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What are best practices to teach "hands-on" skills in a blended environment?

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Abstract

Despite the proliferation of online teaching and learning in physical therapy education, there is a gap that describes best practices used to teach "hands-on" skills. The purpose of this study was to discover the resources used, current and emerging instructional methods, and a list of best practices for physical therapy educators. A national survey and personal interviews gathered information from faculty who taught orthopedic subject matter. The findings suggest faculty used an assortment of resources and instructional methods in a variety of ways. According to the literature and current teaching practices, a blended learning approach is the recommended method to teach orthopedic "hands-on" skills. The data generated a list of best practices, which consisted of a tangible list of pre-class activities and face-to-face instructional methods. Additional research can help faculty make informed decisions based on evidence, feasibility, and availability of technologies. This study serves as a baseline in today's instructional climate and will evolve as educators continue to seek novel approaches in the technological space within physical therapy education.

1. Introduction

Health care is changing, and so should the growing skill sets of clinicians. By the year 2020, the American Physical Therapy Association (APTA) envisions all physical therapists (PTs) will have a doctor of physical therapy degrees (APTA, 2016). The advancement of the profession to the doctoral level encourages autonomous practice, the use of evidence in making clinical decisions, and supports professionalism in PTs' interactions with others (APTA, 2016).

Online programs proliferate in all areas of study to meet the ongoing demands for doctoral education. In a 2018 report from the Babson Research Group, distance education enrollments increased for the fourteenth consecutive year (Seaman et al., 2018). The presence of online degrees in healthcare is on the rise. Many education programs in athletic training, occupational therapy, nursing, and physical therapy offer a combination of online and face-to-face (F2F) instruction to obtain a bachelor's, master's or doctoral degree (All-Star Directories, 2016; AOTA, 2016; APTA, 2016; CAATE, 2016). No accredited online entry-level athletic trainer (AT), occupational therapist (OT), or physical therapy education programs exist in the United States (AOTA, 2016; APTA, 2016; CAATE, 2016). However, it may only be a matter of time before these healthcare programs transition to a fully online format.

As PT education programs transitioned from the master's degree to the doctoral degree (APTA, 2016), additional academic courses increased workload necessary to meet the professional rigor necessary to achieve the new criteria. These changes led to increased demands of physical therapy education students, which included increased costs of tuition, transportation, and living expenses. Additional stress is often placed on students to work during the education experience to subsidize their academic agenda. Today's students require an efficient strategy to balance personal finances, work obligations, and school commitments. Online learning can support "on-demand" learning, student satisfaction, flexibility of learning, and better work-life balance.

Questions exist regarding the appropriate methods to teach "hands-on" skills online in PT education (Blackinton, 2013; Boucher et al., 2013; Thomas et al., 2011). Traditional methods include F2F instruction in a classroom environment. In the last several years, many PT education programs have embraced technology to teach gross anatomy, orthopedics, and clinical skills (Green & Whitburn, 2016; Hurst, 2016; Smith et al., 2011). A recent systematic review by Macnik et al. (2015) summarized the physical therapy literature related to technologies used in physical therapy education. Websites and discussion boards were the most common technologies used, followed by video podcasts, wikis, and blogging (Macnik et al., 2015). Five studies supported the use of websites to improve lab psychomotor skills (Macnik et al., 2015). In addition, several of the studies suggested less time to perform a required task. One study suggested more time to learn; two found no difference in time but fewer costs associated with website simulations (Macnik et al., 2015). The authors provided a curricular map, which detailed technology used in PT education. However, the authors did not specify how to change an existing curriculum.

Despite the popularity of online teaching and learning, there is a gap in the literature that describes best practices to teach "hands-on" skills. The purpose of this study was to discover the available resources, instructional methods to teach "hands-on" skills, and how faculty combined them to teach orthopedic "hands-on" lab content.

The research addressed the following questions:

1. What are the resources used to deliver orthopedic "hands-on" skills?
2. What are the current instructional methods used to teach orthopedic "hands-on" skills in an online environment? How do faculty combine instructional methods and resources to deliver "hands-on" content online?
3. What are the recommended best practices to teach orthopedic "hands-on" skills for the physical therapy profession in an online environment?

2. Literature review & theoretical framework

2.1 Historical perspective

Early research supported the use of CD-ROMs to teach PT musculoskeletal psychomotor skills (Ford et al., 2005; Smith et al., 2006). Almost a decade later, the proliferation of the Internet (Macnik et al., 2015) led to computer-assisted technologies within physical agents and professional issues in PT education (Adams, 2013; Dal Bello-Haas et al., 2013). Technological changes coupled with challenges for high-quality, cost-effective education encouraged educators to find alternative approaches to teach "hands-on" orthopaedic special tests and intervention skills (Boucher et al., 2013). Specific reasons cited in the literature for the promotion of teaching PT skills online include flexibility, location, shortage of practitioners, classroom space, the ability to review and repeat, and personalization of learning (Adams, 2013, Cooper & Higgens, 2015; Green & Whitburn, 2016; Hurst, 2016; Elmer et al., 2016; Van Doom & Van Doom, 2014; Van Duijn et al., 2014). Within the physical therapy profession, the majority of educational programs reported the use of computer-assisted learning (Baumgartner, 2012). No authors reported a quantifiable percentage of course content taught online verses in a F2F environment (Greenberger & Dispensa, 2015). Within the body of literature, there is a gap in terms of describing best practices to teach "hands-on" psychomotor skills in a blended format.

