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A SPORTS INJURY CASE STUDY MODEL : CAPITALIZING ON VIRTUAL REALITY TECHNOLOGY

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ABSTRACT :Virtual reality anatomical models were created to support an online case study approach to sports injury diagnosis and treatment in an undergraduate kinesiology program . A sample of college student was assigned a case study of an ankle injury . The online case included ®bject 2VR models to support the investigation. Mixed method research established that while the case study was designed to supplement classroom experiences, students preferred to engage the case with selective scaffolding from the instructor. This has led to a refined instructional strategy based on student feedback. The virtual reality models were found to be particularly effective for anytime – any place access to solving the case.

KEY WORDS :Sports injury, case study, technology, teaching model

INTRODUCTION

The following research accesses quantitative and qualitative empirical materials to examine the impact of a new technology on the nature of learning within a small sample of students taking a face-to-face sports injury course in a Bachelor of Kinesiology program at a liberal arts university. More specifically, the software Object2VR® was used to create interactive 3dimensional online versions of anatomical models. These models were incorporated as a supplemental resource in an online case study regarding an ankle injury in track and field. The aim of the action research[1] study was to elicit student feedback on how to best incorporate the technology in a meaningful case study exercise. It is important to note that the study was not designed to compare courses with and without the technology much less establish "a better way to do case studies". With a sample of 14 undergraduate students it is understood that the results are limited to a very

specific context. As such the inherent value is in the reader's generalizability to similar settings and more importantly the classification of trends in students' response to emerging technology-enhanced teaching and learning models.

The study was undertaken by an educational researcher working with a Kinesiology professor in his classroom. The rationale for the study was two-fold. In the first instance, the course instructor was attempting to provide a venue for students to practice diagnoses and the development of sports injury treatment plans based on case studies. The intention is that these case studies be attempted outside of the regular face-to-face meetings and therefore supplement the lecture activities. The digital technology in the form of 3d online models makes it possible for students to examine in detail vascular, muscular and skeletal systems anytime-any place.

Using this first study as a foundation and feedback mechanism, a second aim of the work is to build a digital database of Object2VR® anatomical models (with cases studies) and place them online such that developing countries (who are lacking anatomical models) have access to a very specific resource for their teaching. At this time, a partnership with University of Technology Jamaica and their Sports Science program has been spawned for future trials and research on implementation in their context.

1. Case Studies in Higher Education

The effectiveness of case-based learning[2] is founded up on at least three primary notions, notably 1) John Dewey's claim[3] that "we only think when confronted with a problem", 2) that situating learning in meaningful contexts dramatically improves educational impact[4] and finally 3) that cognitive flexibility theory[5] would suggest that using different approaches to ill-structured problems (e.g. lectures, case studies in class versus online) helps students to be flexible in their application of learned approaches.

The case study or the "case approach" essentially supplies students with an authentic scenario, supporting information and an open-ended problem to solve. Typically the problem can allow for multiple solutions. Case studies often serve to integrate assimilated process skills and content knowledge. The approach, which originated in law school education in the late 1800's[6] has since been used successfully in professional schools including business education, medical education and teacher education[7,8,9]. Proponents posit the potential for case studies to: improve critical thinking, encourage growth in judgment, practice evidence-based analysis and advance motivation to learn through integration of theory and practice.

Given the promising history of educational use of case studies, it is not surprising that the instructor would use case studies as one approach to teaching sports therapy students how to diagnose and recommend treatment for injured athletes.

2. Context of the Study

The study was undertaken at a primarily undergraduate liberal arts university of approximately 3000 students and 225 faculty. As the first Canadian laptop university, this particular institution has extensively explored the potential for technology to empower education[10]. All classrooms are fully equipped with multimedia presentation hardware and internet access. Students and instructors routinely use laptop computers in classroom activities.

The action research took place in an undergraduate kinesiology course on sports therapy. The sample included 14 students total (4 males, 10 females), 12 being in the 3rd year and 2 in the 4th year of their 4 year Bachelor of Kinesiology program.

