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Megan M. McLaughlin
University of Findlay

Alfred G. Bracciano
Creighton University

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Abstract

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Keywords

Occupational therapy education, physical agent modalities education, physical agent modalities training

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An Exploration into Effective Pedagogies in Occupational Therapy Education For the Safe and Effective Use of Physical Agents

Megan McLaughlin, EdD, MOT, OTR/L, CHT[1]

Alfred G. Bracciano, MSA, EdD, OTR/L, FAOTA[2]

University of Findlay[1]

Creighton University at the University of Alaska Anchorage and Creighton University[2]

United States

ABSTRACT

Occupational therapy educational standards, established by the Accreditation Council for Occupational Therapy Education (ACOTE), require students to demonstrate knowledge and use of the safe and effective application of physical agents. A recent change requires educators to reflect on pedagogical approaches for electrotherapeutic and deep thermal agents. With a lack of research on pedagogical approaches to teaching physical agents, research on this important topic is essential. The purpose of this study was to identify education and training methods that facilitate the development of competence with complex physical agents. This study used a mixed-methods survey design with follow-up interviews. The survey sample included 98 occupational therapists/Certified Hand Therapists with six follow-up semi-structured interviews. Descriptive statistics and one-way ANOVAs were used to analyze quantitative data. Inductive coding and deductive coding guided by Miller's Pyramid and Bloom's Taxonomy were used to analyze qualitative data. One-way ANOVAs indicated continuing education and fieldwork resulted in higher levels of independence when compared with manufacturer's sales representative training ($p<.05$). Continuing education, fieldwork, entry-level education, post-professional education, and on-the-job training were associated with higher competence levels than no training at all ($p<.05$). Qualitative findings indicated learner demonstration and practice with instructor guidance and feedback on performance are essential for learning physical agents. Several different types of education and training are effective for developing competence in physical agents. When planning learning activities, educators should consider learner demonstration, supervised and repetitive hands-on practice, and feedback to facilitate students' abilities to safely and effectively use complex physical agents.

Introduction

Competence in the appropriate knowledge, theory, and skills of a profession is a necessary prerequisite for being an effective practitioner in any field. Research supports the development of adequate competence in complex interventions prior to use with clients in order to prevent potential harm (Bracciano, 2008; Bracciano, 2021; Mu et al., 2011). According to the American Occupational Therapy Association (AOTA), practitioners are responsible for both attaining and maintaining awareness and competence in the interventions they provide (AOTA, 2015). The application of appropriate and safe interventions first requires effective education and training to learn the proper use and potential risk factors involved in that intervention.

Physical agent modalities or physical agents are a group of interventions that apply various forms of energy to the body as a component of the therapeutic process and include but are not limited to electrotherapy, ultrasound wave technology, heat, and cold therapies (Bracciano, 2008; Bracciano, 2021). Physical agents are used by various rehabilitation professionals with the intent to create a biophysiological response or to modify the area of the body they are applied to (Bracciano, 2008; Bracciano, 2021).

With the complex nature of physical agents as well as the significant potential harm to the client if used incorrectly, adequate practitioner competence is imperative to prevent injury to the client; however, there is little published regarding effective training and education strategies for these interventions (Bracciano, 2008; Bracciano, 2021). This study aimed to explore methods expert occupational therapy (OT) practitioners have used to develop competence in complex physical agents in order to inform the field of OT education on potentially effective teaching strategies for this intervention.

Review of the Literature

Historically, physical agents have not always been an intervention used by OT practitioners. There was a time when physical agents were considered to be a controversial OT intervention with some leaders in the field opposed to their use (Cornish-Painter et al., 1997; Glauner et al., 1997; Huss, 1981; West, 1984; West & Wiemer, 1991). Despite the fact that there are some in the field that have opposed the use of physical agents as an intervention, there are many practitioners and scholars in the field who have argued in favor of using physical agents because of the positive impact they can have in facilitating occupational performance (Ahlschwede, 1992; Bracciano, 2008; Cornish-Painter et al., 1997; Glauner et al., 1997; Huss, 1981; West, 1984; West & Wiemer, 1991). The AOTA (2018) supports the use of physical agents in the practice of OT as a preparatory method to be used before or during interventions to enhance occupational performance or the client’s ability to participate in necessary or wanted daily tasks.

Standards for Education

Competency standards serve as a minimum guideline to evaluate the performance of practitioners entering the field of OT (Rodger et al., 2009). These standards help communicate the expectations of competent performance including practical skills and knowledge alongside the appropriate ethical and legal reasoning required to make effective and safe clinical decisions (Rodger et al., 2009). The Accreditation Council for Occupational Therapy Education (ACOTE) is the accrediting body for OT education. The most current revision of the ACOTE standards is the 2018 Education Standards and Interpretive Guide which went into effect July 31, 2020 (ACOTE, 2018). The 2018 revision states entry-level masters and doctoral OT students must "demonstrate knowledge and use of the safe and effective application of superficial thermal agents, deep thermal agents, electrotherapeutic agents, and mechanical devices" (ACOTE, 2018, p.31). This 2018 revision is notably different than the prior revision. The previous revision of the ACOTE educational standards and interpretive guide (2011) noted entry-level masters and doctoral OT students should demonstrate the use of superficial thermal and mechanical physical agents; however, students only needed to explain the use of electrotherapeutic and deep thermal physical agents (ACOTE, 2011). A significant change in the revised current standards now states students are expected to demonstrate knowledge and safe and effective use of physical agents including superficial, deep, electrotherapeutic, and mechanical modalities (ACOTE, 2011, 2018). Because of the revised ACOTE standards, programs across the nation may need to increase the rigor and attention to which these interventions are taught in order to meet the educational standards and ensure future client safety.