2.2 Flipped classroom models

Flipped classroom models are a recent innovation in higher education. Flipped learning requires active student engagement to learn the material in advance of class time (Berrett, 2012). In contrast to blended learning, flipped classrooms use online instruction to enhance F2F instruction without decreasing F2F time (Lazinski, 2017). Class time challenges students to solve problems, interact, and apply

what they learn to new contexts (Berrett, 2012). Furthermore, the learning process continues after the designated class time ends with post-class assignments and experiences. Persky and McLaughlin (2017) published a review of evidence-based best practices used in the design of flipped classrooms. Recommendations provided guidelines for educators in the development of pre-class assignments, in-class activities, and after-class work.

In the physical therapy literature, the use of flipped classrooms to teach orthopedic "hands-on" skills continues to grow. Boucher et al. (2013) leveraged technology to flip a PT education musculoskeletal classroom. Gaida et al. (2016) reported similar findings of student satisfaction to teach assessment of the lumbar spine and vestibular system in a flipped classroom. Students reported video instruction allowed more control over the learning process, the ability to self-pace, and promoted a deeper understanding of the content (Gaida et al., 2016). Deprey (2018) conducted a retrospective analysis over three consecutive years that described student performance on unit examinations using a traditional, partially flipped, or fully flipped classroom. Students who received the fully flipped classroom approach outscored students in the partially flipped or traditional instructional methods with a medium effect size of 0.76 (Deprey, 2018).

2.3 Blended Models

Blended models are another mode of instruction, which incorporates the use of technology within the instructional design. Blended models differ from flipped classrooms. In a true blended learning model, online activities replace F2F activities (Lazinski, 2017).

However, variations of blended learning models appear across institutions (United States Department of Education, 2019). Van Duijn et al. (2014) compared student performance in cervical spine evaluation and treatment skills after using online video clips versus F2F methods for instruction. The authors reported improved student performance after receiving both modes of instruction (Van Duijn, 2014). Cooper et al. (2017) evaluated the effectiveness of short online video clips (55-188 seconds) to teach peripheral joint mobilization over a semester. Formative assessments scored the students individually and in groups using five criteria: Motivation, safety, exercise, timing, and progression (Cooper et al., 2017). Researchers analyzed the difference between the overall mean average scored obtained individually and in the groups. In the groups, the effect size was moderate (0.68) and small (0.40) for individuals (Cooper et al., 2017). Scores in the experimental group surpassed the control group in every week except one. When the groups changed positions, an interesting "cross-over" effect occurred. The subjects later used information learned by the experimental group when in the control group. The authors concluded the use of instructional videos helped students individually and in groups when learning rehabilitation skills (Cooper et al., 2017). Furthermore, the instructional design supported a self-directed approach to student learning. Greenberger and Dispensa (2015) described the use of video podcasts to teach orthopedic special tests to augment learning in lieu of traditional F2F demonstrations. The authors concluded a live demonstration was comparable to video podcasts to teach orthopedic "hands-on" skills.

Recent research shows student performance with the use of blended instruction compares equally to F2F instruction (Boucher et al., 2013, Van Duijn et al., 2014; Copper & Higgens, 2015; Greenberger & Dispensa, 2015; McCutcheon et al., 2014). Inconsistencies in study design within the physical therapy literature prevent meta-analysis from determining specific protocols or numerical measures in student performance (Boucher et al., 2013; Adams, 2013; Van Duijn et al., 2014; Cooper & Higgens, 2015; Moore & Smith, 2012). In addition to non-uniform practices, faculty may oppose blended instruction. Misconceptions such as an isolated work environment, lack of academic rigor, and courses directed by technology may negatively influence faculty's decisions to adopt blending learning strategies (Blackinton, 2013).

As PT education programs make decisions to move clinical content online, recommendations for best practices could help faculty determine appropriate resources and instructional methods to teach orthopedic "hands-on" skills, which could lead to better student outcomes.

2.4 Theoretical Framework

The theoretical framework that supports this research comes from three fields of study that favor blended pedagogy to teach psychomotor skills in physical therapy: Theory of instructional design, adult learning theory, and social constructivism. The fields connect and work together. Their interdependency influences the teacher, shapes the student, and creates the environment (See Figure 1).

Richard Clark's theory of instructional design states the course design is more important than the medium used. He describes media as "mere vehicles that deliver instruction but do not influence student achievement any more than a truck that delivers our groceries causes changes in nutrition" (Clark, 1983, p.445). So, for educators, the intention in course design can help create cost-effective and supportive strategies for student success.

