focused EBP	• Application of evidence • Use of clinical practice guidelines • Population based clinical questions
Critical inquiry 5	Year 2, Spring Quarter	From EBP to applied research	• Developing a research proposal • Searching the literature for capstone topic

Abbreviations: EBP = evidence-based practice.

practicing their EBP in the actual clinical environment.

Faculty went on to revise the research and EBP didactic coursework, creating a series of 5 required courses, with a total of 156 student contact hours, across the 2-year didactic curriculum. EBP concepts were embedded early within this sequence to help students develop the skills and practice throughout the research and EBP courses, as well as in the clinical courses in the curriculum. Combined, the 5 courses included presentations and activities to address the content areas of research design and statistics, analysis and application of the EBP process, and practical application of both research and EBP.

The faculty recognized the need for the courses to include aspects of practical application to address barriers to implementing EBP to ensure that graduates of the program would be equipped to confront these challenges in real practical settings. One identified barrier to implementation is difficulty finding research that directly addresses the variety of questions that arise in clinical settings.[8-10] Knowing that practitioners who have higher levels of tolerance for ambiguity or uncertainty were more likely to use EBP,[14] faculty developed learning activities in the curriculum that moved from activities with clear-cut answers to ones representing more complex clinical situations. For example, faculty teaching courses in the first-year curriculum used classroom activities in which the assigned literature led students to clear answers with minimal inconsistencies between patient presentations and the literature. In the second year, students were required to formulate treatment plans in which the literature, clinical expertise, and patient preferences either conflicted or were unclear. Scenarios in which uncertainty was prevalent were used across the clinical, research, and EBP curriculum to help students become more comfortable with being uncertain about treatment in complex course-based situations and to move them toward using EBP when real patient situations made the answers to clinical questions less clear.

The time needed to engage in EBP is often cited as a barrier to its implementation.[8-10] Therefore, faculty added timed literature searches, practice of critical appraisals, and development of brief literature summaries to help students become more proficient using EBP skills. By doing so, the faculty aimed at building student confidence in becoming evidence-based practitioners within the time demands of the clinical environment.

Final Course: Virtual Grand Rounds—Evidence-Based Practice in Real Time

The final step toward teaching students skills as EBP practitioners was to create a course in which students used EBP in conjunction with their clinical experiences with real-life application. Situated learning theory suggests that learning is most effective when it occurs in the social and physical context where the skills will be used.[25] The VGR course was developed with this in mind and required students to apply the previously learned EBP skills in an online course, where they asked and answered clinical questions based on real patients during clinical experiences.

On the basis of faculty and student feedback, the VGR was taught as an 8-week online course in which students learned to use the steps of EBP to guide clinical decisions about patients they currently treat. The requirements for the first 4 weeks of the course are in Table 2. During weeks 5 through 7, students repeated the steps of the EBP process with a new clinical question. During week 6, students posted an update on the outcome of the implementation of the first clinical decision. Two required posts, at weeks 4 and 8, asked students to reflect on the overall EBP process and their individual growth as EBP practitioners.

Faculty designed the VGR courses to facilitate workplace environmental supports, identified as important to implementation rates of EBP.[20-22] Students were placed in a VGR with other students who were in similar practice settings so that the discussion of cases could be more in-depth and focused. The instructor for each VGR section also practiced in a clinical setting similar to that in which students were completing their clinical experiences, providing an additional source of focused clinical expertise.

Engagement with colleagues is also a critical aspect of EBP support,[20,22] and students were urged to interact regularly with one another and their clinical instructors (CIs). In addition to discussions with their CIs about their own clinical questions, students were encouraged to discuss their classmates' clinical questions with their

Table 2. Required Discussion Board Assignments for the First 4 Weeks of the Virtual Grand Rounds Course

Week 1	Thursday	Post information regarding clinical site population
		Identify issues to be explored
Week 2	Monday	Reply to classmates' posts
		Post clinical question providing search terms and selected outcome measures
	Thursday	Post background information, CI input on question, and narrative of search
Week 3	Monday	Post clinical bottom line summaries for 2 articles
	Thursday	Discuss final clinical decision incorporating additional articles and all 3 components of EBP
Week 4	Monday	Reply to classmates' clinical decisions
		Post reflection on the process used to answer clinical question and the use of EBP in current clinical setting
	Thursday	Discuss with classmates difficulties encountered and ideas for improving the EBP process

Abbreviations: CI = clinical instructor; EBP = evidence-based practice.

CIs and report back to the group. These planned interactions provided the benefit of the CIs' clinical expertise, but also helped create a collaborative environment and enhanced practice for both the clinician and the student. Throughout the course, students provided additional feedback to one another, further facilitating a sense of collaboration among colleagues. Finally, students were asked to report on the EBP methods the practicing clinicians used in their facility, encouraging students to reflect on workplace supports available and the potential importance of these when seeking employment.