Effective Education for Physical Agents

Physical agents are used by a variety of rehabilitation professionals including occupational therapists, physical therapists, athletic trainers, and chiropractors. Few studies have been published regarding training and education in the use of physical agents in health professions education. Adams (2013) studied student outcomes in a physical therapy course covering physical agents, comparing a hybrid instruction versus a traditional instruction method in a physical therapy academic program. Adams (2013) found that physical therapy students in the hybrid group and traditional instruction group did equally well on final exam grades, and no statistical differences were noted in retention of learning scores. In addition, physical therapy students learning through a hybrid method reported a significantly higher level of course satisfaction (Adams, 2013). Erickson et al. (2017) studied the breadth and depth of hand therapy content (including physical agent content) covered in physical therapy academic education by surveying physical therapy practitioners to determine their perception of new graduate readiness for clinical practice. Results overwhelmingly showed that 80-86% (n=30) of physical therapy practitioners recommended physical agents be taught in academic programs at a level of "independent," which indicates students should be able to select, apply, and perform the appropriate physical agent without any assistance (Erickson et al., 2017). The remainder of participants felt these physical agents should be taught at the "guided practice level" in entry-level education (Erickson et al., 2017).

Few recent studies have addressed training and education for the use of physical agents in the OT process and no studies have addressed education of physical agents with OT students. Studies show that OT practitioners have used several different methods to develop competence in physical agents (Cornish-Painter et al., 1997; Glauner, 1997; Lambert, 2007; Taylor & Humphry, 1991). While this self-driven professional development is beneficial, the types of education sought by practitioners has been found to be inconsistent in length of course or training, depth of content covered, accountability for accuracy, and extent of competency testing (Lambert, 2007; Taylor & Humphry, 1991). This has resulted in practitioners receiving differing levels of education and training with physical agents with likely varying levels of competence in this intervention.

Experiential learning pedagogy is considered to be a valuable and effective component in OT education by both students and faculty (Baird et al., 2015; Knecht-Sabres, 2013; Henderson et al., 2017). There are currently no studies that address effective learning methods for developing knowledge of physical agents with OT students. Physical agents are a unique and complex intervention group requiring knowledge of the modality itself as well as the biophysiological response of the body. It is important to identify potentially effective teaching methods for physical agents because of the significant harm that can be caused if used incorrectly (Bracciano, 2008; Bracciano, 2021). Additionally, academic standards have changed to increase the rigor in which students must demonstrate knowledge of complex physical agents (ACOTE, 2018).

Statement of the Problem

There is a gap in the literature as very little has been published since the 1990s regarding physical agents and OT practitioner competence, use, or education and training of this intervention. Furthermore, there is minimal evidence discussing effective teaching strategies for physical agents with OT students. The ACOTE (2018) standards for education in physical agents changed with the 2018 revision, with students now required to demonstrate knowledge and use of superficial, deep thermal, mechanical, and electrotherapeutic physical agents. This has resulted in the need for educators to reflect on the depth of knowledge students develop during their academic education. There is an urgent need for research on effective training and education strategies for physical agents to ensure adequate competence and prevent injury to clients. Occupational therapy programs need to evaluate the effectiveness and depth of how they are currently teaching this intervention technique. Changes within programs may need to be made to ensure compliance with the revised standards and to ensure students are prepared to safely and effectively utilize physical agents with future clients.

Methods

This study utilized a mixed methods convergent survey design to explore ways in which OT practitioners who use physical agents have developed their expertise with this intervention and participated in the training of novice practitioners and/or OT students. Perceived effectiveness of the trainings they received and/or provided to novice practitioners or students was also explored. The research questions were as follows:

1. What types of training and education received by expert OT practitioners in the use of deep and electrotherapeutic physical agents result in higher levels of perceived competence among OT practitioners?
2. What are the insights expert OT practitioners have regarding the effectiveness of the electrotherapeutic and deep thermal physical agents training and education they have received or provided?

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This study was approved by the University of Findlay Institutional Review Board prior to sending out surveys and collecting data.

Instruments

Quantitative data were collected through a survey. The current study incorporated similar formatting and demographic questioning as Taylor and Humphry (1991) and Bracciano et al. (2007). The survey instrument consisted of four parts and gathered information about the practitioners' current use of various types of deep and electrotherapeutic physical agents, where and how they received their training and education in the use of various types of physical agents as well as the perceived effectiveness of the education, ranking of training and education methods according to effectiveness, and demographic information. Quantitative survey data provided information about demographics, how practitioners were trained, what level of perceived competence they had, what level of independence they had, and if/how they had been involved in training others in the use of electrotherapeutic and deep thermal physical agents. Quantitative data provided answers to the first research question which sought to learn the types of training and education received by expert OT practitioners, the extent to which they used various types of deep thermal and electrotherapeutic physical agents, the level of competence with each type of physical agent, and the types of training and education they may have provided to novice therapists and/or fieldwork students. Qualitative data from semi-structured interviews helped to answer research questions one and two and provided information about the expert practitioners' perceived level of effectiveness of training and education as well as specific learning methods in the use of physical agents. This included effectiveness of training and education they received as well as training and education they may have provided novice practitioners and/or fieldwork students.