In addition to the selection of appropriate instructional strategies, adult learning principles help students succeed in the online environment. Malcolm Knowles described student characteristics necessary for adult learning: Experience, self-directedness, readiness to learn, autonomy, and intrinsic motivation (Knowles, 1973).

Lastly, Lev Vygotsky's theory of social constructivism helps create a learning environment that supports collaboration and connectivism (Vygotsky, 1978). Through individual cognitive processes and social interactions with others, the potential for learning is greater under social constructivism. Collaboration can support teamwork, problem-solving, and enhances the understanding of information over time. Connectivism can help students create meaning through the experiences and networks shared with each other (Schneider, n.d).

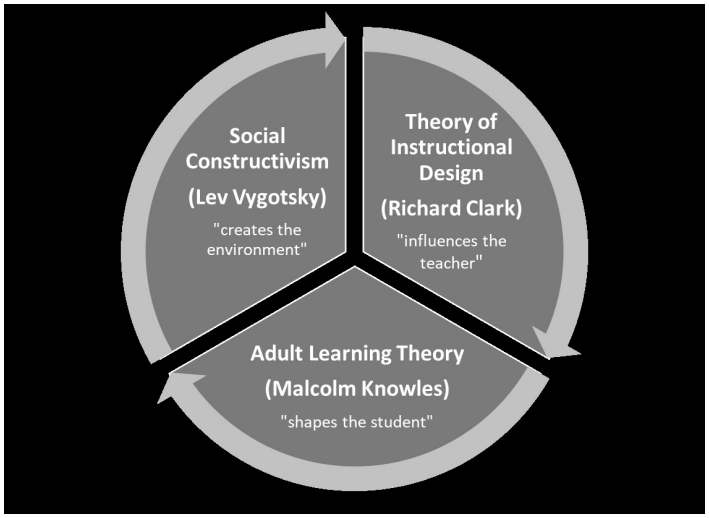

Figure 1. The relationship between the teacher, student, and environment in an online environment.

3. Methodology

The study used a mixed methodology that included both quantitative and qualitative design, as this was the deemed best approach to answer the primary research questions of the study. The researcher used a basic interpretive study in order to discover and understand best practices to teach "hands-on" orthopedic skills. Due to the nascent nature of teaching orthopedic "hands-on" skills in a physical therapy online environment, this approach best addressed an area in development within the profession. In addition, the research questions gathered information related to the resources used, methods of instruction, and faculty perceptions to determine recommendations for PT educators.

3.1 Instrument Development

The researcher developed the survey instrument and interview questions from the literature review and a previous co-authored pilot study. The survey consisted of 14 questions of three types: closed-ended, open-ended, and Likert questions. Questions requested the participants to identify the curricular format, program resources, instructional methods, and how faculty combined resources with instruction. The interviews consisted of 12 structured, yet open-ended questions related to the "how" and "what" of "hands-on" instruction in an online environment. The consensus among content experts (n = 3) established content validity and verified the questions acceptable for dissemination. A copy of the survey instrument and interview questions are in the Appendix.

3.2 Subjects

The researcher used purposeful sampling to select participants for the study. In order to capture an overall opinion from the physical therapy profession at large, the APTA's website provided a method to seek out PT education programs within the United States for the survey instrument. Collection of individual PT education program chairs' emails helped create a database of names and emails. Due to the lack of publication of individual orthopedic faculty member's contact information, email correspondences to PT education program chairs requested forwarding of the survey instrument to faculty assigned to teach orthopedic course content for completion. Authors from the literature and correspondence with peer colleagues from other institutions helped identify prospective candidates for the interviews. In addition, peer-reviewed sources (published literature, professional presentations, and faculty teaching in online PT education programs) helped identify subjects that use online instructional methods for the interviews. A minimum of one published research study or one national presentation on the topic of online teaching and learning in orthopedic PT practice qualified the individual to participate. In addition, faculty assigned to teach one or more courses related to orthopedic content qualified for the interviews. Because of the small sample size, the selection of interview participants depended upon faculty availability and willingness to participate.

3.3 Procedure

An emailed cover letter included a link to the survey and video from the researcher, which explained the purpose and implied consent procedures for participation. The survey launched using Survey Monkey (Survey Monkey Inc., Palto Alto, CA) September 2018, to PT education program chairs (n = 247) with a request to forward the survey to orthopedic PT faculty within their respective programs. In order to increase the response rate, a second email launched two weeks later in order to capture non-responders. The survey remained open for late responders until October 2018. An emailed cover letter helped recruit subjects for the interviews. The researcher selected GoToMeeting.com or Zoom.com and a digital handheld recorder to record the remote interviews. Interview subjects provided informed consent. Each interview ranged between 40 and 60 minutes in duration. The Institutional Review Boards at the University of Findlay and Hanover College approved the study.