The ankle injury case study (Figure 1) was designed for the web around a template which included a scenario (a 21 year old high jumper rolls her ankle; complete with timeframe photos), interactive 3-d anatomical models (Figure 2), an information section (patient history with probing questions, orthopedic assessment, observations), the problem (Figure 3) to be solved and proposed treatment plans (Figure 4). Brukner and Khan's text[11] on clinical sports medicine was helpful in taking a systematic approach to designing the case.
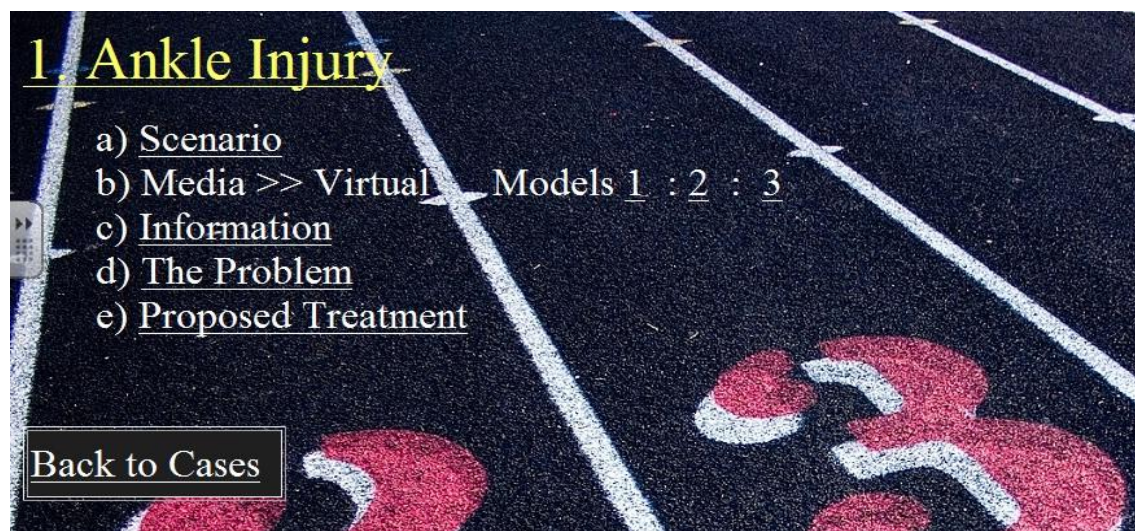
Figure 1. Case Study Structure
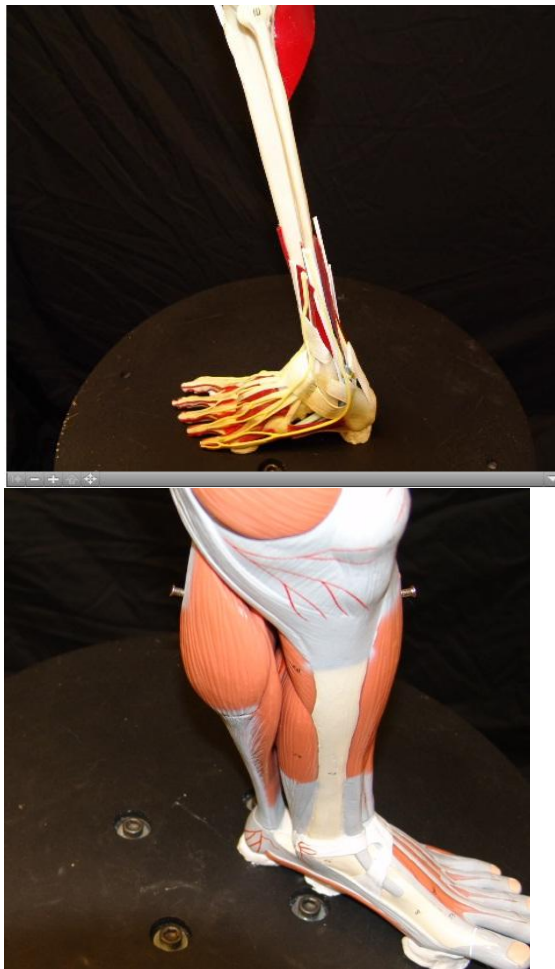
Figure 2a/2b Object2VR® Interactive Models

Figure 3. The Case Problem to be Solved

Problem: Imagine that you perform a comprehensive orthopaedic assessment immediately after the injury on this athlete. Describe in detail what you would do/ask/observe during each of the following steps of assessment: History, Observations, Orthopaedic Assessment Tests

Question #1 – What structures could be injured in this athlete based on what you know?

Question #2 – For each answer to Question #1, describe how the findings would differ in your orthopaedic assessment (e.g. if the hamstring was injured you would find pain and weakness with resisted knee flexion whereas if the quadriceps was injured you would find pain and weakness with resisted knee extension)

Figure 4. Proposed Treatments

Choose the correct treatment plan that you would use initially in the first 24-48 hours post-injury. Also describe in detail why the other two choices are incorrect options as initial treatment plans.