Three OT practitioners/educators certified in the use of physical agents reviewed drafts of the survey and interview instruments as a means to improve content validity. The survey was then piloted with three OT practitioners who met the criteria for the study's population. Revisions were made and included wording adjustments for improved clarity and the addition of responses for answer options.

One limitation of the survey involved question seven which asked about the most effective learning methods practitioners participated in to learn the safe and effective use of electrotherapeutic and deep thermal physical agents. The question asked for only one response; however, the survey did not limit participants to one response electronically and many practitioners selected multiple learning methods. Because the researcher did not know which method the practitioner felt was the most effective of all the methods selected, all responses were accepted with the assumption that those practitioners believed more than one method was most effective.

Participants

In order to access participants who were experienced in the use of physical agents, a purposive sampling method was used through the American Society of Hand Therapists (ASHT). Occupational therapists with the Certified Hand Therapist (CHT) credential were the population sought after in this study. The CHT credential designates the practitioner as an expert in upper extremity rehabilitation, which is a common field in which physical agents are used in intervention (Glauner et al., 1997). Additionally, physical agents are one of many topic areas included on the CHT examination, which helped to establish practitioner competence in this intervention. It is important to note physical therapists can also become certified as a CHT; however, physical therapists were excluded from this study because of the differences in academic preparation of physical therapy students versus OT students. As of June 2021, ASHT had 2,711 members who were certified as OTs and CHTs.

Procedures

Participants were recruited through ASHT. As a membership benefit and to promote research, ASHT reviewed and approved the survey and then sent the survey link via email to their members on behalf of the researcher. It is important to note that while ASHT sent the email and survey link to its members, ASHT did not have access to any research data. The survey was created through Google Forms and was open for a period of four weeks. All participants provided the appropriate informed consent to participate in this study. A question on the survey asked if participants were willing to be contacted for a follow up interview. Those participants who agreed to follow up interviews and provided a valid email address were contacted to schedule an interview. Interviews were scheduled at the convenience of the participant and completed and recorded via Zoom on the researcher's password-protected computer then transcribed with the use of Dedoose.

Theoretical Framework

Miller's Pyramid of Clinical Competence was used to guide survey and interview question development as well as to guide the qualitative analysis. Miller's Pyramid explains the development and assessment of clinical competence in health care professionals (Miller, 1990). In this framework by Miller and later studied and further developed in various health professions, there are five established levels of clinical competence that include from lower skill level to higher: *Knows, Knows How, Shows, Does,* and *Does Better* (Fu, 2015; Jensen et al., 2017; Miller, 1990; Sellar et al., 2018; Wass et al., 2001). Miller's Pyramid has been studied with Bloom's Taxonomy by various researchers in an attempt to align learning objectives and action verbs with the various levels of clinical competence (Fu, 2015; Moore et al., 2014). This framework provided an avenue for the current study to identify pre-determined qualitative themes and codes to bridge the gap from the clinical world (what the practitioners did to become competent) to the academic world (how educators can use this information to assist students).

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Data Analysis

Data for part one and two of the survey were analyzed through descriptive statistics to calculate mean perceived competence levels and mean perceived independence levels for each physical agent based on the corresponding primary training type. For the purpose of this research project, competence was defined as having the capacity to function in a professional or clinical environment with the skills, abilities, and qualities necessary (ACOTE, 2018). Independence was defined as the ability to use physical agents without the help of a manual or guidance from another person. Inferential statistics, specifically, single-factor analyses of variance (ANOVAs) with post hoc Tukey tests were used to determine if there was a statistically significant difference between competence (dependent variable) and primary training type (independent variable) as well as between independence (dependent variable) and primary training type (independent variable). Part three of the survey explored participants' experiences with training and educating others in the use of physical agents. This section was analyzed through descriptive analysis. Various demographic questions were asked in part four of the survey and analyzed using descriptive statistics to gain information about the participants.

Qualitative analysis of the open-ended semi-structured interview questions was done using themed codes from previous research with Bloom's Taxonomy and Miller's Pyramid as a means to categorize the types and preferences of training and education expert practitioners had received. Although the participants were not necessarily educators, the use of Miller's Pyramid and Bloom's Taxonomy allowed the researcher to translate their words into language identifiable and useful to OT educators. This process was made possible through the use of descriptive qualitative analysis using a priori codes from Bloom's Taxonomy and Miller's Pyramid (see Table 1). As a means to thoroughly analyze qualitative data, the researcher also utilized an inductive coding process. Both types of data were analyzed separately and then compared as a means to determine correlations between the qualitative and quantitative data.

