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The Development of a Computer-Assisted Learning Module in Physical Therapy Neurologic Education: A Mixed Methods Case Study

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ABSTRACT

Context: Computer-assisted learning (CAL) interventions have been used in contemporary allied health and medical education to supplement classroom instruction. Emphasis has shifted from tutorial activities to creating interventions that address higher level critical thinking skills. **Purpose:** The purpose of this mixed methods study was to investigate student perceptions of their critical thinking skills and overall impression of a CAL intervention. **Methods:** Videotape of patient treatment activities were embedded into a Microsoft PowerPoint™ presentation to guide students through the processes of evaluation and treatment to create a CAL module. Physical therapy students from two neighboring universities volunteered to participate. Students were randomly assigned to either Group 1 (CAL module) or Group 2 (video) and viewed their intervention following traditional lecture and lab activities. Students then completed Minute Papers and members of Group 1 participated in a Focus Group Discussion. Common threads and themes were generated by triangulating the numerical data from the Minute Papers with the written and verbal responses from the Minute Papers and Focus Group Discussion. **Results:** Significant differences were detected with the Mann Whitney U tests of the median Likert scores comparing the CAL module and video groups on the Minute Papers on four of seven items. The qualitative data generally revealed positive student perceptions related to the interventions, with the responses being more favorable towards the module than the video intervention. The majority of students felt that the interventions offered visual reinforcement, supplemented their learning experience, and further developed their clinical reasoning skills. **Conclusions:** Student response to the CAL module was more favorable than to the video alone. This instructional intervention warrants further investigation.

INTRODUCTION

The ultimate goal of teaching a physical therapy curriculum is to prepare students for their clinical experiences and practice as professionals. Physical therapy educators must provide students with opportunities to use pertinent information in reaching management decisions that reflect authentic clinical situations.[1] Evidence demonstrates that while neurologic expert physical therapists possess identical skills as entry-level physical therapists, they do so with high efficiency and proficiency, and have a preference for the systematic style of information processing. The ability to progress therapeutic intervention for patients is the result of the therapists' ability to synthesize past experiences with opportunities for observation of patterns and timing of clinical improvement.[2,3] This is known as critical thinking (CT). Critical thinking has been related to clinical decision-making and as a component of clinical reasoning in allied health education.[4] One operational definition of CT is "the ability to question logically, to identify, generate, and evaluate elements of logical arguments, to recognize and differentiate facts, illusions, assumptions, and hidden assumptions, and to distinguish the relevant from the irrelevant."[5]

Patients with neurologic impairments have variable and unique clinical presentations within diagnostic groups. Persons with stroke can differ with regard to cognition, physique, motor function, sensation, socioeconomic background, age, discharge environment, perceptual deficits, swallowing ability, speech, and medical history. All of these elements must be considered

comprehensively when establishing a plan of care. Like other areas of specialty within the profession of physical therapy, neurologic rehabilitation is not prescriptive as each treatment plan and set of goals is distinctly developed according to each patient's unique clinical presentation. Since the academic setting typically lacks access to a variety of authentic patients, educators are challenged with developing teaching methodologies that offer such experiences for students. Mock demonstration, paper problem cases, and use of video have been helpful. However, it had been contended that while students demonstrate competence in the area of content knowledge, they have difficulty developing clinical reasoning skills. Fell states that "For the physical therapy student and the novice therapist, progression appears to be a particularly challenging aspect of the ongoing development and refinement of an intervention plan of care."[2]

Computer-assisted learning (CAL) is defined as learning that supplements regular classroom activities with computer activities during or surrounding class time.[6] Of the educational goals related to CAL in health care education, enhancing critical thinking (CT) and problem-solving skills are among them.[7] Efforts to develop CAL programs that facilitate CT skills in medical education students have been emphasized in recent years. Computer assisted learning has been supported by the medical community as a method of providing alternate means of education.[8-10] Movement towards CAL occurred in response to curriculum reform in medical schools towards problem-based learning (PBL) models, not only in the United States, but also abroad. According to Barrows and Tamblyn, the basic outline of the PBL process is for the student to encounter the problem first, problem-solve with clinical reasoning skills and identify learning needs in an interactive process.[11] Students must then independently search for necessary information, apply it to the problem, and summarize what has been learned. Compared to lecture and discussion, PBL fosters activation of prior learning, high motivation to learn, and the development of self-directed learning skills. In the health sciences, it also promotes the structuring of new, accessible knowledge in clinical context and the development of effective clinical reasoning skills.[7,12] Computer assisted learning offers the ability to combine the principles embedded in traditional and problem-based learning to promote student learning to a greater degree. Computer assisted learning can also be designed so that students work independently to facilitate PBL. Contemporary CAL programs used in medical education simulate patient scenarios either with text or by creating a virtual patient, use live video streaming, and provide opportunities for patient assessment.[8-10]