3.4 Data Analysis

Microsoft Excel software (Microsoft Corporation, Redmond, VA) assisted in the descriptive statistical analysis and visual representation of data in the survey instrument. Chi-square analysis helped determine potential differences among the respondent's replies. Data analysis of the interviews used an integrative approach and an a-priori list developed from the pilot study. Following transcription of the interviews, MAXQDA software (VERBI software GmbH, Berlin, Germany) helped code and identify themes among the participants' narrative responses.

4. Analysis and Discussion

4.1 Results

Of the 247 email invitations sent, 72 faculty members (survey respondents) answered the survey (response rate = 29%).

Additionally, four faculty members (interview subjects) participated in the interviews. The majority (62.5%) of survey respondents reported a traditional "in-person" curricular format, while less than half (37.5%) used a blended format. The percentages of the orthopedic curriculum taught online varied from 0% of the content to as high as 76-99%. (See Figure 2). All interview subjects (n = 4) used blended instructional methods.

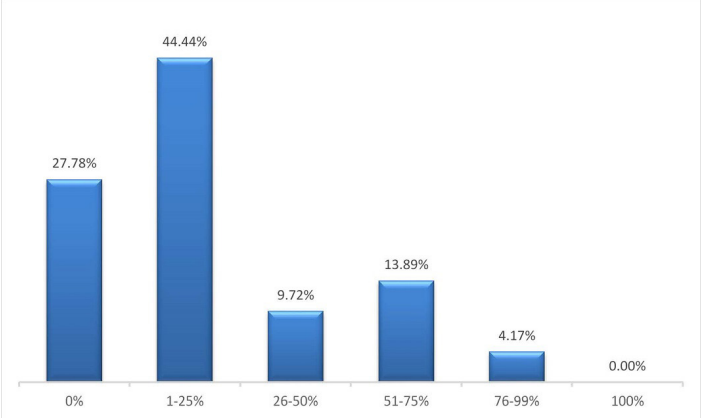

Figure 2. Percentage of the orthopedic curriculum taught by respondents in an online format.

4.2 Traditional and Online Resources

Textbooks were the most common traditional resource (80.5%, n = 72) used among the survey respondents and interview subjects (n = 4) followed reported lab manuals (75.0%), overhead video projectors (61.1%), smartboards (9.7%) and other resources (35.0%) such as apps, lab handouts, models, whiteboards, lectures, and live demonstrations (See Figure 3).

Figure 4 summarizes the most common online resources used in delivering orthopedic "hands-on" content. The most common online resource used was live or prerecorded videos (88.7%, n = 71) followed by the use of prerecorded lectures (63.4%), professional websites (36.7%), student interactive platforms (Quizlet, Kahoot, Poll Anywhere, 31.0%), discussion boards (20.0%) and podcasts (8.4%). Chi-square analysis revealed no statistically significant differences ($p<0.001$) among the traditional and online resources.

Videos were highly utilized to deliver orthopedic "hands-on" content, either live or pre-recorded, and helped augment course content for both faculty and students. Faculty created videos or used pre-fabricated online videos to teach orthopedic content, to serve as a student resource, and for assessment of students' skills. Table 1 illustrates survey respondents and interview subjects' reported use of pre-recorded video resources.

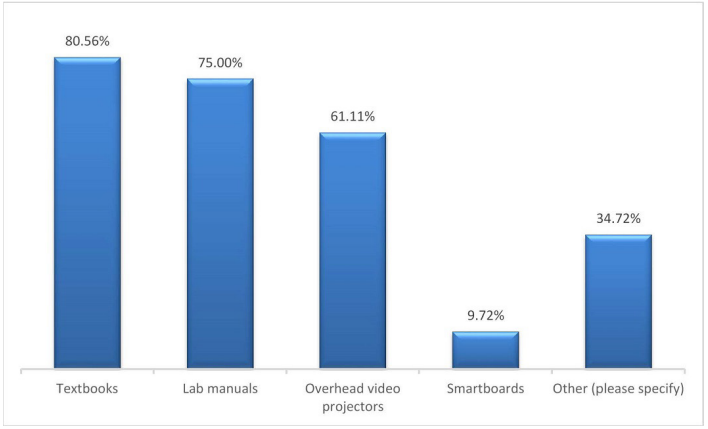

Figure 3. Traditional resources used by the respondents to deliver orthopedic "hands-on" content to respondents in an online format.