<u>Initial Treatment Plan #1</u>

-Strengthening Exercises – lunges, squats, Thera-band exercises w/ movements of the ankle

-Heat – using a hot pack, hot whirlpool, or heating pad

-Protect the Injured Area

-Therapeutic Modalities – pulsed ultrasound, interferential current (IFC), transcutaneous electrical nerve stimulation (TENS)

Initial Treatment Plan #2

-Pressure – using either a tensor wrap, horseshoe technique, compression sleeve or ankle wrap/tap e

-Ice – ice bath, ice packs, crushed ice, cubed ice

-Elevate – keep the ankle elevated above the level of the heart

-Rest/Protect the injured area

-Therapeutic Modalities – continuous (thermal) ultrasound, interferential current (IFC)

with a hot pack, transcutaneous electrical nerve stimulation (TENS)

Initial Treatment Plan #3

-Pressure – using either a tensor wrap, horseshoe technique, compression sleeve or ankle wrap/tape

-Ice – ice bath, ice packs, crushed ice, cubed ice

-Elevate – keep the ankle elevated above the level of the heart

-Rest/Protect the injured area

-Therapeutic Modalities – pulsed ultrasound, interferential current (IFC), transcutaneous electrical nerve stimulation (TENS)

Over a period of four weeks, students were asked to visit and complete the ankle injury case study online. Following the sequence of information above they were expected to submit a hard copy solution to the case study problem presented. The 3-d models (created for the online environment as QuickTime® movies) could be manipulated by 1) moving the mouse over the model to rotate the model in the x, y and z planes and 2) magnifying the salient features of the model such as muscle attachment sites.

3. Research Methodology

An electronic survey was designed to obtain quantitative information regarding students': 1) comfort level with standard computer technology, 2) relative ease of accessing the case study online, 3) opinion about the structure of the case study and the included information and 4) reaction to using the online 3-d anatomical models. The survey was field-tested with 3 students to remove ambiguous questions. A total of 14 students consented to participate in the electronic survey. The sample included 9 females and 5 males enrolled in the 3rd or 4th year of a 4-year Bachelor of Kinesiology degree program.

The survey results were analyzed for emergent trends and based on the results, a standardized open-ended interview schedule was developed[12]. The schedule was field-tested with three randomly-invited students from the sample in an effort to remove ambiguous interview questions. From the sample, six students (4 female, 2 male) were invited to participate in a 30 minute audio-recorded interview. The interviews were transcribed and coded[13] in an iterative process which incorporated tallied notes regarding the earlier survey results. A preliminary analysis was completed and peer debriefing[14] was employed as a means of triangulating the interpretation of the results.

A single focus group of three students was invited to respond to the intermediate results in an effort to corroborate the results[15]. Interviews were conducted with the instructor by the educational researcher at the beginning, middle and end of the research process. The instructor interviews probed areas of 1) technical challenges for students, 2) informal student feedback on the quality and format of the case study, 3) reaction to the Object2VR® models and 4) level of difficulty of the case. A synopsis of interview notes contributed to the empirical data.

4. Results

The survey was designed to establish trends in student response such that interviews could yield more fruitful understandings of the nature of the learning model. The survey was 30 questions in length and all questions asked students to respond on a Likert scale from strongly agree (1 on the scale) to strongly disagree (5 on the scale).

The first five questions dealt with comfort level as related to general computer technology use including word processing, databases, spreadsheets, email and internet. This was purposeful in that the researchers wanted to determine student predisposition to technology. If students expressed a negative attitude towards technology at the onset, it would be difficult to attribute ultimate findings expressly to the new

technology intervention (i.e. using the online case study and virtual models). For the statement "I am confident in my use of (insert technology here)" the average response on the Likert scale for these questions was 1.97 with the spreadsheets being slightly less familiar to students. It was therefore determined that the computer technology would not inherently predispose students to dislike the online case study approach. This was not an unexpected finding in that these students have necessarily been exposed to a laptop university setting for at least three years.

The following discussion draws on the results of the survey, interviews with both students and instructor, and focus group sessions.