Table 1

Paired Miller's Levels and Bloom's Categories with Corresponding Language in Current Literature

Miller's Pyramid of Clinical Competence Level	**Bloom's Taxonomy Category**	**Language from Current Literature**
Does Better	-	innovation in field or skill, further advanced practice, experience, and/or research moves field forward, expert
Does	4 Analysis 5 Synthesis 6 Evaluation	action, analysis, evaluation, synthesis, problem-solving, managing completely, judgement calls, doing in practice, do independently with clients in workplace, authentic performance, unsupervised practice
Shows	3 Application	performance, application, effectively demonstrate how to perform, supervised performance, demonstrate without a client, integrate knowledge with skills, performance test, standardized patient test, demonstrate with supervision, simulation
Knows How	2 Comprehension	translate information, comprehension, show understanding and insight, perform with observation, clinical context-based testing, application of knowledge to problem-solving, interpretation, clinical reasoning, knows how to apply knowledge
Knows	1 Knowledge	knowledge base, recall information, knows what is required, explain, demonstrate understanding, factual recall, identify, content knowledge

Note. Keywords with corresponding pyramid levels were gathered from previous research by Jensen et al. (2017), Miller (1990), Moore et al. (2014), Sellar et al. (2018), and Wass et al. (2001).

Results

Demographics

One hundred and thirty-two (N=132) practitioners completed and submitted the survey. After reviewing for inclusion criteria, the total number of surveys used for data analysis was 98. The span of entry-level graduation year ranged from 1980 through 2018 with a median year of 1996. The participants' primary work setting in OT was in an outpatient

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facility (58.3%; *n*=98), followed by private practice (17.3%; *n*=98), academic institution/higher education (9.2%; *n*=98), physician-owned practice (8.2%; *n*=98), acute care hospital (5.1%; *n*=98), and rehabilitation center (2.0%; *n*=98).

Six participants agreed to be interviewed and returned written consent. Interview participants had a variety of primary work positions that included education in an OT academic program, practicing as a part-time or full-time practitioner, and a combination of clinical practice and adjunct teaching involvement. The range of entry-level graduation year was from 1992 through 2011 with a median year of 2002.

Relationship of Training Received on Competence

Survey Results

Primary Training and Education Received. The overwhelming majority of practitioners (*n*=98) participated in continuing education for their primary training with physical agents, ranging from 39-47 practitioners (depending on physical agent type). On-the-job training was also prevalent with a range of 24-34 practitioners who participated in this type of training as their primary method for developing competence.

Level of Perceived Competence and Independence. Pivot tables were used to determine relationships between primary training type and perceived competence level within the study sample. Across all physical agents, fieldwork education as the primary training type was associated with the highest mean competence level among all the training types. Continuing education and fieldwork education were associated with a perceived competence level 4 or higher (4.08 and 4.22), which falls within the *Does – Does Better* levels on Miller's Pyramid. Entry-level education, manufacturer's sales representatives, on-the-job training, post-professional education, and self-teaching were all between the *Shows* level (3) and *Does* level (4) of competence ranging from 3.53-3.96.

Pivot tables were also used to determine relationships between primary training type and independence with use of physical agents. Responses for independence level were compiled into one of three categories: not competent enough to use (1), needs assistance or supervision of another professional or manual to use (2), or independent in use (3). Independent in use was defined the ability to use the agent safely and effectively without the assistance of others or a manual. Fieldwork had the highest mean level of independence among all training types with a 3.0 (independent). Continuing education and self-taught were the next highest in this group, both at a 2.83 level of independence. Continuing education, entry-level education, manufacturer's sales representative training, on-the-job training, post-professional education, and self-teaching were associated with needing assistance of another person or manual to completely independent (range of 2.7-2.83). No training had a mean level of 1 (1.17), which indicates physical agents were not used due to lack of competence.

Table 2

Mean Perceived Competence and Independence Levels per Primary Training Type

Primary training type	Mean competence level per training type	SD	Mean independence per training type	SD
Continuing education	4.08	0.64	2.83	0.50
Entry-level education	3.88	0.56	2.74	0.60
Fieldwork	4.22	0.52	3.00	0.00
Manufacturer's Sales Rep training	3.53	0.77	2.70	0.67
No training	2.50	1.00	1.17	0.39
On-the-job training	3.96	0.62	2.81	0.49
Post-professional education	3.96	0.84	2.79	0.42
Self-taught	3.71	1.11	2.83	0.41

Note. Participants were asked to rate perceived competence and independence levels for each physical agent listed. Competence (according to Miller's Pyramid) = Does (4), Shows (3), Knows How (2), Knows (1). Independence levels = Does not use (for reasons not related to competence) (0), not competent enough to use (1), needs assistance or supervision of another professional or manual to use (2), or independent in use (3).

Effective Training and Education. A one-way ANOVA determined that there was a statistically significant difference in perceived competence between the various training types received (F(7/545) = 5.97, p = <.05). Post hoc Tukey testing for multiple comparisons demonstrated that there were significant pairwise differences in competence levels between several types of primary training methods. A statistically significant difference was found with continuing education ($p < .01$) and fieldwork ($p < .05$) when compared with manufacturer's sales representative training. Continuing education, entry-level education, fieldwork, on-the-job training, and post-professional education all demonstrated statistically significant differences ($p < .01$) when compared with competence levels from no training.