The final step of the EBP process, evaluate outcomes, is difficult to include in most classroom activities because it requires assessment and reflection of an actual real-world intervention. In the VGR course, when students reported their patient care plan, they were required to identify how they would measure the outcomes of their interventions. In the second half of the course, students reported back on their actual outcomes and how those compared with the anticipated outcomes based on their plan. This required students to collect data on patients and evaluate their outcomes for future clinical practice.

The initial pilot of the VGR course required that students ask and answer 3 clinical questions across the 8-week period of the clinical experience. Students were required to post to a discussion board each step of the process, including full critical appraisals of research articles and a well-developed clinical decision and treatment plan. Feedback from students and faculty at the end of the pilot period indicated that the workload was too heavy and not appropriate for the time demands of the clinic. Students reported frustration with the academic nature of the assignment and felt that it was unrealistic for clinical practice. On the basis of this feedback, the activities in the course were modified by decreasing the number of questions students asked and answered and allowing students to write shorter summaries of their critical appraisals of the literature.

To build student appreciation of EBP as an integral part of clinical practice, the manner in which the course was presented and discussed before the start of the clinical experiences was modified. Initial communication with students indicated that they viewed the course as an academic requirement outside of their clinical experience requirement, rather than viewing EBP as part of clinical practice. As a result, faculty decided to present the course in conjunction with clinical education information, describing it an opportunity to practice the skills of EBP with patients they were treating in the clinical environment.

Following the pilot, additional reflection activities were added asking students to write about the clinical decision implementation, outcomes achieved with implementation, obstacles encountered in completing the EBP process, and clinician use of EBP in their practice setting. As part of this reflection, students also were asked to comment on ways to improve the EBP process. In the final week, students completed a personal growth reflection, including thoughts about what it meant to practice in an evidence-based manner, whether they believed that they had the skills to effectively and efficiently implement an EBP approach in their practice, and how they felt that they would use EBP in the future. Students also contemplated the benefits of an EBP approach to the patient and clinical practice.

Assessment of Student Outcomes

Outcomes of the research and EBP curricular changes, including the implementation of the VGR courses, were assessed with student surveys throughout the curriculum and alumni feedback collected after 1 year in clinical practice. The Evidence-Based Practice Beliefs (EBPB) scale and the Evidence-Based Practice Implementation (EBPI) scale were used to assess beliefs, attitudes, and implementation of EBP in students across the physical therapy program at ATSU. The EBPB scale was designed to measure individual's beliefs about the use and value of EBP. It consists of 16 items, with each rated on a 5-point Likert scale from strongly disagree to strongly agree. The EBPI scale consists of 18 items in which participants rate how many times they have performed a specific task in the past 8 weeks. Scores range from 0 to 4 for each item, representing a frequency of 0, 1–3, 4–5, 6–7, and $\geq$8 times per week. The total score on each scale is the sum of all item scores. Both scales were previously validated in practicing nurses[26] and have been used with PTs.[21] Two questions on the 18-item EBPI scale were modified to better reflect the EBP curriculum at ATSU (questions 12 and 13).

All physical therapy students completed both the EBPB and the EBPI at program entry and at the end of years 1, 2, and 3 (graduation). The data reported in this study are the results of data collected over a 3-year period. Evidence-Based Practice Beliefs and EBPI

overall scores were analyzed using an analysis of variance with Scheffe post hoc analyses to determine differences across time in the program ($P < .05$). Individual questions that reflected areas identified as important to curriculum assessment were selected, and visual analysis of score changes across the program was completed. Alumni were also surveyed 1 year after graduation and were asked to rate the extent to which their education prepared them for evidence-based physical therapy practice.

STUDENT OUTCOMES

A total of 727 EBPB surveys and 719 EBPI surveys were completed by students in the program during the 3 years of data collection. Each data point analyzed included approximately 180 survey responses, with response rates ranging from 96% to 100%. Exact response values are presented in Table 3.

Overall Change in Evidence-Based Practice Throughout the Curriculum

From program entry to graduation, students reported increasingly positive attitudes about the value of EBP and their confidence in implementing it in practice (Figure 1). Significant differences ($P < .05$) were found between the EBPB scores for each year of data collection with the exception of a nonsignificant change between year 1 and year 2 ($P = .998$). Significant differences ($P < .05$) between all years of data collection with the exception of a nonsignificant change between year 1 and year 2 ($P = .702$) were also found for EBPI scores (Figure 2). The overall EBPI score at graduation resulted from each EBPI item reaching a mean of 1.5 (range 1.0–2.5). These scores indicate that during the final clinical year, students performed each EBP skill somewhere between 1 and 5 times during an 8-week period. Visual analysis of an individual cohort, the Class of 2015, showed that cohort change followed that demonstrated by the larger group data (Figures 1 and 2).