Students found the online case study environment easy to access but made several suggestions about streamlining the technology. With regard to navigation, students preferred that each web page document that comprised the case should open in a unique window. Interviews revealed that the Object2VR ® models were detailed enough for students to access the necessary information to complete the case study. The lack of instructions for using the VR models was an issue that arose frequently. The consensus was that a simple web page update including instructions for rotating and enlarging the models would be very useful. Interviews of both students and instructor indicated that a more pressing problem was the speed at which the VR models loaded. In some instances students assumed the models were not working and requested help from the instructor and researcher. Depending on the student's internet access, the load speeds were found to vary widely. This is a significant concern which will be dealt with by the instructor given that an ultimate aim of the project is to make these models accessible to sports therapy programs in developing countries. Students appreciated the supplemental timeframe pictures of the ankle injury and suggested in the focus group that more media could be used to make it clear how the injury occurred. In response the instructor could consider linked video clips where accessible.

This sample of students found the case study format used to be very easy to follow. In interviews they made mention of the value of the probing questions that accompanied diagnoses/data analysis components within the case. The level of difficulty of the case was judged by students to be challenging yet appropriate given that their course concerned studies of lower extremity injuries. The focus group offered a recommendation regarding the nature of the cases. They felt that more common injuries should be added to the case database first but also more "critical" cases. When asked to explain one student said "in some injuries, the neck or back for instance, it is quite critical that we take the correct approach; it is important that we see those cases; we can do the most damage making mistakes with those injuries".

In considering the possible options for treatment, the students suggested that the choices offered good distractors. The format of getting students to choose one of three possible treatment protocols was purposeful. Instructors at all levels will recognize that students have misconceptions that are recurrent year

after year. By building these misconceptions into the choices students have, these distractors force them to confront their prior knowledge and undergo conceptual change[16]. Students suggested that there were aspects of each protocol that helped them discount distractors and narrow their choice. In their recommendations for the instructor, they added that it might be useful to include protocol choices that changed the sequence of treatment options.
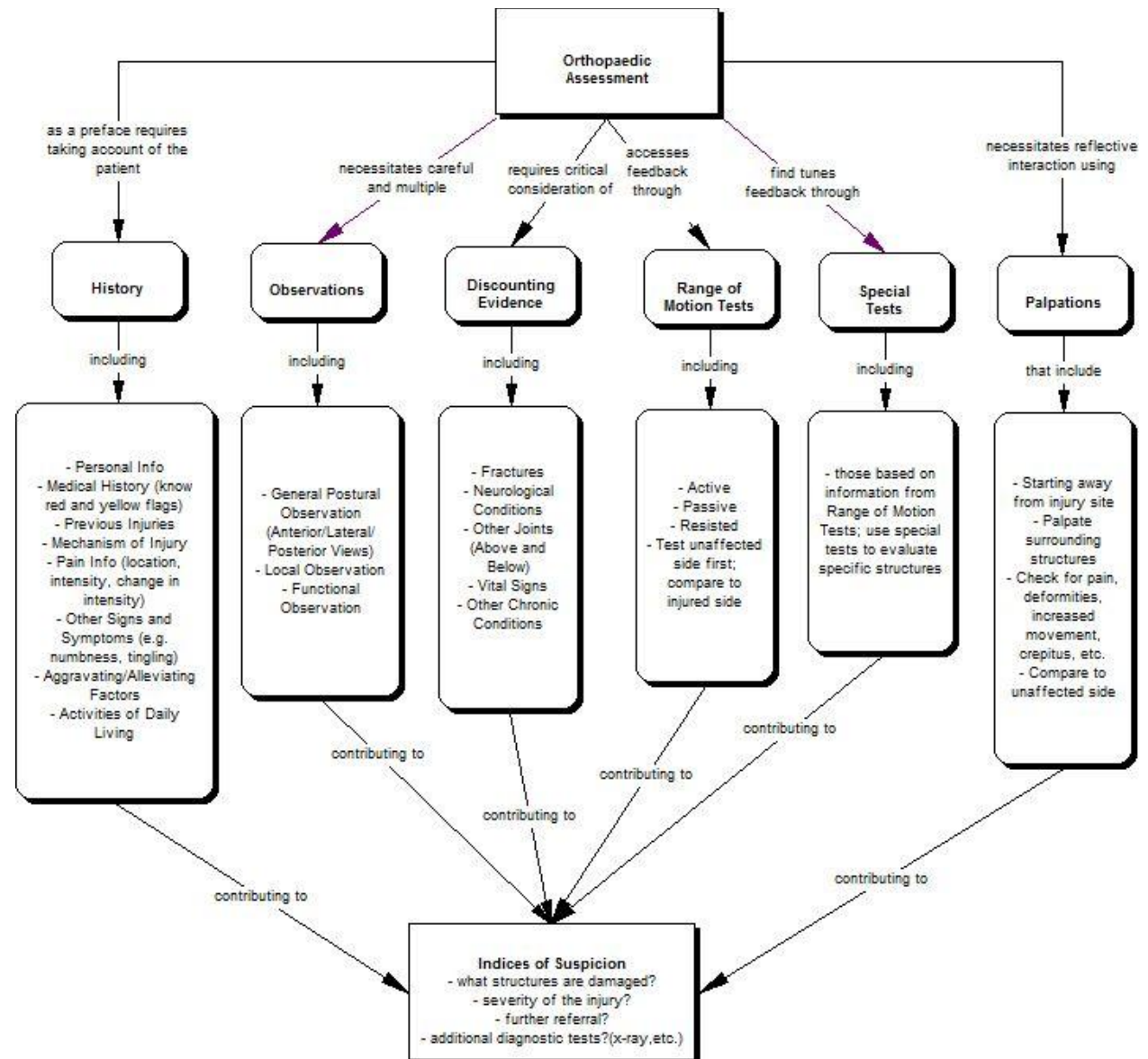
In the interviews, a message emerged that the students would like feedback on their protocol choices. Said one student "I know that I was wrong but why was I wrong, what did I miss in the diagnoses; I need to know that information otherwise I will keep making the same process mistakes". This was the first indication of many that culminated in the focus group suggesting that the case study might be more effective with increased instructor involvement. In our discussions it was clear that while students felt the technology could stand on its own as a learning tool, it perhaps would be much more effective if integrated into the face-to-face lectures. In a related query, students were asked how the online case study compared to typical textbook case studies. Students unanimously preferred the media-enriched online version yet saw potential for a hybrid approach.