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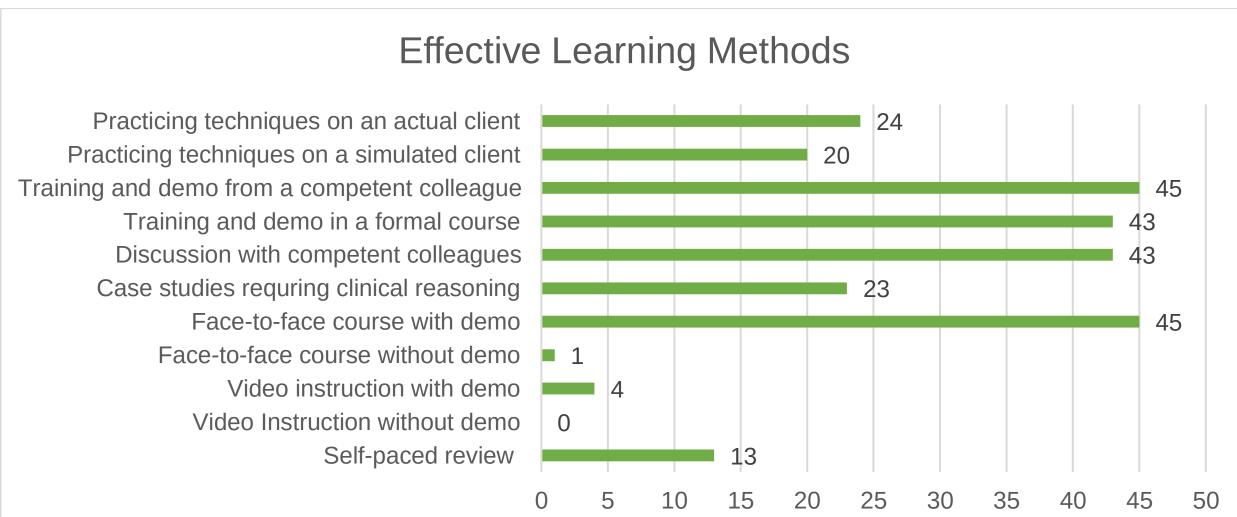
One-way ANOVA testing determined that there was a statistically significant difference in independence in use of physical agents between the various training types received ($F(7/463) = 19.28$, $p = < .05$). Post hoc Tukey testing for multiple comparisons showed a statistically significant pairwise difference in independence level between no training and all other training types ($p < .01$), including continuing education, entry-level education, fieldwork, manufacturer's sales representative training, on-the-job training, post-professional education, and self-teaching methods. The result indicated that an absence of training was associated with a lower level of independence in the use of physical agents when compared with all other training types.

Figure 1 displays each type of learning method presented and the number of practitioners who selected each as a most effective tool for developing their own competence. Face-to-face lecture courses with a demonstration component as well as training and demonstration with a competent colleague were both selected most frequently as the most effective method for learning, with 45 practitioners selecting each. Discussions with competent colleagues as well as training and demonstration through a continuing education course were selected by 43 practitioners. Courses without demonstration were selected the least, including face-to-face lecture-based course without demonstration and video instruction without demonstration.

Figure 1

Effective Learning Methods as Perceived by Practitioners (reported in frequency)



Expert Practitioner Insights on Effectiveness of Training

Survey Results

Figure 2 shows the two teaching and learning methods that aligned with Miller's Pyramid *Knows* level (readings at 3.07 and lectures at 3.28) and were ranked by the practitioners as the least effective methods for learning electrotherapeutic and deep thermal physical agents. The two teaching and learning methods that aligned with the

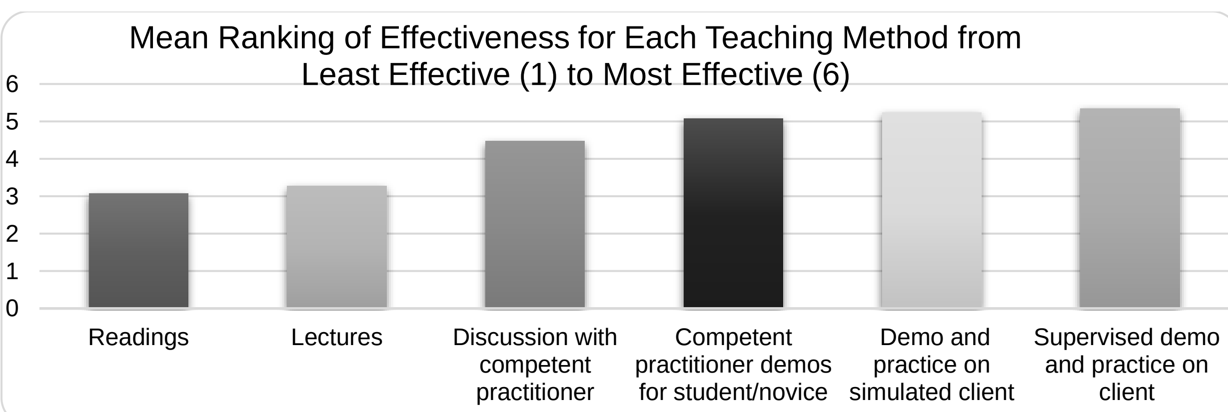
Knows How level, discussion with a competent practitioner and competent practitioner demonstration, were ranked at a 4.47 and 5.08 respectively for overall effectiveness. The highest mean rankings of the practitioners included demonstration on a simulated client (mean rank = 5.23) and supervised demonstration on a client (mean rank = 5.35). These two types of learning methods are considered to be at Miller's *Shows* level because it requires knowledge application as well as actual performance of a skill. The results indicated practitioners believed teaching and learning methods involving supervised demonstration in actual clinical or simulated clinical situations were most beneficial for developing competence.