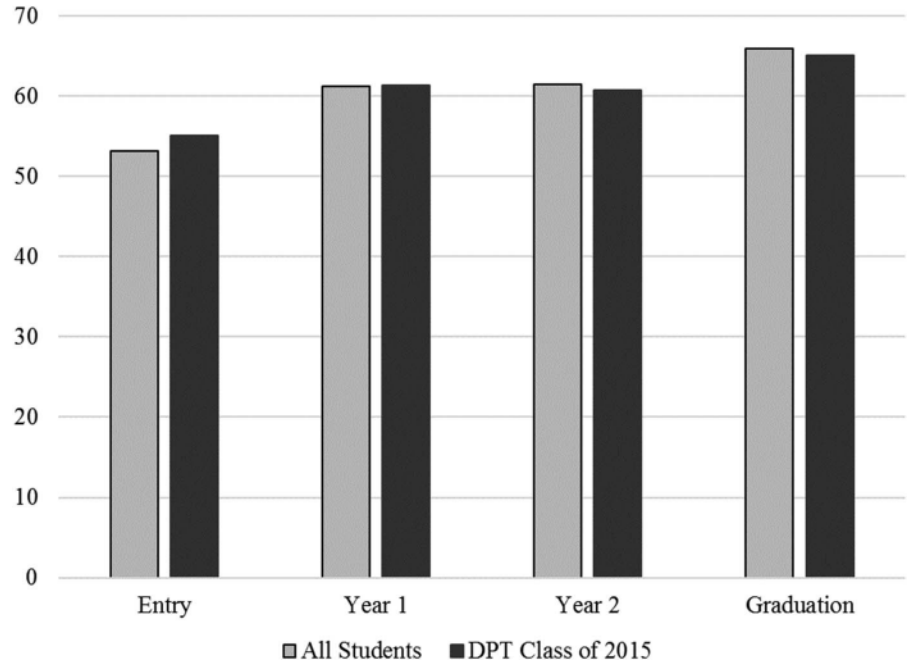
Alumni were also surveyed 1 year after graduation. They were asked to rate the extent to which their education prepared them for evidence-based physical therapy practice on a 5-point Likert scale ranging from poor (1) to excellent (5). Response rates of the alumni who experienced the revised curriculum ranged from 47% to 70%. The alumni rated their preparation from 3.9 to 4.2 with a mean of 4.1, indicating very good.

Table 3. Number of Potential Respondents (*N*) and Response Rates (%) for Each Data Collection Point

Data Collection Point	Total, *N*	EBPB Response Rate, % (*n*)	EBPI Response Rate, % (*n*)
Program entry	187	100 (187)	98 (183)
End of year 1	185	96 (178)	96 (177)
End of year 2	185	99 (184)	99 (183)
Graduation	178	100 (178)	99 (176)
Total	735	99 (727)	98 (719)

Abbreviations: EBPB = Evidence-Based Practice Beliefs; EBPI = Evidence-Based Practice Implementation.

Figure 1. Mean total Evidence-Based Practice Beliefs (EBPB) Scores across the curriculum. The total score on the EBPB scale is the sum of all item scores. The total score ranges between 16 and 80



Responses on Individual Questions Related to Aspects of Evidence-Based Practice

Individual questions from both the EBPB and EBPI that reflected areas identified as important to curriculum assessment were selected, and visual analysis of score changes on these questions across the program is presented below.

Development of Knowledge and Skills

Question 2 on the EBPB (I am clear about the EBP process) relates specifically to the respondent's perception of his or her knowledge of the steps of EBP. Responses to this question indicated increasing knowledge throughout the didactic curriculum that continued to increase during year 3 of clinical experiences and completion of the VGR course. The mean score was just below 3 (2.9), meaning students neither agreed nor disagreed with this statement at entry to the program, but it increased to 4.3 by the end of year 2, indicating that the student agreed or strongly agreed that they were clear in their knowledge of EBP steps by the end of the didactic curriculum. The score on this question continued to increase during the final year of clinical experiences, with an end mean score of 4.6, indicating continued increase in knowledge of the EBP process.

Practical Application

Responses to the questions regarding the different aspects of practical application, specifically about tolerance of uncertainty, accommodation of time demands, and use of workplace supports were selected as a means to analyze student growth in these areas.

Tolerance of Uncertainty. To assess students' ability to tolerate uncertainty in clinical decision making, 5 questions were selected for analysis because they related to the student's beliefs regarding EBP in actual patient care. Increased belief scores following clinical

Figure 2. Mean total Evidence-Based Practice Implementation (EBPI) Scores across the curriculum. The total score on the EBPI scale is the sum of all item scores. The total score ranges between 0 and 72