The focus group session generated more suggestions for active learning. Students said they would like to have checklists embedded in the case study where the intent was to work with a partner to actually practice the injury testing/diagnosing protocol on each other and work through an itemized protocol. Finally, in interviews, students repeatedly referred to a preferred teaching and learning model where the instructor could respond to their questions as they worked through the case, particularly when they did their first case assessment.

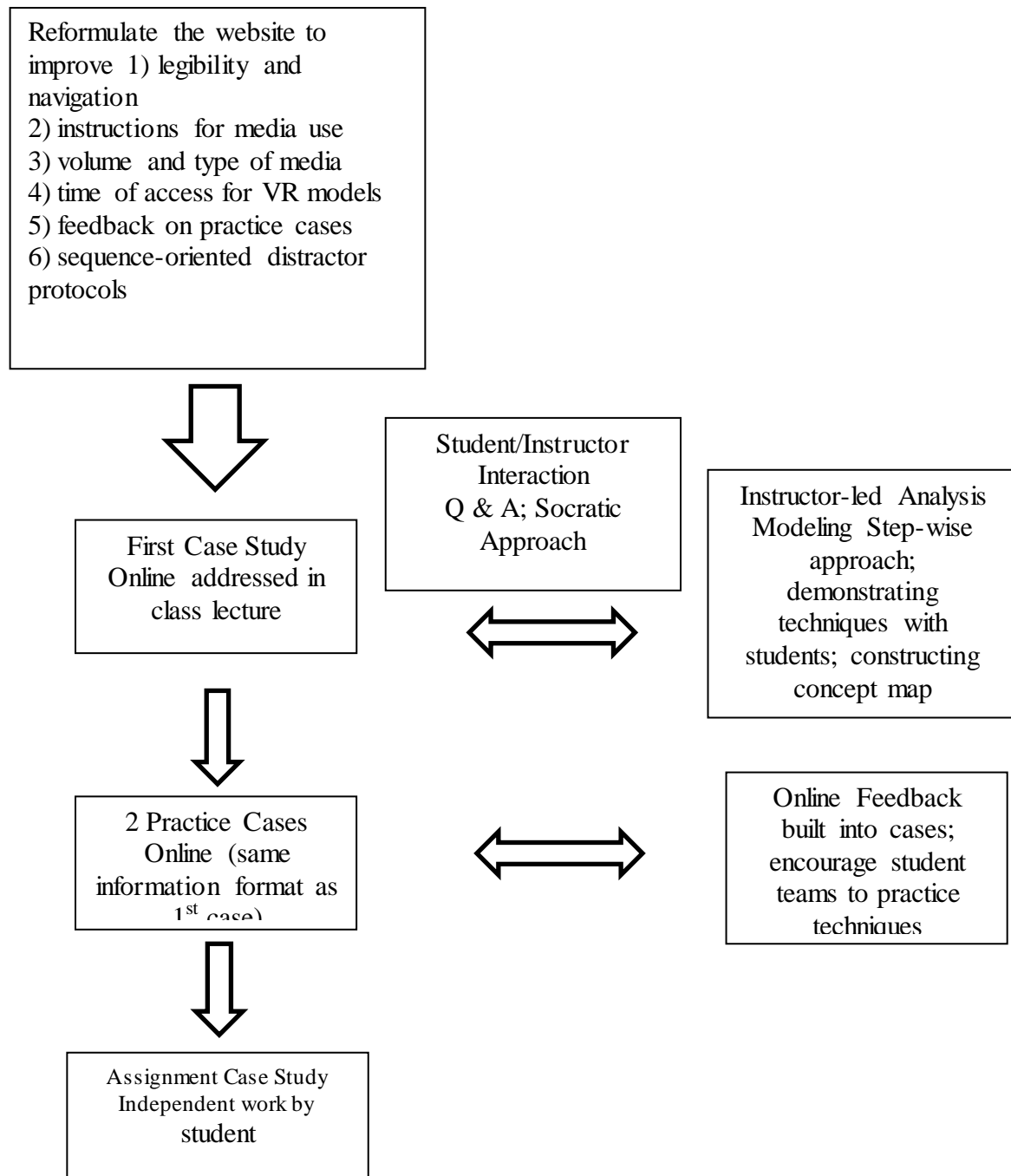## 5. Discussion: Improving the Instructional Model