Interview Results

Primary Training and Education Received. Interview participants had varying levels of education and included educators as well as practitioners (see Table 3). Practitioners noted they engaged in several different types of education and training to learn about physical agents. Some referenced their undergraduate education as helping them to prepare. Participants B, C, and F, who all graduated between 2009 and 2011, noted learning about physical agents in their academic programs. Participants B and C also discussed having a fieldwork rotation in hand therapy during which they were able to further discuss application, have supervised practice, and perform supervised use on patients. Participants A, D, and E all referenced having beneficial training from sales representatives from medical equipment companies. These practitioners all graduated entry-level education in the 1990s. Self-teaching, on-the-job training, and seeking out continuing education courses were themes noted by participants graduating in the 1990s.

Figure 2

Mean Rankings for Six Types of Teaching and Learning Methods



Effective Training and Education. While all participants noted the importance of the *Knows* and *Knows How* level of knowledge, participants D and E highlighted the importance of knowing the foundational science and information behind the physical agents. Participant E, an educator, emphasized the importance of students knowing two main things: the “basic science, including physics, biology, and chemistry, and they need to know the modalities specific stuff, you know, how do you use it.” Participant D noted, “you’re not going to understand that ultimate functional outcome if you don’t understand the reason why you’re using the modality. If you don’t understand the basics, just doing the modality doesn’t make sense.”

Table 3

Interview Participants with Demographic Data

Interview participant	Current position	Year of entry-level graduation	Entry-level degree	Highest degree held
A	Part-time practitioner	1995	Bachelor	Bachelor
B	Full-time educator	2011	Master	Doctorate
C	Full-time practitioner	2009	Master	Master
D	Full-time practitioner, occasional work as guest lab instructor	1992	Bachelor	Bachelor
E	Full-time educator	1992	Master	Doctorate
F	Full-time practitioner, occasional work as a proctor for lab exams	2011	Master	Master

The most referenced type of effective education and training had to do with physical demonstration of the physical agent (*Shows*). Four of the participants reported this level of performance as the most effective in their own learning and/or the learning of novice practitioners and students they have worked with. Participants believed having supervision and feedback during performance facilitated learning significantly and helped to ensure competence and safe use of the physical agent. Participant D expressed that continuing education, where she could participate in break-out labs and practice on peers with the course instructor present for supervision, was very helpful in her early learning of the physical agents. When asked what the most helpful strategies were for him, Participant F stated,

> The most effective was just having the teacher right there with you – you walked through what you were going to do and actually could apply it to them. They can correct you right there in the moment. There’s nothing like actually doing it in person. You can talk out everything, but I don’t think you can demonstrate that you know how to do it otherwise.

Participant C also spoke to the benefits of practicing the skill and use of physical agents.

> The hands-on practice helps and the repetition…I found it useful when my coworkers would give me feedback. They could be there to check things, like electrode placement or that I was moving the ultrasound head appropriately, from a distance and come intervene if there were issues. That supervision when you first get into it and a contact person was helpful.

Participant D reported that learning the safe and effective use of physical agents was, “Similar to driving a car, you can read about how to drive a car, but until you actually do it, you don’t fully understand it.”

Evidence-based Practice. Four of the six participants spoke about evidence-based practice as an essential element that impacted their use of physical agents; furthermore, some emphasized the importance of students learning this in their education to prevent the overuse or misuse of physical agents in practice. Participant C reported she does not remember learning about evidence for or against physical agents in her academic program, which led to her having a skewed understanding of their effectiveness and use when she entered practice. She emphasized the need to thoroughly educate students and new practitioners on the use of physical agents and the evidence to support or refute them so new practitioners are better able to make informed clinical decisions. Participant E also discussed the importance of students learning the literature and evidence to guide physical agent use rather than the general theories behind them that might not be backed by evidence.

Triangulated Data

Survey results from multiple questions indicated expert practitioners believed the most effective learning methods for developing knowledge in the safe and effective use of physical agents should include demonstration and practice on a simulated client (including a colleague or peer), supervised demonstration and practice, and in-person courses involving demonstration and practice. This mirrors data collected in the interview portion of the study, in which participants were found to identify the most effective education and learning methods in the *Shows* level as well, including practicing with physical agents under the supervision of an instructor or competent colleague to provide feedback and guidance as needed. The mixed-methods results showed that education and training in the use of complex physical agents should include opportunities for practice, demonstration, performance, application, and supervision in simulated or actual clinical situations.

Discussion

Competence in the knowledge, theory, and skills of a profession is a prerequisite for being an effective practitioner in any field. It is important for educators to analyze the extent to which soon-to-be practitioners are prepared to provide OT services as students transition from student to entry-level practitioner. It is imperative to study effective pedagogies for teaching OT students complex physical agents and their biophysiological impact due to the risk of potential harm to future clients as well as to meet recent changes in academic standards. The current study aimed to explore effective training and education received by expert practitioners who have developed competence in complex physical agents as a means to inform the field of OT education of potentially effective teaching methods.