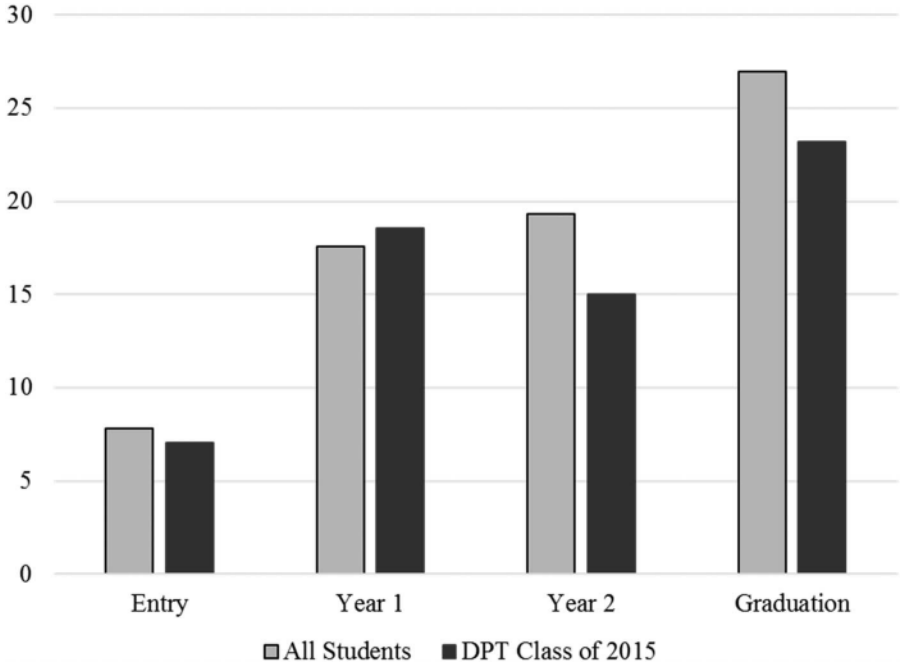
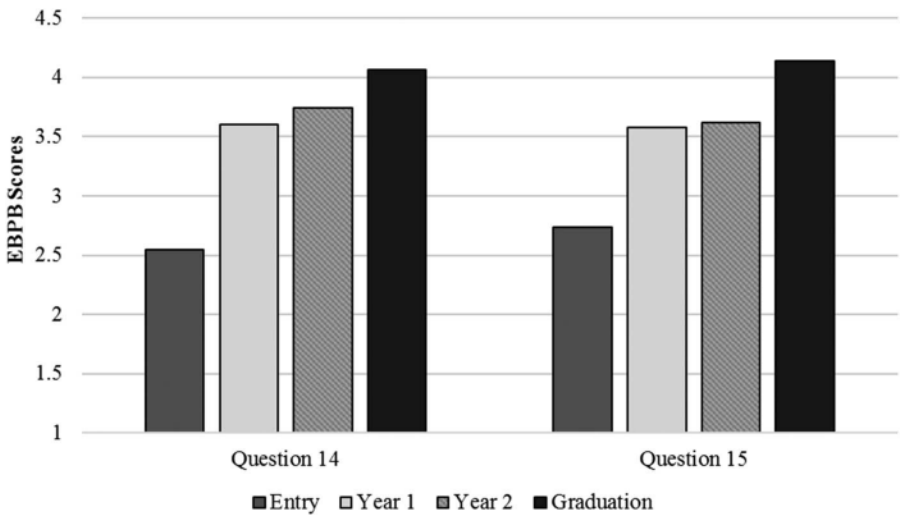


Figure 3. Evidence-Based Practice Beliefs (EBPB) mean scores supporting students' confidence to apply EBP in real patient situations. Evidence-Based Practice Beliefs mean scores for questions 14 (I know how to implement EBP sufficiently enough to make practice changes) and 15 (I am confident about my ability to implement EBP where I work) across the curriculum. The EBPB score for each statement is based on 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). EBP = evidence-based practice



experiences during year 3 on EBPB questions 14 (I know how to implement EBP sufficiently enough to make practice changes) and 15 (I am confident about my ability to implement EBP where I work) support the student's confidence to apply EBP in real patient situations (Figure 3).

Student responses to questions 1, 5, and 9 on the EBPB scale also indicate students' continued belief in EBP despite encountering the difficulties of application in real practice. Question 1 (I believe that EBP results in the best clinical care for patients), question 5 (I am sure that evidence-based guidelines can improve clinical care), and question 9 (I am sure that implementing EBP will improve the care that I deliver to my patients) all showed students agreeing with the statements throughout the program, with mean scores at 4.1 at program entry and 4.4 at graduation.

Scores on the EBPI scale that related to uncertainty came from questions 1 (used evidence to change my clinical practice) and 14 (used an EBP guideline or systematic review to change clinical practice where I work). In both cases, the implementation rates were higher during the final year, indicating student use of EBP in clinical practice (Figure 4).

Accommodation of Time Demands. Several time-related items on the EBPB provided information on students' confidence to deal with the time demands of the clinic. Question 11 directly asks about students' perception of the amount of time that EBP takes. This question is reversed scored on the scale, with an original high score indicating the student agrees or strongly agrees with the statement that EBP takes too much time. The scores ranged from 2.5 to 3.0, indicating that students neither agree nor disagree with this statement. Questions 6 (I believe that I can search for the best evidence to answer clinical questions in a time efficient way) and 8 (I am sure that I can implement EBP in a time efficient way) address the ability to search and implement EBP in a time efficient manner. Mean scores on these items increased by 0.8 from entry to graduation, with the largest increase occurring during the final year of clinical experiences. Question 15 (Figure 3) measured students' confidence in their ability to implement EBP where they work and showed the greatest change, indicating that students' confidence in implementing EBP grew even with the time demands of the clinical setting.

