THE DEVELOPMENT OF AN INNOVATIVE APPROACH

TO TEACHING FEMALE PELVIC ANATOMY

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DEDICATION

I would like to thank the members of my Graduate Committee, Lew Calver, Kim Krumwiede, and Marlene Corton for all the hard work and guidance they gave me. Lynn Tilden, my husband, deserves special appreciation for his support, patience and advice during this enterprise. Also Shadow my Siamese, Princess my Russian Blue, her daughter Inky and three other strays have given much affection, mirth and commotion while I tried to work.

THE DEVELOPMENT OF AN INNOVATIVE APPROACH TO TEACHING FEMALE PELVIC ANATOMY

by

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THESIS

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Southwestern Medical Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

The University of Texas Southwestern Medical Center at Dallas

Dallas, Texas

May, 2006

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Publication No. _____

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The University of Texas Southwestern Medical Center at Dallas, 2006

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In an effort to develop an improved teaching resource for female pelvic anatomy, this study tested two versions of a new training aid on a group of forty-one students for comparison. One strategy was paper-based and the other was computer-based. The web-based computerized model had two modules, “Pelvic Support” and “The Vulva and Perineum.” The modules contained text, video, animations, quizzes and interactive colorized images. The student could roll the cursor over a term and bring up a highlighted structure in the image. Animations demonstrated hard to explain pelvic movements. Videos showed clinical procedures. The computerized model was compared to a paper-based model with the same

text and images, but no videos, animations, color or interactivity. A randomized trial was conducted giving each student one module in paper form and one module in computerized form. The study used a pretest, posttest and follow-up test to measure the change in learning with each training strategy. A questionnaire was given at the end to assess opinions of both models and another to assess their opinions of the elements found in the computerized model. There was no significant difference in the ability to learn with a computerized dynamic format or a paper-based static format. There was a difference in the students' preference for the computerized model.

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List of Definitions

3d animations –Illustrations that do not look flat and are coordinated to produce movement.

Application – Computer program in information technology that is written to perform a specific purpose.

Banner – Graphic at the top of a web page to hold the title, logo, navigation buttons and other information.

Burn – Write computer data to a compact disk.

Button – Icon, picture, word, or number that links to another picture or page.

CD – Recordable compact disk on which computer data (text, web sites, videos, games, graphics, statistics, etc.) are written and stored. They can be written over or added to.

CD-ROM – Compact disk with read only memory.

Code –To write a program (v.); Collection of machine symbols that represent data or instructions for operating a computer program or application (n.).

Dreamweaver MX® – Application that allows a designer to create a web site quickly, integrates other applications such as Flash® and contains code for many complicated operations.

Feedback – Answers, scores and explanations that automatically appear on the page in a separate window when a quiz is taken.

Fireworks® – Computer program that allows for easily creating graphics and designs that can be exported into Dreamweaver® for finishing.

Flash® – Computer program that allows a designer to create an animated 2d movie. It is easily imported into Dreamweaver® and put on a web site.

Frames – A Web page element like a pane that compartmentalizes contents. Several panes appear in one browser window. Each frame is a Web page. When a link is clicked in one frame, the other frames do not change. Allows navigation buttons, logos, links and graphics to always be visible while visiting other pages.

Front Page® – Application that uses frames to make websites.

Hyperlink – Synonym for both link and hypertext link, a connection within or outside of a web page.

Icon – Visual object that represents a program or site and uses the path to that program when clicked by the cursor.

Interactivity – Series of changes that occur when the user clicks on buttons or when the arrow keys or enter key is used. Allows links to work, windows to pop up, menus to drop down, illustrations to change, and text to appear.

Interface – Interconnection of windows and pages in a logical order to establish a website or other working computer program.

Levels – Hierarchy of pages in a website: Home, Secondary Page, Tertiary Page.

Link – Selectable connection using hypertext to switch from one picture to another, such as a word or object to another word, a page or a web site.

Mac – Macintosh brand of computer that is known for excellent graphic work.

Macromedia Shockwave® Player – Plug-in that streams video and sound to display complex and elaborate movies, i.e. player, for Windows and Mac operating systems.

Maya® – Application that allows a designer to easily produce a 3d animation.

Menus – List of links that appear in a separate window when the menu button is clicked or rolled over with the cursor.

MS Office® – Application to do tasks necessary in business or an office, such as Word, Excel, and Power Point.

Navigation – Movement around a website or an application by clicking the cursor on a button.

PC – Personal Computer that is not a Macintosh.

Photoshop® – Application to edit photos, draw graphics, and add colors, layers and type.

Plug-in – An application which does not come with a program but is added in order to run a variety of movies, such as QuickTime®, Real Player and Windows Media Player.

Premier Pro 1.5® – Application to produce movies on computer using pictures, video, music and animations.

QuickTime® – Plug-in to play animations and video produced in Flash®, Premier Pro and other programs.

Roxio-Toast® – Application to burn a CD.

Scroll – Exposing other parts of a page by clicking on the scrollbar to the right of a page.