In physical therapy education, much of the early use of CAL reported in the late 1980s was related to teaching human anatomy as cost of human cadavers and their storage was expensive.[13,14] The most common use of CAL was tutorial CD-ROMs. Students were given the option of using these CD-ROMs to supplement traditional classroom instruction. When considering the effectiveness of CAL, there is consensus among CAL studies in physical therapy education that CAL was equivalent to traditional lecture, though the sample sizes of most of the studies were relatively small.[15-19] Prohibiting factors to use of CAL include lack of time and institutional support and technologic difficulties.[6,20,21] As the interest in CAL and ease of use expanded and improved over the years, more contemporary studies have included application for gait analysis, nutrition, orthopedic and musculoskeletal evaluation instruction, pediatric standardized evaluative scoring, and scientific writing.[22-28] Again, content knowledge comparing CAL and traditional teaching methodologies was determined to be comparable.

Medical education research has been heavily concentrated on skills and competency assessment, and suggests that attention should rather be devoted to the development of clinical reasoning skills.[29,30] Ford et al. affirms that use of CAL as an alternate or adjunct to traditional methodologies could improve the efficiency and effectiveness of education future physical therapists. He states that future study should incorporate various student learning styles and expand to include higher order thought processing.[26] Likewise, the study of CAL application and the acquisition of psychomotor skills among students and the relationship to teaching methodologies is a relatively new area of research in health care education.[25,31] In physical therapy, "the academic environment must provide students with opportunities to learn...of major importance is emphasis on CT, ethical practice, and provision of culturally competent service to meet the changing needs of society."[32] One study concluded that CAL interventions can support small collaborative student groups and enhance CT skills without taxing faculty.[33] However, work in the area of CAL and CT remains largely under-researched, especially in the field of physical therapy education.[26]

This case study was designed to investigate the impact of a novel CAL module on physical therapy students' attitudes about their CT in an adult neurologic rehabilitation course. The intent of the module was to supplement classroom teaching, by creating a "virtual" clinical experience using the Internet. Specific questions this case study was designed to answer included (1) To what extent do students perceive that their clinical reasoning skills, as described by Barrows and Tamblyn, change following the use of a CAL module/video intervention?[11] (2) To what extent do students perceive that the CAL module/video interventions contribute to their learning? and (3) To what extent did the module/video help students to visualize the syndrome differently than lecture and lab alone?