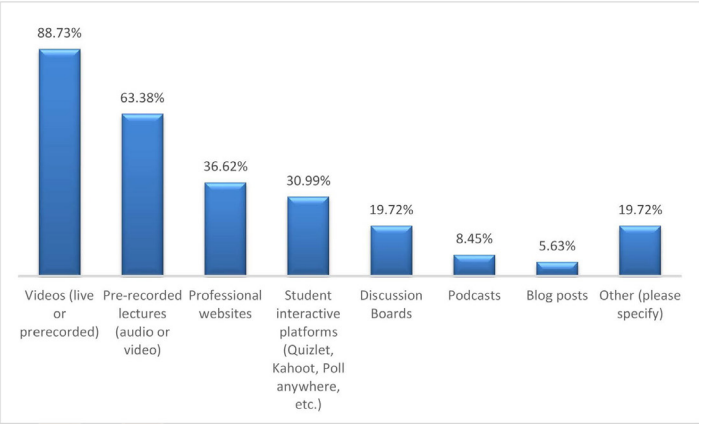

Figure 4. Common online resources used by respondents to deliver orthopedic "hands-on" content.

Table 1

Faculty's Use of Pre-recorded Video Resources

Instruction	"I record video demonstrations for students to practice, provide written instructions and pictures of how to perform skills, and provide web videos as examples for students to see a positive test or pathology." "I use videos to initially introduce 'hands-on' content and then have standard demonstration/practice in lab sessions."
Student Resources	"Videos were a helpful resource for students to go back to and review in the future."
Skills Assessment	"[Students] create their own videos, and then they post them into Canvas for me to view and…for their classmates to view. I give feedback in a very public forum so that they can learn from each other."

4.3 Instructional Methods

The majority of survey respondents (95.8%, n = 72) and interview subjects (n = 4) believed training of "hands-on" skills required F2F instruction. As one subject said, "We use demonstration and practice, as the students have to use their hands to do hands-on-skills." Another subject echoed with similar comments, with the use of F2F lab time for a demonstration of techniques, instructor feedback, and time for students to practice skills. In short, as one survey respondent stated, "Hands-on" means "hands-on." All lab activities are done in person." In addition to F2F instruction, videos (80.6%) and the flipped classroom (51.4%) were

other common methods used for "hands-on" instruction of orthopedic skills in order to prepare students for the lab. (See Figure 5). Less common were flipped classrooms (51.4%), voice-over PowerPoint lectures (14.0%), CD-ROMs (15.3%), and professionally (14.0%) or self-made (8.3%) podcasts. Chi-square analysis revealed no statistically significant differences ($p<0.001$) among the instructional methods.

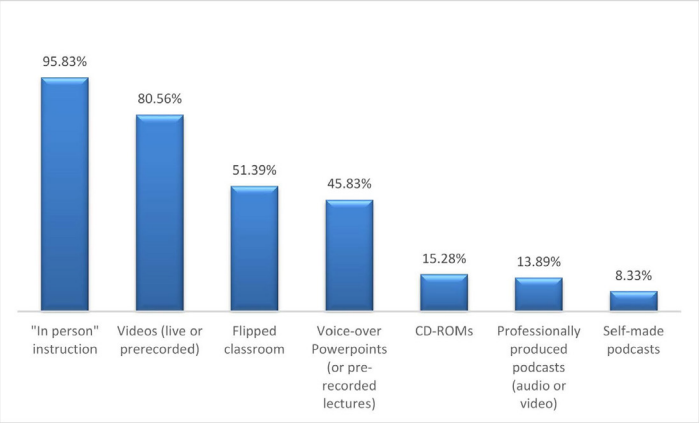

Figure 5. Respondants' reported common instructional methods used to teach orthopedic "hands-on" content.

4.4 How Faculty Combined Instructional Methods and Resources

Survey respondents and interview subjects reported the use of textbooks as valuable resources for instruction to provide background information, fill in educational gaps, or as a future reference. Pre-recorded lectures (20 minutes to 1-2 hours in length) viewed by students before the lab helped save time for "hands-on" practice. Video demonstration of orthopedic techniques was available for all students to view before F2F lab time. The use of formative low-stakes assessments prior to lab helped evaluate students' knowledge and skills. The approach to student feedback before F2F time varied. Some faculty provided feedback, while others did not. Faculty used online synchronous class sessions in different ways. A common use of online synchronous sessions was for weekly lectures, office hours, or for student questions.

Despite the varied pre-class activities among the interview subjects, the overall intent appeared to prepare students for F2F lab time for "hands-on" instruction. F2F lab time consisted of "hands-on" training. Faculty overwhelmingly agreed F2F lab time was an important element in the development of "hands-on" skills. Faculty found F2F time important for demonstration, facilitation of group discussion, and the opportunity for students to work through case scenarios with peers.

4.5 Traditional and Online Resource Selection and Use

In this study, textbooks were the most common traditional resource used by faculty. Textbooks offer the ability to review the course content, clarify information, and augment lecture and lab materials for students. In the literature, many studies report a similar value of textbooks in a blended environment (Boucher et al., 2013; Elmer et al., 2016; Gaida et al., 2016). Although the majority of survey respondents and interview subjects reported favorable use of textbooks, not all survey respondents felt this way. In some cases, perhaps faculty perceived online textbook resources as cumbersome or difficult to navigate. In addition, textbook use may look different in a blended environment due to disparities in students' learning preferences. Students can locate unknown information quickly on the Internet. Alternative resources such as phone apps, websites, or online videos may make it more desirable for students to access information. Faculty need to consider other options for future learners, which can teach students information literacy and critical appraisal of information obtained on the Internet.