The increase in the overall EBPI scores seen during the final year while students were on clinical experience also indicate that students were able to implement EBP despite the time demands of a busy clinic (Figure 2).

Consideration of Workplace Environment and/or Supports. Although specific questions on the EBPB and EPBI scales do not ask about the work place supports available, a variety of questions (4, 6, 8, 10, 16, and 18) on the EPBI scale ask about sharing information with colleagues in the workplace, considered to be one type of workplace support. For these questions, the values increased at the end of year 1 (after the first clinical experience), were maintained during year 2 of the didactic program, and then increased again during final clinical experiences. These score increases indicate that students were using EBP within the work environment and interacting with colleagues regarding its implementation (Figure 5). Question 18 asks students how

Figure 4. Evidence-Based Practice Implementation (EBPI) mean scores supporting students' use of EBP to change clinical practice. Evidence-Based Practice Implementation mean scores for questions 1 (used evidence to change my clinical practice) and 14 (used an EBP guideline or systematic review to change clinical practice where I work) across the curriculum. The EBPI score for each statement is based on a range of 0 (no times) to 4 (≥8 times). EBP = evidence-based practice

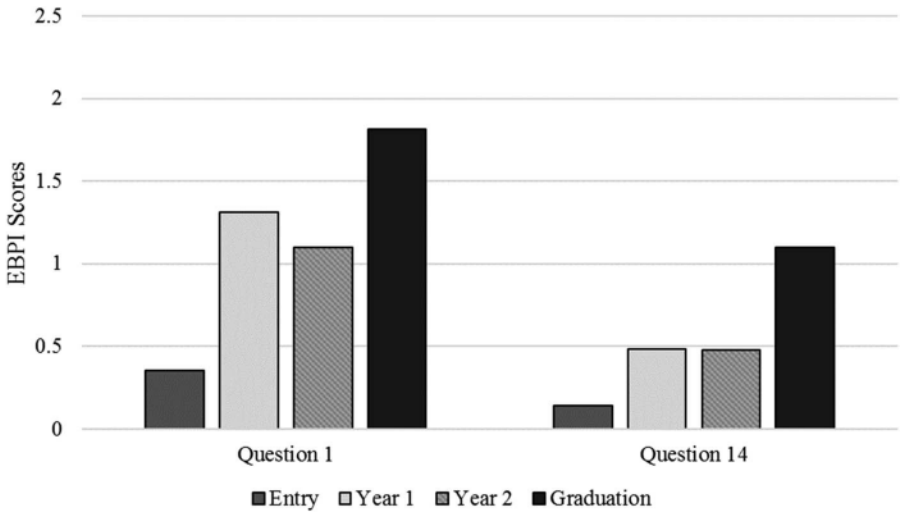
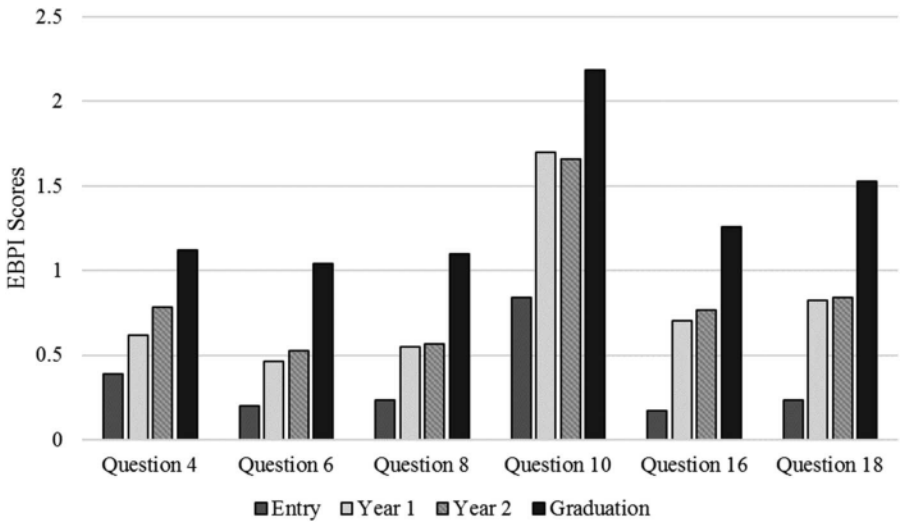


Figure 5. Evidence-Based Practice Implementation (EBPI) mean scores supporting students' sharing of evidence and interaction with colleagues. Evidence-Based Practice Implementation mean scores for questions 4 (informally discussed evidence from a research study with a colleague), 6 (shared evidence from a study or studies in the form of a report or presentation to more than 2 colleagues), 8 (shared an EBP guideline with a colleague), 10 (shared evidence from a study with a multidisciplinary team member), 16 (shared the outcome data collection with colleagues), and 18 (promoted the use of EBP to my colleagues) across the curriculum). The EBPI score for each question ranges from 0 (no times) to 4 (≥8 times). EBP = evidence-based practice



often they promote the use of EBP with colleagues. The mean score on this item almost doubled during year 3, increasing from 0.8 to 1.5, indicating that students were discussing the use of EBP with their CI or other colleagues at least 1–3, and often 4–5, times per week over the length of the experience.