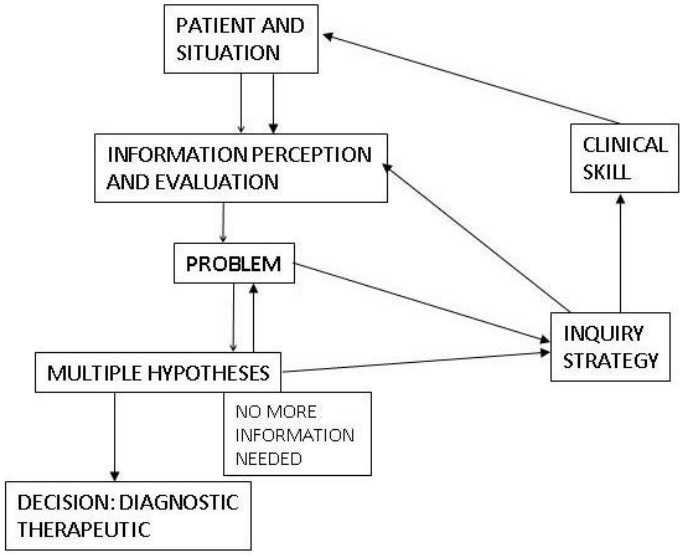
METHODS

Development of the CAL Module

Bloom and his colleagues published a Taxonomy of Educational Objectives in the cognitive domain.[34] The taxonomy is designed to be a classification of the student behaviors which represent the intended outcomes of the educational process and consists of a six-tiered pyramid. The lower levels of the pyramid include knowledge, comprehension and application. The upper levels of the pyramid include analysis, synthesis and evaluation and build upon the lower levels.[35] Knowledge is the lowest level of intellectual ability and involves memorization. The uppermost level, evaluation, involves making decisions and having the ability to support views, which requires an understating of values. Spiro and Jehng identified six classifications of computer-assisted instruction (CAI) available for educational purposes.[36] *Drill and Practice* instructional programs simply assist with previous learning through repetition. *Tutorials* are designed to introduce unfamiliar subject matter. These first two CAI types address Bloom's taxonomy levels of knowledge and comprehension. *Instructional Games* present material in a competitive, entertaining manner. *Simulations* require students to apply acquired knowledge to a novel situation, equivalent to Bloom's level of analysis. *Problem-solving* software calls for students to utilize high level cognitive abilities to analyze, problem-solve, and implement a solution. A *Discovery-environment* is one where students are given a high level of freedom in determining the specific information presented.[36]

Contraversive pushing syndrome (CPS), the CAL module topic, is a perceptual deficit related to stroke, characterized by patients actively pushing towards their affected side. Consent to videotape patient treatment sessions of patients with CPS was obtained. The 30 to 90 second video clips were edited and embedded in a Microsoft PowerPoint™ presentation to create the CAL module. The types of questions developed to accompany each video clip were related the various levels of Bloom's taxonomy; some asked students to regurgitate content while others required students to utilize clinical decision-making skills. Therefore, the purpose of the module is to guide students through the process of evaluation and selection of appropriate treatment techniques by having students answer questions about the patient-therapist interactions they viewed. The module attempts to promote CT and clinical reasoning in students, utilizing their prior knowledge coupled with the current patient scenario. In other words, the CAL module facilitates the student's ability to apply classroom knowledge to the clinical setting. The conceptual framework guiding the development of the CAL module and data collection materials was Barrows and Tamblyns' Model of the Clinical Reasoning Process (Figure 1).[11]

Figure 1. When the clinician has obtained sufficient information to establish his hypothesis or probable hypotheses, he closes the process and makes a diagnostic and management decision.

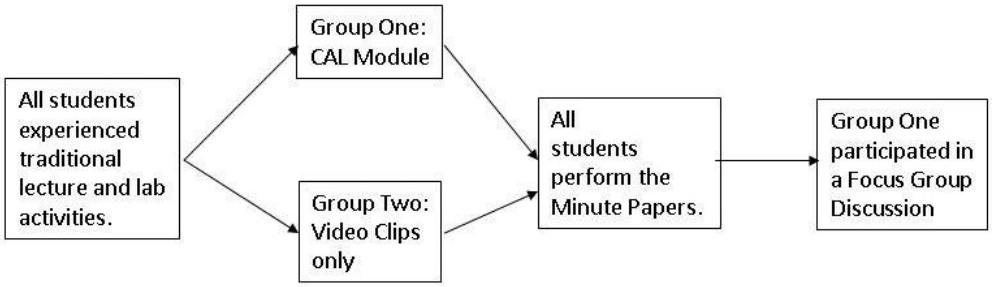


Sample

Convenience sampling of physical therapy students from two neighboring, mid-sized, and accredited universities was used to recruit participants. Consent was obtained from the Human Subjects Committees at both universities, with participation being voluntary. The 37 participants were randomly assigned to one of two groups. Since the sample size was small, blocked

randomization using grade point average (GPA) as a reference was used. Pairs of students were matched by GPA, and then randomly assigned to one of the groups to ensure that the GPA of Groups One and Two were identical. Group One (n=19) experienced the CAL module and Group Two (n=18) only viewed the video clips. The interventions were administered following the traditional lecture-lab teaching segment for CPS. The same faculty member taught the content at both universities to ensure continuity of instruction. Group Two was given access to the module after data collection, to avoid the ethical dilemma of withholding potentially beneficial educational resources.

Figure 2. This case study was a quasi-experimental design using two-group post-test design only.