Primary Training and Education Received

Previous research on physical agent modality use in OT shows practitioners utilized a wide variety of education and training to learn how to safely and effectively use physical agents in practice (Bracciano et al., 2007; Cornish-Painter et al., 1997; Glauner, 1997; Lambert, 2007; Taylor & Humphry, 1991). The current study supports the findings of previous work, further validating that OT practitioners participated in a wide variety of education and training in order to develop competence in the use of physical agents. Taylor and Humphry (1991) cautioned against on-the-job training in their study because it may not adequately cover all areas of knowledge needed for practitioners to safely and effectively use physical agents in practice (Taylor & Humphry, 1991). In contrast to Taylor and Humphry's (1991) reported concerns about on-the-job training potentially resulting in varying levels of competence, statistical analysis from the current study did not find a significant difference in competence or independence in the use of physical agents when comparing on-the-job training with other training types such as continuing education, entry-level education, fieldwork, and post-professional education. The current study aligns with Glauner and colleagues' findings and determined the most common primary training type engaged in was continuing education followed by on-the-job training. The findings from this study suggest practitioners continue to value and engage in continuing education courses when seeking to learn more about physical agents. Face-to-face courses requiring demonstration and training are perceived to be more effective methods of learning complex physical agents compared with asynchronous formats.

Effective Training and Education

The current study demonstrates that continuing education and fieldwork education were associated with higher perceived competence in the use of physical agents when compared to manufacturer's sales representative training. Additionally, continuing education, entry-level education, fieldwork, on-the-job training, and post-professional education were associated with higher perceived competence levels than no training at all. As far as independence in the use of physical agents, all other methods of training and education resulted in higher levels of perceived competence than no training at all, including continuing education, entry-level education, fieldwork, manufacturer's sales representative training, on-the-job training, post-professional education, and self-teaching methods. Descriptive analysis within the survey sample showed fieldwork education and continuing education were associated with higher mean levels of perceived competence with physical agents compared with the other methods of education and training for participants in the study. Fieldwork education was also associated with the highest mean level of independence in using physical agents compared with other types of training within the survey sample. Practitioners wanting to further develop their competence and independence in physical agent use in practice may consider participating in continuing education, especially courses requiring an application or hands-on component in addition to learning about foundational concepts of physical agents. OT students wanting to develop their competence in physical agent use may benefit from fieldwork rotations in practice areas that commonly use physical agents, such as hand therapy or outpatient rotations.

In addition to engaging in training to develop their own competence, many expert practitioners have also participated in mentoring, training, and educating others (students and/or novice practitioners) in the use and application of physical agents. Triangulated results from this study revealed that the most effective learning methods for physical agents involved activities emphasizing demonstration, practice, and supervised application. Effective learning methods included formal, in-person continuing education courses that required a demonstration component as well as discussion and practice with a competent colleague or instructor. Additionally, the most effective educational methods included those that required the learner to demonstrate or show how to apply and use the physical agent. The presence of a competent colleague, mentor, or instructor was emphasized as another key factor to supporting knowledge growth. Supervision, guidance, and feedback from an instructor or mentor was found to be very important for this stage of learning.

Schaber (2014) described “learning by doing” in OT education as experiential learning, deeming it one of the three signature pedagogies of OT education. The current study found that expert practitioners developed competence in using physical agents through engaging in learning methods that required them to perform the skills of a practitioner in the field, which aligns with experiential learning pedagogy. The most effective learning methods included those that required practitioners to demonstrate, practice, perform, and simulate use of the physical agents. Expert practitioners who have been involved with teaching and mentoring students and novice practitioners also believed learning methods that required supervised demonstration and practice, direct feedback on performance, and simulated client scenarios were the most effective for developing knowledge and competence.

The current study determined that expert practitioners perceived experiential learning to be the most effective and valuable learning methods for the development of competence in physical agents in themselves and those they have trained or mentored. Baird and colleagues (2015), Knecht-Sabres (2013), and Henderson and colleagues (2017) found OT faculty and students valued experiential learning methods as well. Knecht-Sabres and colleagues (2013) found that a combination of case scenarios, hands on lab-activities, and standardized patient experiences significantly improved OT students’ perceptions of comfort and skill level. Furthermore, these learning activities provided an environment where students could practice clinical skills without the potential for harming real clients. Results from the current study show that expert practitioners believed similar learning methods with physical agents such as hands-on activities, practice of clinical skills, and simulated client and case experiences were beneficial to developing knowledge for themselves as well as others they have trained.

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While experiential learning was considered by expert practitioners to be the most essential for developing competence in physical agent use, it is also important to consider the importance of developing the foundational knowledge necessary to use physical agents. Qualitative results from this study determined that some experts also emphasized the need to fully understand the foundational aspects of physical agents, including biology, physics, and kinesiology prior to learning how to apply them. Understanding the basics of physical agents is key to understanding how and when to use them with clients.

Expert practitioners have engaged in various types of education, training, and learning activities in order to develop competence in the use of electrotherapeutic and deep thermal physical agents. Statistical analysis demonstrates a variety of training methods as potentially effective for developing competence and independence in the use of physical agents such as continuing education, entry-level education, fieldwork, post-professional education, and on-the-job training. This suggests that developing competence in physical agents can be achieved in a variety of ways. Manufacturer's sales representative training is likely not as effective in developing competence when compared with the other types of training and education.

Descriptive statistics within the sample showed mean perceived competence levels were highest among those that participated in continuing education or fieldwork as the primary training method. Mean independence levels were highest in those that participated in fieldwork education as their primary method for learning complex physical agents.