Assess and Reflect on Outcomes

Students' abilities to assess their clinical decisions and reflect on their application of EBP to clinical practice were appraised by looking at questions related to collection of data and evaluation of the outcome. Three different EBPI questions—question 5 (I have collected data on a patient problem), question 7 (I have evaluated the outcomes of a practice change), and question 17 (I have changed practice based on client outcome data)—relate back to concepts of outcome data collection. Mean scores on these questions increased by at least 0.5 during year 3, indicating that students were incorporating these aspects of EBP into clinical practice.

Student reflections for each of their clinical questions during the course were gathered at the completion of the EBP process. In addition, at the end of the course, students reflected on the use of EBP in their clinical environment and their growth as an EBP practitioner. Representative student comments from these reflections are captured in Table 4.

DISCUSSION

This report describes the implementation and outcomes of a research and EBP curriculum that included the development of an online course to practice EBP in real clinical practice. The importance of EBP is clearly highlighted in the literature,[8,13] but there are many constraints on the clinician's ability to use EBP.[7-9,13]

Using the curriculum design process described by McKimm and Barrow,[24] the research and EBP curriculum, concluding with the VGR course, was designed to build a strong EBP foundation, address specific barriers to EBP implementation, and increase positive attitudes and beliefs regarding the use of EBP throughout the program. The methods described in this article may help other programs integrate EBP into their curricula in a manner in which barriers to implementing EBP are directly addressed.

Students in the current study identified increases in knowledge of the EBP process throughout all 3 years of the professional physical therapy program. Improved knowledge and development of skills may increase confidence for critically appraising the literature and interpreting statistics and results. The 5 didactic courses established a strong foundation of skills as demonstrated by reports of increased knowledge in the EBP process and confidence with the ability to implement EBP. In addition, EBP implementation increased throughout the 3 years and was at the highest following the final clinical year when students participated in the newly developed VGR, suggesting that improved confidence translated to increased EBP use. Although it is not possible to discern whether this increase was a direct result of participation in the VGR, previous literature suggests that implementation increases with practice of EBP skills in real clinical settings.[6] Students' overall EBPB scores were also

Table 4. Sample Student Comments From Course Reflections

EBP process reflection
I thought I was much more proficient at implementing the EBP process this time compared with my last effort 3 weeks ago. I used time throughout the day to search for the literature, thus decreasing the burden of doing it all at home.
I feel that I was able to come up with an appropriate plan of care for this patient based on the EBP process. I feel that the time I spent on the process was significantly decreased as well, as I am becoming more comfortable with the process.
While we were in the classroom, so much of the focus was on the research and evidence we could find because we did not have the experience or real patients who responded to our treatment. With experience and real patients, I have been able to see the importance of all 3 aspects of EBP.
The discussions with my CI and other providers, in my clinical setting, have gone well and are effective for my decision-making process.
Growth as EBP practitioner reflection
I have found that I have grown even more through this experience to incorporate EBP principles. Although finding the most relevant research to fit the presentation of the patients I work with has been a challenge, I have found through this experience better ways of approaching the research. One thing I have learned is to look at the research from multiple perspectives and in a broader approach.
Through my experiences in my various clinical settings the last 8 months, I have witnessed many things, both good and bad, pertaining to practitioners using an EBP approach for selection of assessment and intervention procedures. I think I have grown during this time and now have a much larger clinical expertise bank to draw from and have become more efficient at selecting and evaluating current research to support my chosen assessment and intervention strategies.
I believe that an EBP approach is vital for me to continue to grow and become an expert clinician. I find that the more I learn, the reality of how much room I have to grow becomes even more apparent. Having discussions and observing expert clinicians, delving into the literature, and reflecting on patient preferences fill these gaps in my knowledge and understanding, and propel me to become better.
I feel that if I do not adopt an EBP approach to my practice I would be doing my patients/clients a disservice by not being the best clinician I can be… I see myself continuing to use EBP in the future and trying to encourage other clinicians around me to do the same.
After spending almost 4 weeks at my clinical setting, both observing and discussing EBP with my CI and other clinicians, I can see that it is a significant component of their practice.

Abbreviations: CI = clinical instructor; EBP = evidence-based practice.

highest following the third year, indicating that the clinical environment further increased essential knowledge and skills.