Data Collection Procedures

Cross used the classroom to obtain student feedback on learning during the learning process.[37] Minute Papers is a technique first introduced by a physics professor at the University of California, Berkeley, and later revised by a Harvard statistics professor. He would ask the class to write the answers to the following questions: "(a) what was the most important thing you learned today and (b) what questions remain uppermost in your mind as we conclude this session."[37] Minute Papers were used in this study because of administrative ease to obtain feedback about the students' impressions of the interventions. Two different but content-similar Minute Papers were developed corresponding with each intervention. A Likert-type scale was assigned to each question along with an opportunity to free text. A score of one was associated with a "no assistance" response, and a score of five was associated with a "high level of assistance" response. Questions for the Minute Papers were developed using Barrows and Tamblyns' Clinical Reasoning Model, previous literature, and corroboration of another faculty member.[33] Topics included understanding and visualizing CPS, and perceptions of clinical reasoning skills. Because of the Likert-scale, the Minute Paper surveys were dual-purposed, generating both quantitative and qualitative data.

A focus group discussion was conducted at each university with the intent of enhancing the richness of the Minute Papers. "The focus group interview works because it taps into human tendencies. Attitudes and perceptions relating to products, services, or programs are developed in part by interaction with other people."[38] The script for discussions was developed using Barrows and Tamblyns' Clinical Reasoning Model, the CAL module itself, and corroboration of another faculty member.[33] Content included questions about specific slides within the module and student opinions about the module. The module was displayed during the discussions so that students could refer to it. Paper and pencil prompts, verbal cueing, and active listening were techniques the focus group administrators used to facilitate student responses, while audio taping ensured accurate data collection. Focus group transcriptions were completed by the author. Recurrent threads within the transcriptions were documented and themes were generated.

The Minute Papers provided descriptive, ordinal data. Frequency lists, cross tabs, and percentages were generated from this information. Raw data was categorized by similarity of statements and converted into descriptive statements. From these statements, interpretative themes were generated. This process is systematic and verifiable. A systematic process follows a prescribed, sequential process. A verifiable process is one that can be reproduced by another researcher.[38] Information from the quantitative and qualitative segments of the Minute Papers and focus group discussions was triangulated. Triangulation refers to a process whereby concepts are confirmed using more than one source of data.[39] This process provides clarification of the data through collaboration of various sources. Because the Minute Papers contained seven Likert scale items, Mann Whitney U tests were used to analyze the differences between the video and CAL module groups. This test is a nonparametric equivalent to the parametric t-test for independent samples. Because the groups were not representative of the population and were unequal, combined with the fact that nominal and ordinal data was collected, nonparametric comparison was indicated.[39]

RESULTS

RQ1: To what extent do students' perceive that their clinical reasoning skills change following a CAL module/video intervention, as indicated by demonstrating the distinct behaviors of the critical reasoning process described by Barrows and Tamblyn?[11]

RQ1a: To what extent do students perceive that they demonstrate information perception and interpretation following the intervention?

The majority of video students (n = 10, 56%) scored a three and most of the module students (n = 12, 63%) scored a four. A Mann Whitney test of the median responses for both groups yielded a U value of 84.50 and a significance value of $p < .01$ (Table 1). A number of module (n = 10, 53%) and video students (n = 5, 28%) commented that the intervention provided visual reinforcement. One video student stated, "I was able to determine what level of assistance the patient needed for each activity and where they were on the recovery continuum." Another 22% of students (n = 8) felt that they needed more information. The module focus groups were relatively small (n=3, n=4). In the module focus group discussions, one question asked "How did you know that he was aphasic and not apraxic?" A student stated "He was able to understand what the physical therapist was saying and realign himself when the physical therapist prompted him to."

Table 1. Numerical Responses to Question 1a*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	0	4	**10**	3	1	18	14.19
Module	0	0	6	**12**	1	19	23.55
Total	0	4	**16**	**15**	2	37	

* Did the use of this module/video help you to gather information about the patient simply by viewing him?

RQ1.b: To what extent do students perceive that they demonstrate hypothesis generation following the intervention?

The majority of video students (n = 8, 44%) scored a three and most of the module students (n = 13, 68%) scored a four. A Mann Whitney test of the median responses for both groups yielded a U value of 68.50 and a significance value of $p < .001$ (Table 2). Most students did not comment directly about their ability to develop impressions about the patients but rather commented that the intervention was helpful. A few statements made were related to the helpfulness of visual reinforcement, and the need for further clarification. In the module focus group discussion, the students correctly identified safety issues and expected outcomes.

Table 2. Numerical Responses to Question 1b*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	0	5	**8**	5	0	18	13.31
Module	0	0	4	**13**	2	19	24.39
Total	0	5	**12**	**18**	2	37	

* Did the use of this module/video help you to begin to develop impressions about the patient?

RQ1.c: To what extent do students perceive that they demonstrate inquiry strategy and clinical skills following the intervention?