The use of video resources in this study resonated with sources in the existing literature. Boucher et al. (2013) required students to view pre-recorded lectures before the lab. Moore and Smith (2012) created video podcasts for student acquisition of transfer and gait training skills. Thomas et al. (2011) used a computer program to help students identify anatomical structures. Van Duijn et al. (2014) created short video clips as a resource for students to learn cervical "hands-on" skills. Consequently, findings from this research and in the literature revealed an assortment of resources used in a variety of ways.

4.6 Current instructional methods

Instructional methods varied among faculty. By far, survey respondents favored traditional F2F instructional methods over online instructional methods to teach orthopedic "hands-on" skills. Within PT education, traditional instruction entails F2F instruction, demonstration, and practice. Other strategies used to teach and practice skills consist of case scenarios, role-plays, and peer practice within the confines of the classroom. Most faculty can relate to familiar instructional strategies due to past experiences as a student. Feedback consists of "in-person" constructive criticism and positive reinforcement. Due to the "hands-on" nature of a "hands-on" profession, safe practice is another important reason for F2F instruction. Interview subjects were more willing to experiment with online instructional methods if simple and efficient. Most faculty have access to a cell phone, video camera, or a tablet that can produce "homemade" videos. However, some faculty have less time available and require students to purchase website subscriptions with professionally produced videos at their disposal.

Adoption of videos to augment traditional instructional methods appear in the literature. Van Dujin et al. (2014) blended traditional and video instruction to teach special tests of the cervical spine. Adams (2013) used CD-ROMS in combination with a traditional lecture to teach modalities within a PT education program. Greenberger and Dispensa (2015) reported the use of videos to help teach orthopedic special tests, goniometry, manual muscle testing. While evidence supports the use of instructional videos in the literature, what does the literature reveal about student achievement?

As early as 2005, Ford et al. (2005) reported psychomotor skill

acquisition with the use of videos to learn musculoskeletal special tests exceeded that of textbook instruction. Studies compared to F2F instruction of orthopedic "hands-on" skills to the use of video instruction showed equal student performance and outcomes (Adams, 2013; Van Duijn et al., 2014; Cooper & Higgens, 2015; Moore & Smith, 2012). The flipped classroom was another reported instructional method used to teach orthopedic "hands-on" skills. Video instructional strategies may contribute to the flipped classroom student experience. In the current study, faculty reported the use of a flipped classroom for clinical reasoning skills, active learning culture, flexible environment, and support for the teacher as a learning resource.

4.7 Combining Instructional Methods and Resources

In addition to traditional F2F instruction, video instruction, and the flipped classroom approach, faculty used a combination of instructional methods and resources to deliver orthopedic course content. Combining multiple forms of media with instructional methods equated to the reports in the literature. Marques de Silva et al. (2012) reported the use of multiple resources (figure, videos, and graphic animations) along with interactive components (discussion boards, online tests, and links to other websites) as an effective strategy to teach bronchial hygiene to physical therapy students. Boucher et al. (2013) reported similar multiple strategies and resources (pre-class activities, in-class lab, and post-class assignments) in the flipped classroom approach.

Based on the literature and the findings of this research, faculty reported many ways to teach orthopedic "hands-on" skills in an online environment. Most faculty favored an eclectic approach, similar to the habits of PTs working in the profession at large. PTs in clinical practice teach patients with a variety of instructional strategies and resources to treat body function/structure, activity limitations, and participation restrictions. Teaching may include F2F demonstrations, recommendations for web-based educational programs, instructional home program videos, or a combination of resources based on the PTs' clinical experience. Therefore, the eclectic approach to patient care may translate into the academic environment. On the other hand, perhaps faculty enjoy the flexibility and autonomy to experiment, which enhances personal gratification in the teaching experience. Regardless of motivational factors, as technology continues to evolve, PTs will likely prefer a variety of instructional strategies and resources.

4.8 Recommended Best Practices

The synthesis of the survey responses and interviews created a tangible list of strategies, divided into pre-class activities and F2F instruction used to teach "hands-on" content. The findings suggest a blended instructional approach to teach orthopedic "hands-on" skills. In addition, the data suggested unique characteristics among faculty who taught "hands-on" skills in an online environment.

Pre-class activities with a variety of traditional and online resources helped prepare students for F2F lab time. Textbooks offered a preview of the course content and a student resource for future reference. Faculty delivered lecture content in various formats: Pre-recorded/posted online, in real-time through the use of synchronous sessions, or in a F2F classroom environment that ranged from 20 minutes to 2 hours. Videos were popular among survey respondents and interview subjects and used in a variety of ways. Some faculty used videos to introduce concepts and aid with instruction, while other faculty used videos to simulate the clinical environment. Others reported videos helped in the assessment of student skills, peer feedback, and self-reflection. Polling software and online cases helped promote active learning in an online environment. Formative assessments helped prepare students for "hands-on" lab time.