Although the uncertainty in the clinical environment, which cannot be replicated in the classroom, could be a barrier to generalizability[8,12,13] and lead to decreased beliefs in the EBP process, this was not the case for ATSU students. Building layers of uncertainty early in the research and EBP curriculum allowed students to become comfortable with ambiguity, which has been identified as important for the increased use of EBP.[14] Within the framework of a "real" clinical environment where generalizability is more complex, students continued to report high levels of confidence and increased EBP use. The value and importance placed on EBP use can decline after graduation,[27,28] so it is essential that students believe that generalizability is feasible.

The increases in student EBP knowledge, skills, and application can decrease the time needed to be an evidence-based clinician even with the time demands of the clinical environment.[7,8,13] However, classroom-only use of EBP is not sufficient to practice, promote, and develop into an evidence-based clinician. After participation in the VGR, students in this study reported growth in searching efficiency and EBP implementation, indicating that the time demands of clinical practice cited in previous literature[8-10,12,13,15,16] were not prohibitive to the use of EBP. Imbedding EBP activities within clinical practice seemed essential to students' growth as evidence-based practitioners as indicated by their reflections. By situating practice of skills within the time constraints of the clinical environment, the setting where EBP takes place, students were equipped to move away from the reliance on clinical expertise to evidence-based physical therapy.[29]

As the profession and education's recent attention toward EBP integration indicates,[1,2,30,31] creating a culture of EBP in the clinical environment is important to moving the profession forward. With the administrative and time constraints present in clinical practice, collaborations among colleagues practicing in the same clinical environment can enhance information sharing and EBP implementation by making evidence more readily accessible.[17] The design of the VGR course, in which students are grouped in similar practice settings, allows colleagues to serve as additional support promoting this culture for carryover into full-time clinical practice. In addition, the course brings the student and CI into conversation as clinical questions are asked, literature is discussed, and clinical decisions are formed. In this study, students identified such discussions as taking place frequently (often 4–5 times) over the 8-week period, with reflective comments supporting the interactions contributed to their growth as an evidence-based practitioner. In addition, as these conversations occur more frequently, the workplace can become a more supportive environment to practice EBP.[19-22]

Limitations

The authors recognize generalizability of the VGR course as a limitation. The success of the VGR course cannot be separated from the foundational research and EBP curriculum, which could not have been accomplished without administrative support for such significant curriculum revisions. Minor modifications to 2 questions on the EBPI scale were made to reflect current practice and practice related to physical therapy, which may have influenced the overall scores on the scale. Although students completed surveys anonymously, they may have responded with higher scores because faculty administered surveys as part of program assessment. In addition, there was no mechanism to confirm the accuracy of student answers regarding the self-reported frequency of their EBP use. All students in this cohort study participated in a VGR, so no data representing the influence of the clinical setting alone on EBP implementation were available

for comparison. Although students were placed in the VGR with students in similar practice settings, there was no control for the EBP practice or culture in each clinical environment. Different workplace supports may have influenced students' actual implementation or their reports of implementation.

CONCLUSION

The development of the VGR course described in this article shifts EBP from an academic exercise in the classroom to an activity imbedded in real clinical practice. The ATSU curriculum was developed to address barriers to EBP identified in the literature including developing a tolerance for uncertainty, recognizing time demands in the clinic, providing appropriate workplace supports, and allowing for assessment and reflection. The online course imbedded in clinical practice is essential for the development of graduates who will not only believe in EBP but will also implement it in practice. Other programs may find this integrated course helpful in removing barriers to EBP and developing graduates equipped to integrate EBP in the clinical environment.