The video group responses (n = 17, 94%) were near-equally distributed over the scores of two, three, and four. Responses (n = 17, 89%) from the module group were mostly scored with a three or four. A Mann Whitney test of the median responses for both groups was not significant ($U = 117.00$, $p > .05$) (Table 3). A number of module (n = 11, 58%) and video students (n = 9, 50%) stated that they were better able to identify other possible perceptual deficits and physical impairments after viewing the patient. One module student correctly stated, "I saw neglect and inattention issues, some strength deficits, and a decrease in active range of motion." Another group of module students (n = 6, 32%) commented that the visual reinforcement helped with their learning. A small group of video students (n = 3, 17%) stated that they were not yet ready to use clinical reasoning skills. In the module focus group discussion, the students were able to differentially diagnose the presence of hemi-neglect from two other perceptual deficits.

Table 3. Numerical Responses to Question 1c*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	0	**5**	**6**	**6**	1	18	16.00
Module	0	0	**8**	**9**	2	19	21.84
Total	0	5	**14**	**15**	3	37	

* Did the use of this module/video help you to begin to think about other impairments you would assess?

RQ1.d: To what extent do students perceive that they demonstrate problem formulation following the intervention?

Most of the students (n = 28) from both groups scored the question with a three or four (video = 14, module = 14). A Mann Whitney test of the median responses for both groups was not significant (U. = 166.50, p > .05) (Table 4). A group of video (n = 9, 50%) and module students (n = 7, 36%) stated that they were better able to prioritize treatment strategies after viewing the patient. One module participant commented, "Treatment progression is confusing with this patient population, so it was nice to see how it is progressed in an actual clinic." An additional group of module students (n = 8, 43%) stated that while they had some idea related to prioritizing patient treatment, they were not yet confident with their response. A few comments stated that the intervention was helpful, with others requesting more information. In the module focus group discussions, students were able to accurately respond to treatment of the hemiplegic arm, identify appropriate treatment positions for the patient, and verbalize why traditional tactile cues would be unsuccessful with this patient population. Students were also able to provide rationale for treatment activities for patients at different functional mobility levels.

Table 4. Numerical Responses to Question 1d*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	1	2	**6**	**8**	1	18	18.75
Module	0	2	**9**	**5**	3	19	19.24
Total	1	4	**15**	**13**	4	37	

* Did the use of this module/video help you to prioritize treatment activities with these patients?

R Q 1.e: To what extent do students perceive that they demonstrate diagnostic and/or therapeutic decisions (closure) following the intervention?

The video student (n = 16, 89%) responses were uniformly distributed across the scores of two, three and four. The majority of responses of the module group (n = 11, 58%) were scored a four. A Mann Whitney test of the median responses for both groups was not significant (U = 152.00, p > .05) (Table 5). Comments related to this question were varied and more difficult to interpret, as students did not directly comment about their clinical reasoning skills. A number of module (n = 11, 58%) and video students (n = 6, 33%) commented about long-term outcomes. Additional comments addressed short-term outcomes, requested past medical history, treatment interventions, and stated that they (the students) had some thoughts related to patient outcome, but were not confident with their response. During the module Focus Group discussions, students were able to identify a reasonable functional discharge status.

Table 5. Numerical Responses to Question 1e*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	0	**5**	**4**	**7**	2	18	17.94
Module	0	3	4	**11**	1	19	20.00
Total	0	8	8	**18**	3	37	

* Did the use of this module/video help you to think about the patient outcome following an inpatient rehab stay?

RQ 2: To what extent do students perceive that the interventions (module or video) contribute to their learning of the content?

Most of the video students (n=10, 56%) scored a two, while most of the module students (n=11, 58%) scored a four (Table 6). One module participant stated, "Seeing a clinical example followed by questions and other scenarios gives a few ways to retain information." A Mann Whitney test of the median responses for both groups yielded a U value of 65.00 and a significance value of p <.001. A number of module (n=15, 79%) and video students (n=5, 28%) commented that visual reinforcement helped them

to better understand the syndrome. The students stated that being able to witness the amount of cuing provided by the physical therapist influenced their perceptions of the patient's level of function and response to treatment.

Table 6. Numerical Responses to Question 2*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	0	**10**	4	4	0	18	13.11
Module	0	1	5	**11**	2	19	24.58
Total	0	11	9	**15**	2	37	

* To what extent do students perceive that the interventions (module or video) contribute to their learning of the content?