Our own recent research[17] has corroborated Clarke and Mayer's finding[18] that, "From the plethora of media comparison research conducted over the past sixty years, we have learned that it's not the delivery medium, but rather the instructional methods that cause learning" p14. Good pedagogy must lead technology and not vice-versa. This sample of students was adamant that the interaction with their professor was an important component of their learning. They found the technology to be useful for its anywhere-anytime access but suggested that, alone, it was only a "supplemental and complimentary" way to learn. Said one student "we need to see our prof work through the problem; have him think out loud as he follows a systematic approach to diagnosing the injury and establishing a therapy protocol". In an effort to respond to this critique and to capitalize on the established benefit of graphic organizers[19], the instructor will in future courses scaffold the instruction by building up a concept map[20] with students regarding the process of diagnosing sport injury. A sample of a map is shown in figure 5.

Figure 5. A Concept Map to Support Case Study Analysis

As an action research study the primary aim is to improve instruction using an evidence-based approach. The richness of the quantitative and qualitative feedback regarding students' preferred learning styles and the necessary learning supports, has prompted the instructor and researcher to posit a model to be implemented in the instructor's next offering of the course (see Figure 6).

Figure 6. A Model for Improved Instruction

This model maintains the instructor's learning objectives while potentially promoting a "process-oriented" model of improved interaction with students. In considering the likelihood of success of this model, it is useful

to refer to the 7 principles of good practice in undergraduate teaching[21] namely: 1) contact between faculty and students, 2) cooperation between students, 3) active learning, 4) prompt feedback, 5) time on task, 6) high expectations and 7) respect for diversity in learning styles. This improved instructional model has considerable overlap with these criteria (See Table1).

Table 1. Seven Principles of Good Practice (Chickering & Gamson, 1986)

Principles	Model Response
Contact between faculty & students	Instructor involvement in case study analysis; Socratic
Cooperative student learning processes	Students working on practice cases together
Active Learning	Demo & practice of diagnoses techniques
Prompt Feedback	Q/A with professor; online feedback in practice cases
Time on Task	To succeed at diagnosis & suggested protocols requires dedicated practice
High expectations	Expectation that students will practice cases & submit the final case analysis based on their mastery
Respect for varied learning style	Demos of techniques, cooperative learning, text-based case materials, audio-visual support materials

6. Condusions

This action research study has determined that students find the Object2VR® movies to be a useful technology given that they provide flexible access to anatomical models to support their case studies. From the valuable feedback in the form of surveys, interviews and focus groups, it seems clear that students have a decided preference to adopt a teaching and learning model that invokes more instructor involvement and scaffolding of the diagnosis and treatment process. A model has been proposed that responds to this critique and furthermore builds upon established principles of quality instruction. The investigation has established the importance of eliciting strong qualitative rationale[22] for why and how and we use technology in classroom interventions.

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