REFERENCES

1. Standards and Required Elements for Accreditation of Physical Therapist Education Programs. *Commission on Accreditation in Physical Therapy Education*. http://www.capteonline.org/uploadedFiles/CAPTEorg/About_CAPTE/Resources/Accreditation_Handbook/CAPTE_PTStandardsEvidence.pdf. Accessed May 14, 2018.
2. Tilson JK, Levine D, Fay D, et al. *Doctor of Physical Therapy Education Evidence-Based Practice Curriculum Guidelines*. 2014. http://www.ptresearch.org/site/1/SIGS/EBP/EBP%20PT%20ED%20MANUAL%20FINAL%202-24-15.pdf. Accessed May 14, 2018.
3. Kaplan S, Tilson J, Levine D, et al. Strategies for using the APTA section on research evidence-based practice curriculum guidelines. *J Phys Ther Educ*. 2016;30:23-31.
4. Dizon JMR, Grimmer-Somers KA, Kumar S. Current evidence on evidence-based practice training in allied health: A systematic review of the literature. *Int J Evid Based Healthc*. 2012;10:347-360.
5. Flores-Mateo G, Argimon JM. Evidence based practice in postgraduate healthcare education: A systematic review. *BMC Health Serv Res*. 2007;7:119.
6. Coomarasamy A, Khan KS. What is the evidence that postgraduate teaching in evidence based medicine changes anything? A systematic review. *BMJ*. 2004;329:1017.
7. Schreiber J, Stern P. A review of the literature on evidence-based practice in physical therapy. *Internet J Allied Health Sci Pract*. 2005;3:1-10.
8. da Silva TM, Costa Lda C, Garcia AN, Costa LO. What do physical therapists think about evidence-based practice? A systematic review. *Man Ther*. 2015;20:388-401.
9. Jette DU, Bacon K, Batty C, et al. Evidence-based practice: Beliefs, attitudes, knowledge, and behaviors of physical therapists. *Phys Ther*. 2003;83:786-805.
10. Salbach NM, Jaglal SB, Korner-Bitensky N, Rappolt S, Davis D. Practitioner and organizational barriers to evidence-based practice of physical therapists for people with stroke. *Phys Ther*. 2007;87:1284-1303.
11. Schreiber J, Stern P, Marchetti G, Provident I, Turocy PS. School-based pediatric physical therapists' perspectives on evidence-based practice. *Pediatr Phys Ther*. 2008;20:292-302.
12. Bayley MT, Hurdowar A, Richards CL, et al. Barriers to implementation of stroke rehabilitation evidence: Findings from a multi-site pilot project. *Disabil Rehabil*. 2012;34:1633-1638.
13. Scurlock-Evans L, Upton P, Upton D. Evidence-based practice in physiotherapy: A systematic review of barriers, enablers and interventions. *Physiotherapy*. 2014;100:208-219.
14. Timmermans S, Angell A. Evidence-based medicine, clinical uncertainty, and learning to doctor. *J Health Soc Behav*. 2001:342-359.
15. Dannapfel P, Peolsson A, Nilsen P. What supports physiotherapists' use of research in clinical practice? A qualitative study in Sweden. *Implement Sci*. 2013;8:1-13.
16. Jansen L, Rasekaba T, Presnell S, Holland AE. Finding evidence to support practice in allied health: Peers, experience, and the internet. *J Allied Health*. 2012;41:154-161.
17. Bridges PH, Bierema LL, Valentine T. The propensity to adopt evidence-based practice among physical therapists. *BMC Health Serv Res*. 2007;7:103.
18. Harding KE, Porter J, Horne-Thompson A, Donley E, Taylor NF. Not enough time or a low priority? Barriers to evidence-based practice for allied health clinicians. *J Contin Educ Health Prof*. 2014;34:224-231.
19. Ubbink DT, Guyatt GH, Vermeulen H. Framework of policy recommendations for implementation of evidence-based practice: A systematic scoping review. *BMJ Open*. 2013;3(1):e001881.
20. Menon A, Korner-Bitensky N, Kastner M, McKibbon KA, Straus S. Strategies for rehabilitation professionals to move evidence-based knowledge into practice: A systematic review. *J Rehabil Med*. 2009;41:1024-1032.
21. Tilson JK, Mickan S, Howard R, et al. Promoting physical therapists' use of research evidence to inform clinical practice: Part 3—Long term feasibility assessment of the PEAK program. *BMC Med Educ*. 2016;16:1.
22. Perry SB, Zeleznik H, Breisinger T. Supporting clinical practice behavior change among neurologic physical therapists: A case study in knowledge translation. *J Neurol Phys Ther*. 2014;38:134-143.
23. Bernhardsson S, Johansson K, Nilsen P, Öberg B, Larsson MEH. Determinants of guideline use in primary care physical therapy: A cross-sectional survey of attitudes, knowledge, and behavior. *Phys Ther*. 2014;94:343-354.
24. McKimm J, Barrow M. Curriculum and course design. *Br J Hosp Med (Lond)*. 2009;70:714-717.
25. Brown JS, Collins A, Duguid P. Situated cognition and the culture of learning. *Educ Res*. 1989;18:32-42.
26. Melnyk BM, Fineout-Overholt E, Mays MZ. The evidence-based practice beliefs and implementation scales: Psychometric properties of two new instruments [corrected]. *Worldviews Evid Based Nurs*. 2008;5:208-216.
27. Connolly BH, Lupinnaci NS, Bush AJ. Changes in attitudes and perceptions about research in physical therapy among professional physical therapist students and new graduates. *Phys Ther*. 2001;81:1127-1134.
28. McEvoy MP, Williams MT, Olds TS, Lewis LK, Petkov J. Evidence-based practice profiles of physiotherapists transitioning into the workforce: A study of two cohorts. *BMC Med Educ*. 2011;11:100.
29. Manns PJ, Norton AV, Darrah J. Cross-sectional study to examine evidence-based practice skills and behaviors of physical therapy graduates: Is there a knowledge-to-practice gap? *Phys Ther*. 2015;95:568-578.
30. *American Physical Therapy Association Vision Statement for the Physical Therapy Profession and Guiding Principles to Achieve the Vision*. http://www.apta.org/Vision/. Accessed May 14, 2018.
31. American Physical Therapy Association Strategic Plan. *American Physical Therapy Association*. http://www.apta.org/StrategicPlan/Plan/. Accessed May 14, 2018.