RQ 3: To what extent did the module/video help you to visualize this syndrome differently than lecture and lab alone?

The video students were near-equally distributed over the scores of two, three, four, and five. The majority of module students (n = 13, 68%) scored a five in response to this question. A Mann Whitney test of the median responses for both groups yielded a U value of 67.00 and a significance value of $p < .005$ (Table 7). The majority of module (n = 13, 68%) and video students (n = 9, 50%) stated that the visual reinforcement was helpful to their understanding. A module participant stated, "I need to be able to see a patient in order to piece everything we learn together. Sometimes it's not enough to only have lecture and lab." Another module participant stated, "All syndromes and diseases we learn in class should have a video and show how a physical therapist treats the patient. It would be much more helpful than lecture and lab alone. This will be a great tool to help students refer back to after lecture and lab to confirm ideas if it were posted on Blackboard© and then discussed before an exam." When commenting about the difference between experiencing the CAL module and watching a video, focus group participants stated, "I think it (the module) makes you think about it more . . . it makes you pay close attention to the details . . . Some of the questions that came up within the module helped to prompt thinking about what you were watching." Students thought that CAL modules developed for other aspects of neurological rehabilitation would be helpful and that the application of this teaching methodology could be applicable to other content areas in the curriculum.

Table 7. Numerical Responses to Question 3*

	No Assist				High Assist	N	Median
	1	2	3	4	5		
Video	1	4	3	4	3	15	12.47
Module	0	0	5	1	**13**	19	21.47
Total	1	4	8	5	**16**	34	

* To what extent did the module/video help you to visualize this syndrome differently than lecture and lab alone?

DISCUSSION

The results of this mixed methods study indicate that participants were more favorable of the CAL module compared to the video intervention, with significant differences noted with the Mann Whitney U tests of the median Likert scores comparing the Minute Paper responses on four of seven questions. To summarize the written responses, the majority of students felt that the interventions offered visual reinforcement, supplemented their learning experience, helped them to predict the long term outcomes for the patients, and further developed their clinical reasoning skills. While the types of comments were similar between Group 1 (module) and 2 (video), Group 1 commented twice as much as Group 2. Both groups appreciated the video of authentic patient treatment sessions.

Seventy-nine percent of the module and only 28% of the video group commented that the visual reinforcement from the intervention was helpful to their understanding of the perceptual deficit of contraversive pushing syndrome. Some students stated that the questions within the CAL module further enhanced the learning experience, since they were asked to reflect upon what they viewed. Literature in physical therapy education supports the practice of reflection. "Reflective activities can be used to help bridge theory with practice. Reflection allows time for analyzing, synthesizing, and integrating complex information and examining alternative strategies and their consequences."[40] The CAL module was created to promote more active learning as the student interacts with the questions within the Microsoft PowerPoint™ presentation. Findings from this study were consistent with those reported by Sellheim: "A majority of student respondents talked about how deep learning processes are promoted when they can apply what they are learning to real patients."[41]

While students in both groups recognized repetition within the intervention, the majority of students perceived this as helpful. This finding is consistent with previous investigations related to CAL in physical therapy education.[15,17-19,42] Students in this study

stated that they appreciated having the opportunity to watch the patient-therapist interaction. Opportunities for educators to allow students to witness patient-therapist interactions serve several purposes. Students can better perceive how a patient with a particular impairment will present. The observation would serve as a learning tool to improve hands-on skills of students as they watched the physical therapist perform evaluation and treatment techniques with a patient. In addition, literature support this interaction as modeling professional behavior.[1,12,43-46] The video clips of patient-therapist interaction also provide students with a reference for actual treatment time devoted to a particular activity and the intensity and variety of cueing provided by the therapist. Since the CAL module in this case study contains actual patient treatment sessions, the module essentially "brings the clinic to the classroom." Conventional video of patients is invaluable, but is essentially a passive activity. Because students interact with the video in the CAL module through the PowerPoint presentation, the activity now becomes dynamic. Schittek-Janda et al. (2004) used the virtual patient to "reflect a real scenario as much as possible and to put the student in the role of the professional."[10] The results demonstrated that students who experienced the virtual patients performed a more complete history interview and had more empathy for the patients. Other literature states that use of CAL in allied health education provides a safe environment for students to practice patient care activities.[47, 48]