Both survey respondents and interview subjects strongly supported F2F instruction in the development of "hands-on" skills. Many faculty reported the necessity of practice with individualized feedback from the instructor. The F2F time allowed time to answer student questions and "apply" information rather than "show" techniques. Some faculty spent F2F time for a demonstration of "hands-on" skills while others used little F2F time for a demonstration. Instead, case scenarios and group discussions helped to promote deeper learning and application of pre-class information. F2F instruction helped develop clinical reasoning skills through fictitious patients or real-world examples from the faculty's clinical experiences. Figure 6 illustrates the recommended best practices of pre-class activities and F2F instructional strategies.

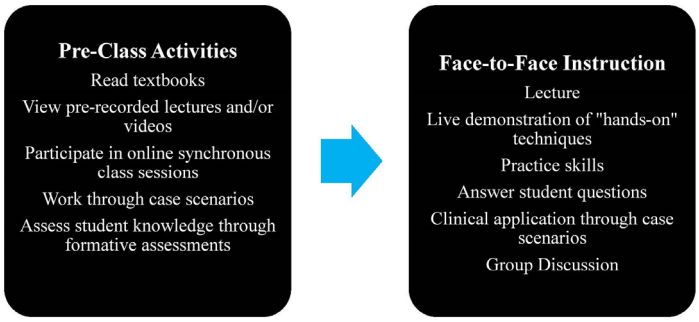

Figure 6. Recommended best practices to teach orthopedic "hands-on" skills.

In addition to the list of best practices, one unexpected finding of this research was the unique characteristics and underlying attitudes of the interview subjects and a small minority of survey respondents, which appeared to create a culture of flexibility, open-mindedness, and willingness to experiment. Faculty appeared open to experiment with trial and error, help from a mentor, or by the exploration of the literature.

5. Conclusions and Recommendations

5.1 Conclusions

Blended learning is an emerging concept in PT education. As supported by the theoretical frameworks of instructional

design (Clark, 1983), adult learning theory (Knowles, 1973), and social constructivism (Vygotsky, 1978), blended learning requires the involvement of the teacher, student ,and environment. The three elements of the theoretical framework are interdependent and must work together for a successful student educational experience.

A gap exists in the literature, which describes best practices used to teach orthopedic "hands-on" skills. The results of this study showed PT educators favored an eclectic approach to teach orthopedic "hands-on" skills. The flipped classroom was a popular method used to engage students. Videos used as an instructional strategy and resource had the potential to enhance the learning experience for both faculty and students. A blended learning approach is the recommended best practice to teach orthopedic "hands-on" skills based on current teaching practices. Faculty who taught in blended environments appeared to adapt an underlying culture of open-mindedness, willingness to experiment, and flexibility. This study serves as a baseline in today's instructional climate and will evolve as educators continue to seek novel approaches in the technological space within PT education.

Best practices reveal a combination of pre-class activities using traditional and online resources and F2F instructional methods as preferences of faculty assigned to teach orthopedic "hands-on" content. The list of best practices was similar to strategies found in the literature (Boucher et al, 2013; Greenberger & Dispensa, 2015; Van Duijn, 2014).

When conducting a blended PT course, educators may want to consider student readiness with online technologies. The use of a student readiness survey early in the curriculum can determine technological knowledge gaps that may require additional training or attention. If faculty need assistance in instructional design, training opportunities are available through organizations such as Quality Matters and The Online Learning Consortium. For help with video production, hosting a synchronous class session, or orientation to technologically enhanced resources, faculty can work closely with the institution's information technologists or teaching and learning specialists. Lastly, exercise patience when trialing blended teaching strategies. Faculty may want to consider changing one or two classes before blending an entire course.

One limitation of this study was the small sample size. Generalization of the results to the population of PT educators may not reflect the opinions of all faculty assigned to teach the orthopedic curriculum, nor represent a broad perspective within the profession. Future research in flipped classrooms and blended approaches can improve the student learning experience. Additional research that evaluates clinical performance skills and licensure passage rates can help advance best practices and proper allocation of resources.

As reported in this study, faculty members have the responsibility for the creation of an active learning environment in order to leverage the best of F2F instruction and online resources. Faculty expect students to participate in the learning process. Future graduate students will need to continue to balance personal responsibilities and will rely on technology to enhance their learning experiences. As technology continues to advance and shape the physical therapy profession, educators should maintain an entrepreneurial attitude towards life-long learning. Some of the best ideas may come from risk-takers and innovative thinkers in PT education.

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7. Appendix

Survey Instrument

1. **Which Learning Management System (LMS) do you use?**

☐Blackboard
☐Canvas
☐Desire to Learn
☐Moodle
☐Sakai
☐Other (please specify:_____)

2. **To what extent do you agree with the statement?**
"The LMS meets my needs to deliver orthopedic "hands-on" content".