Search engine – Function such as Google™ and Dog Pile™ to find a subject over the Internet.

Site – Location of a group of web pages linked to an index or home page.

Site map – Picture of how a web site is linked together.

Slice – Section of a web page organized by the code or application to instruct the computer how to display a graphic image on the computer screen. Slices are grouped to produce a web page. Individual slices can be edited without affecting other slices.

Template – Underlying design or plan for a page that is the same from page to page. Editing the template edits every page based on it or linked to it and maintains consistency.

CHAPTER ONE
Introduction

THE DEVELOPMENT OF AN INNOVATIVE APPROACH TO TEACHING FEMALE PELVIC ANATOMY

Background

Between preclinical medical school anatomy classes and residency and fellowship, many years pass. Students typically have not studied anatomy for four years. Much of the anatomic knowledge is forgotten. They also need more specific anatomic teaching in their specialty of obstetrics and gynecology. Students, fellows and residents need a refresher course in anatomy because of the number of years since their gross anatomy course as first year medical students.

Thesis Research Problem

Computers are abundant upon college campuses. Students of today have become very accustomed to using computers. One study found that students had used personal computers for more than three years. (Khalil, Lamar, and Johnson, *Using Computer-Based*, 70) Many courses taught today have a computer-based component to aid learning and comprehension. The Department of Obstetrics and Gynecology at the University of Texas Southwestern

Medical Center wanted to have a computerized component for the anatomy class. The program needed to cover specifically four areas: a pelvic anatomic explanation including anatomic illustrations, several videos of fresh cadaver dissections, animations showing the concept of anatomical movements, and videos of common obstetrical and gynecologic surgical procedures to provide clinical correlations.

It was necessary to create such a computerized training aid to achieve this goal. The training aid needed to have illustrations based totally on female cadavers. New illustrations needed to be produced to accurately show the desired structures and structures that are hard to distinguish in cadavers. Photos of fresh cadavers were needed instead of photos based on cadavers that are not fresh and have become stiff. Stiff cadavers don't present a realistic view of the way structures look in living tissues. In addition, videos of procedures on fresh cadavers would look and respond more like living tissue and better prepare students, fellows and residents for the operating room.

The research question was: is it possible to create a computer-based program that integrates anatomic explanation and illustrations, videos of fresh cadaver dissections, animation, and videos of common obstetrical and gynecological procedures?

Significance

Obstetrical and gynecologic students, residents, and fellows will have an interactive training visual which is more precise, represents life, avoids repetition of older material, is specific to

the female pelvis, and satisfies the requirements of the obstetrical and gynecologic practice. This training visual will aid in anatomic instruction in the dissection lab. This training visual will be in the form of a web-based curriculum on a CD-Rom, which will be distributed around the country to medical schools and research institutions and possibly be put on the Internet.

Solution

I created a web-based educational program to be used as a model for a larger program of ten modules. It was designed to be used to train obstetrical and gynecologic students, residents, and fellows to identify the anatomy of the female pelvis, topographical relationships of the anatomy, movements and clinical procedures.

Objectives

1. To prepare a web-based interface that can be used for ten modules.
2. To organize the text in easy to read sections.
3. To design a way of letting users know where they are and where they have been in the module.
4. To design an interactive test for each module, with feedback and a total score.
5. To make interactive labels for illustrations and text.
6. To prepare an interactive interface with the animations and video.
7. To evaluate the effectiveness of the module by testing it on the target audience.

CHAPTER TWO
Review of the Literature

OVERVIEW

The Problem

There is a great number of websites on anatomical subjects that can be accessed by computer. Most of the anatomical websites were on the brain, the skeleton, the extremities, and the torso and could be adjunct material for a class. Some of the sites were about female pelvic anatomy, but were not designed for use as a course. Many of the latter were single pages put out by universities for patient education. Some pelvic anatomy pages were single-page chapters of a larger atlas. There was a scholarly article in an on-line journal, which detailed female pelvic anatomy. There was nothing in electronic media that could be used as a manual to study female pelvic anatomy.

RESULTS OF SEARCH

Papers on Computer-based Learning Aids

Two papers were found on a project similar to Interactive Female Pelvic Anatomy, written by Khalil, Johnson & Lamar. Sixty-four veterinarian students in a comparative anatomy class were to study the canine skull and digestive tract. Half studied a CD training aid and half

used a paper-based. A pretest and posttest were given to measure learning. The two strategies were then evaluated.