Actual gains in content knowledge should be assessed quantitatively and psychomotor skills could be evaluated through practical examinations.[26] While this study investigated student perceptions of the development of their clinical reasoning skills related to the CAL intervention, more objective data beyond the student self-reports presented in this study is desirable. However, previous studies have been unsuccessful with measuring significant change using standardized tests of the California Critical Thinking Disposition Inventory, the California Critical Thinking Skills Test of the Watson-Glaser Critical Thinking Appraisal. It has been suggested that perhaps these tools are not sensitive enough for physical therapy assessments, or that their application needs to reflect learning over a longer period of time.[4,49,50] The development of critical thinking skill/clinical reasoning skills is an important goal for professional physical therapy education, even though meaningful measurement of change during the educational process remains difficult.[4] Further investigations related to the development and measurement of critical thinking skills in physical therapy students in clearly warranted.

Lastly, the instructional power of the CAL module may be further enhanced by increasing the number of modules within a course. It would be ideal for each content segment to have a corresponding CAL module to supplement classroom teaching. The CAL modules could include the answers to the text questions within the Microsoft PowerPoint™ presentation and be posted on Backboard© for students to use independently outside of class. Students would then be free to view the modules as often as they would like in preparation for written and practical examinations.

Implications for future research to include study by faculty of their own classrooms were discussed by Sellheim in an article addressing educational factors influencing physical therapy students' approaches to learning.[41] While many faculty members intuitively perform a less rigorous action, more formal investigation is needed to investigate specific teaching methodologies. Action research is a process of systematic inquiry of one's own classroom. "Its purpose is to provide educational practitioners with new knowledge and understanding enabling them to improve education practices or resolve significant problems in classrooms and schools."[51] The process utilizes traditional research methodology in a cyclical, oftentimes collaborative, manner.

Limitations

Limitations of the study include a small sample size, convenience sampling, researcher bias, and outcome measures, as all of the measures were created for this study because of the specificity of the content. Conducting a similar study at a university unfamiliar to the researcher would better control for bias. Students in this study thought favorably of the researcher as an instructor as evidenced by course evaluations. This may have influenced the responses on the Minute Papers and focus group discussions.

CONCLUSIONS

Students appreciated the CAL module in this project and suggested that similar modules be developed and applied to other facets of physical therapy education. Research investigating the development of clinical reasoning skills should continue to investigate the use of CAL in physical therapy education. With the expansion of physical therapy education programs to the doctoral degree level, an introspective look at instruction is warranted as it is imperative that educators continue to develop innovative teaching methodologies to promote student CT skills and sustain interest and enthusiasm for academic as well as life-long learning.

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KEYWORDS
Computer-assisted learning, physical therapy education, critical thinking

APPENDIX A
Minute Papers for the CAL Module Group (Group 1)

1. **Did the use of this module help you to:**

a. **gather information about the patient simply by viewing him?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

b. **begin to develop impressions about the patient?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

c). **begin to think about other impairments you would assess?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

d). **prioritize treatment activities with these patients?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

e). **think about the patient outcome following an inpatient rehab stay?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

2. **To what extent do you feel that this module helped you understand pusher syndrome?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

3. **To what extent did this module helped you visualize this syndrome better than lecture and lab alone:**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

APPENDIX B
Minute Papers for the Video Group (Group 2)

1. **Did the use of the video help you to:**

a. **gather information about the patient simply by viewing him?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

b. **begin to develop impressions about the patient?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

c). **begin to think about other impairments you would assess?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

d). **prioritize treatment activities with these patients?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

e). **think about the patient outcome following an inpatient rehab stay?**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

2. **To what extent do you feel that the video helped you understand pusher syndrome?**

1----------2---------3---------4---------5
No assistance High level of assistance