☐Strongly agree
☐Agree
☐Neither Agree nor Disagree
☐Disagree
☐Strongly Disagree

3. **How would you describe the curriculum format used to deliver orthopedic "hands-on" course content?**

❑Traditional face-to-face Instruction
❑Complete Online Instruction
❑Blended Instruction (combination of in person and online instruction)
❑Other (please specify): ___

4. **What percentage of your orthopedic curriculum is taught in an online format?**

❑0% ❑1-25% ❑26-50% ❑51-75% ❑76-99% ❑100%

5. **Which of the following traditional resources do you use to deliver orthopedic "hands-on" content? Mark all that apply.**

❑Textbooks
❑Lab manuals
❑Overhead video projectors
❑Smartboards
❑Other (please specify): ___

6. **To what extent do you agree with the following statement?**
"Textbooks provide online teaching resources that are useful."

☐Strongly agree ☐Agree ☐Neither Agree nor Disagree ☐Disagree ☐Strongly Disagree

7. **Which of the following online resources do you use to deliver orthopedic "hands-on" content? Mark all that apply.**

❑Discussion boards
❑Blog Postings
❑Podcasts (audio or video)
❑Wikis
❑Pre-recorded lectures (audio or video)
❑Live Streaming Videos (YouTube or Vimeo)
❑Student Interactive Platforms (Quizlet Live, Kahoot, PollAnywhere, etc.)
❑Other (please specify): ___

8. **How do you use traditional and/or online resources to deliver "hands-on" content?**

Please elaborate: _____

9. **Which instructional method/s do you currently use to teach orthopedic "hands-on" content? Mark all that apply.**

❑CD-ROMs
❑Face-to-face instruction
❑Flipped classrooms
❑Websites
❑Self-made podcasts (audio or video)
❑Professionally produced podcasts (audio or video)
❑Live streaming videos (such as YouTube or Vimeo)

10. **If you use the Flipped Classroom to teach orthopedic "hands-on" content, why do you use this approach? Mark All That Apply.**

❑Promotes flexible learning environment
❑Establishes an active learning culture
❑Allows class time for clinical reasoning skills
❑Supports teacher as classroom resource
❑Promotes intentional teaching in person instruction verses student independent exploration
❑I do not use the Flipped Classroom approach

11. **What are the some of the new or emerging teaching techniques that you use to teach orthopedic "hands-on" content?**
Please elaborate:_____

12. **How did you acquire the skill set to deliver orthopedic "hands-on" skills in an online or blended format? Mark All That Apply.**

❑Self-taught Methods
❑Researched the Literature
❑Mentorship from Peer Colleagues
❑University Training
❑Continuing Education Courses
❑Other (please specify): ___

13. **What do you perceive as some of the benefits of teaching "hands-on" skills in an online environment? Mark All that Apply.**

❑Flexibility of learning (Time/Place)
❑Ability to review and repeat
❑Facilitates active learning
❑Increased student motivation
❑Increased student participation and preparedness
❑Increased communication between student and teacher
❑Deeper understanding of course content
❑Improved examination scores
❑Increased class time for application of concepts
❑Personalization of learning
❑Classroom space limitations
❑Increased student satisfaction
❑Increased teacher satisfaction
❑Other (please specify): _____

14. **What do you perceive as the challenges of teaching "hands-on" skills in an online environment? Mark All That Apply.**

❑Higher student workloads
❑Higher teacher workloads
❑Decreased student participation and preparedness
❑Student frustration with an active learning approach
❑Communication gaps between student and teacher
❑Decreased examination scores
❑Increased potential for cheating
❑Lack of release time for instructional preparation
❑Differences in student learning styles
❑Intellectual property or copyright issues
❑Lack of available technology
❑Lack of technology support
❑Other (please specify): _____

Interview Questions

1. Which Learning Management System do you use?
2. Does the Learning Management System meet or not meet your needs to deliver "hands-on" PT content? Why or why not?
3. How would you describe the curriculum format used to deliver course content (traditional, in person, blended)?
4. Which traditional resources do you use to deliver orthopedic "hands-on" content?
5. Which online resources do you use to deliver orthopedic "hands-on" content?
6. How do you combine traditional and online resources to distribute course content?
7. How do you currently teach orthopedic lab content (Videos, flipped classroom, websites)? Can you give me an example of one of your labs?
8. How did you acquire skills to deliver orthopedic lab content online?
9. How do you blend the use of online resources with your instructional methods to deliver "hands-on" content? Can you provide specific examples? (areas may include: palpation,
posture assessment, goniometry, manual muscle testing, repeated movement testing, muscle length tests, joint play/mobilizations, spinal manipulation, special tests)
10. Do you have any new/emerging instructional methods that you would like to share?
11. Which type of "hands-on" content do you choose not to put online? Why?
12. What do you perceive as some of the benefits and challenges in online teaching and learning? Why?