Implications for Occupational Therapy Education

The results of this study help to close the gap in providing evidence-based practices for the effective education of physical agents. The field of OT education can gain insight into potentially effective pedagogies for teaching physical agents through studying the methods expert practitioners have used to gain competence for themselves as well as through training and mentoring novice practitioners and students. The educational standards for electrotherapeutic and deep thermal physical agents changed as of July 31, 2020, stating students should "demonstrate knowledge and use of the safe and effective application of superficial thermal agents, deep thermal agents, electrotherapeutic agents, and mechanical devices as a preparatory measure to improve occupational performance. This must include indications, contraindications, and precautions" (ACOTE, 2018, p. 31). Expert practitioners in this study emphasized the need to practice and perform physical agent use in order to safely and effectively use them because of the potential health risk to the client if they are not used correctly. Additionally, students should understand the theory and research behind the use of physical agents to ensure they are using the intervention in an evidence-based and judicious manner.

The findings from this study supported the use of experiential learning in teaching complex physical agents to OT students. Previous research in OT education also supports experiential learning as a preferred and effective method for preparing future generations of OT practitioners (Baird et al., 2015; Henderson et al., 2017; Knect-Sabres, 2013; Knect-Sabres et al., 2013; Schaber, 2014; Schaber & Candler, 2020). Learning methods including supervised demonstration and practice of skills, practice with the opportunity for feedback and guidance, and engagement in simulated client experiences are considered to be the most effective in developing competence in the use of physical agents. Educators should evaluate whether they are incorporating these methods effectively when designing modules and activities for students to learn complex physical agents. Supervised demonstration using case studies and application of physical agents should allow opportunities for students to observe the proper application of the agent and then practice applying the agent on a peer or simulated client while receiving guidance and feedback as needed from the instructor. Simulation as a form of experiential learning is considered to be an effective pedagogical approach for developing clinical skills (Reichl et al., 2019) and perceived competence in OT students (Baird et al., 2015; Knect-Sabres et al., 2013).

Curricular content in OT programs is strongly guided by the standards established by ACOTE, the accrediting body for OT education. However, ACOTE does not dictate how programs teach or meet the educational standards; instead, they allow each program the autonomy to interpret and apply the standards to its own unique curricular design. Previous revisions of the ACOTE standards interpretive guide have specified students do not have to physically demonstrate the application of physical agents in order to "demonstrate knowledge" (AOTA, 2011, p.26). This interpretation by OT educators of the term "demonstrate" as an educational objective is contrary to the findings of the current study and limiting to competency and acquisition of knowledge by new graduates and students. The current study determined that experts in the field believed students should *physically demonstrate* and practice the use of complex physical agents in order to promote effective and safe future use in practice. This presents a potential disconnect between pedagogical approaches of educators and what practitioners in the field expect from students. Additionally, experts emphasized the importance of students understanding evidence-based use of physical agents to strengthen and foster clinical reasoning. In future standard revisions, it may be beneficial for ACOTE to consider these recommendations from expert practitioners to facilitate active learning and the safe application of physical agents as a component of a more rigorous academic process and learning activities.

Limitations

As mentioned previously, one limitation of the study involved a technical error in the electronic survey form. Question seven asked about the most effective learning methods practitioners participated in to learn the safe and effective use of electrotherapeutic and deep thermal physical agents. The question asked for only one response; however, the survey did not limit participants to one response electronically and several selected multiple answers.

This study asked expert practitioners who are both occupational therapists and CHTs to share information on how they developed competence as well as how those they have mentored have responded to training and education in physical agents. Only a small percentage of participants were OT educators. The participants' knowledge of education, pedagogy, and learning methods was not determined; however, Miller's Pyramid of Clinical Competence and Bloom's Taxonomy were used to guide the development of the survey responses and the deductive codes used in qualitative analysis to try and translate the practitioners' experiences to information valid to OT education.

Future Research

This study researched various types of training and learning engaged in by expert practitioners; however, it did not define or address specific details of what was involved with each training type. For example, continuing education courses may have had different formats or different contact hours therefore, the level of learning that occurred may be different from one course to another. Future research should address or define the quality of the training to learn more about the extent and effectiveness of each type of training and their outcomes. Indicators of the potential quality of a continuing education course may include the length the course, course objectives covered, amount of continuing education credit, or whether a course meets or exceeds state regulatory requirements for physical agents. Researching these details will help to quantify the course offerings and further differentiate types of courses that are beneficial for developing competence.

Some participants in the current study emphasized the importance of learning foundational information about physical agents. A practitioner must first understand the foundational concepts and principles behind how and why a physical agent impacts a client in order to safely and effectively use these interventions. Future research should identify theory and evidence to guide the learning of important foundational information related to physical agents. Additionally, some learning methods discussed in this study may be more appropriate to didactic education than with other types of education and training. For example, although video was rated lower by expert practitioners, video-based learning activities may be more applicable for use in didactic education. Further research should explore these differences to better identify effective learning methods for various types of education.

Future research should address the level of effectiveness of training and education for other OT skills. Occupational therapists are trained in various types of clinical assessment and intervention skillsets; therefore, it is important to study effective pedagogical approaches to learning these varied clinical skills. Occupational therapy education is a growing literature base and would benefit from further research to determine how the profession should best prepare the next generation of OT practitioners.

Conclusion

The current study compared perceived competence and independence with primary training types received by the practitioners. Future research should address a more objective level of competence and independence to determine the effectiveness of training and education in physical agents. While there is a recent increase in pedagogical research in OT, this literature base is still growing. Future studies should address effective teaching methods for various OT clinical skills and interventions. While this study addressed perceived competence and independence as it relates to the use of physical agents, the same types of education and training may or may not be appropriate for learning other types of clinical skills.

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