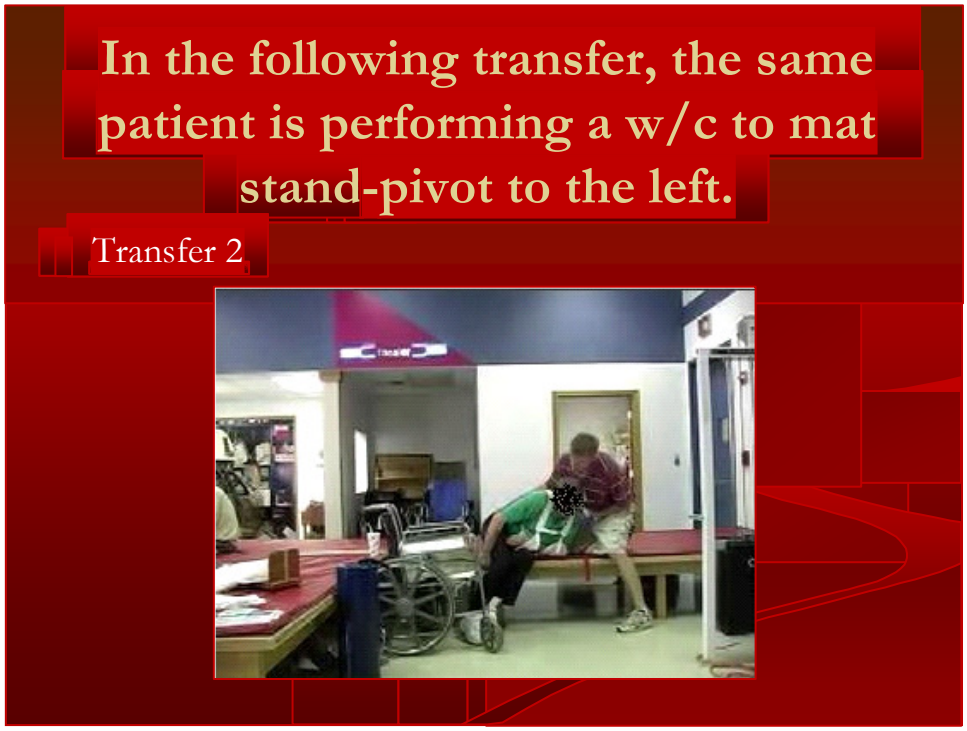
Briefly explain your response:

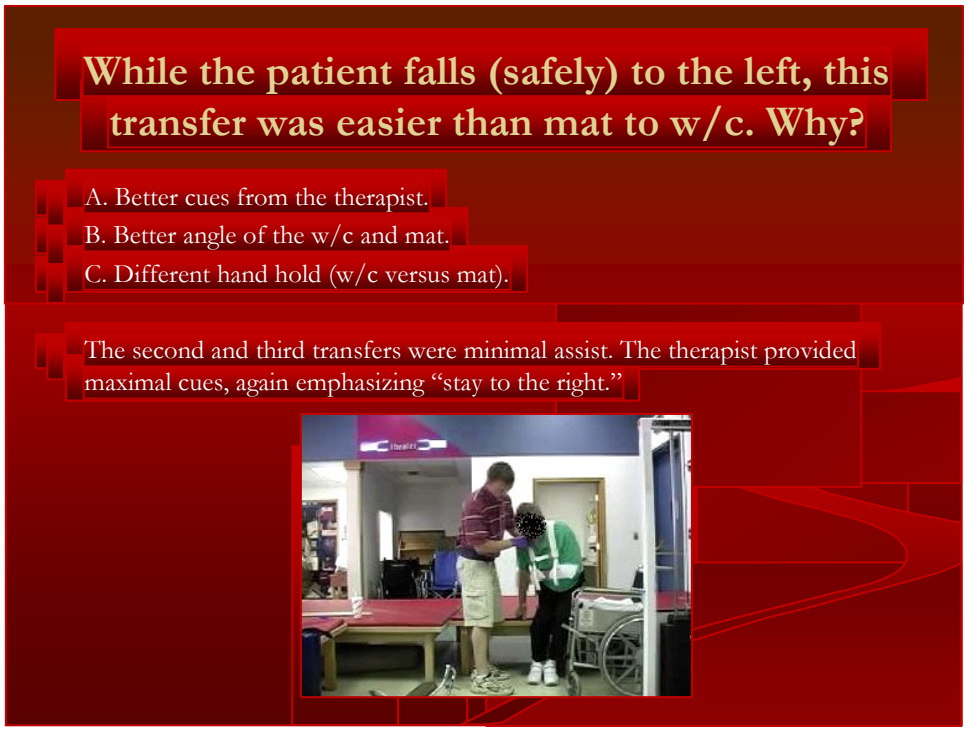
3. **To what extent did the video helped you visualize this syndrome better than lecture and lab alone:**

1----------2---------3---------4---------5
No assistance High level of assistance

Briefly explain your response:

APPENDIX C
CAL Module Video Clip Snapshot






View the video of this patient ambulating. The therapist assists by advancing the (L)LE and stabilizing the knee during stance.
View clip: Gait Trial