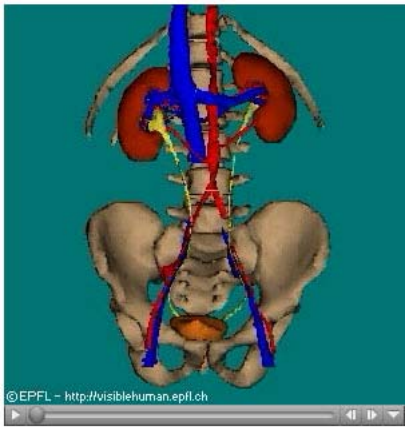
The first paper was “Using Computer-Based Interactive Imagery Strategies for Designing Instructional Anatomy Programs” (Khalil, Johnson & Lamar). Students expressed positive attitudes towards computer-based training strategies. They felt the self-directed aids enhanced their learning. They felt the interactive images were helpful

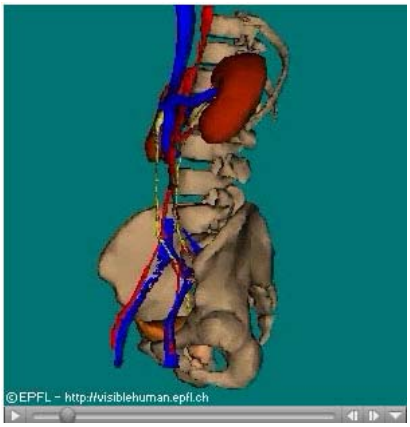
The second was “Comparison of Computer-Based and Paper-Based Imagery Strategies in Learning Anatomy” (Khalil, Johnson & Lamar). They found no significant difference between the two strategies, computer-based and paper-based. Students had a preference for the computer-based strategy.

Electronic Media: Websites

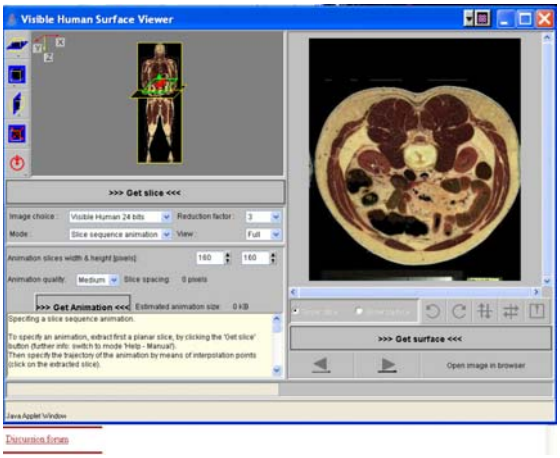
Anatomy Websites

Visible Human Server (Prof. R.D. Hersch) has interactive atlases in seven categories. The site offers a “virtual anatomic construction kit” to view the human body in slices and sample animations made from the slices. It is not a training aid or a laboratory guide. The site is an anatomical data set licensed from the National Library of Medicine Visible Human Project, Prof. Ackerman. Figures 2-1 and 2-2 show slices and a sample animation based on a slice.





Figures 2-1-1. VHS, animation starting. 2-1-2, VHS, animation rotating.



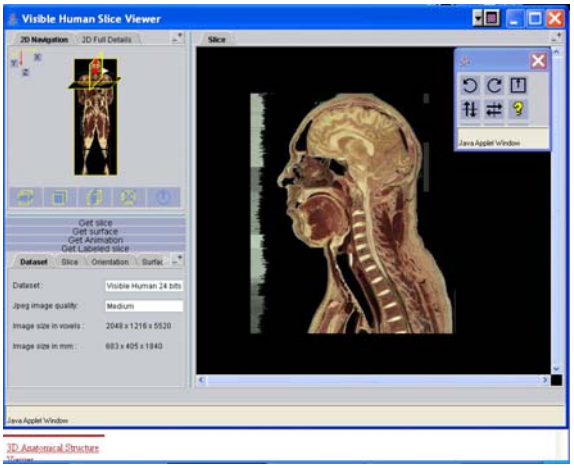


Figure 2-2-1. VHS, transverse slice. Figure 2-2-2. VHS, sagittal slice.

Online Atlases

Online Atlases, Digital Anatomist Project, “Brain” (John W. Sundsten, is a site with 2d and 3d views of the brain, MRI scans, computer reconstructions and 3d animations. It also has a “Neuroanatomy Interactive Syllabus” to accompany the brain section with 27 chapters of a page each. There are also two other sections without syllabuses in the Online Atlases about the thoracic organs and the knee.

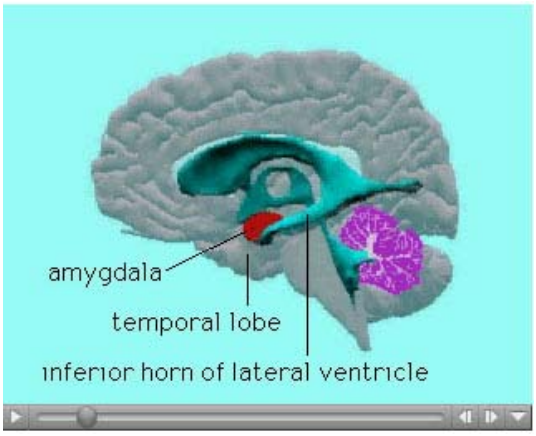


Figure 2-3, Online Atlases. "Brain," animation still.

Anatomy Modules (Webmaster Michael L. Richardson, M.D.) has eight modules available such as "Normal Knee Anatomy 1", and "Normal Distal Thigh Anatomy 1" which each has one page of text; the latter includes a thigh animation of slices from Visible Human Server.

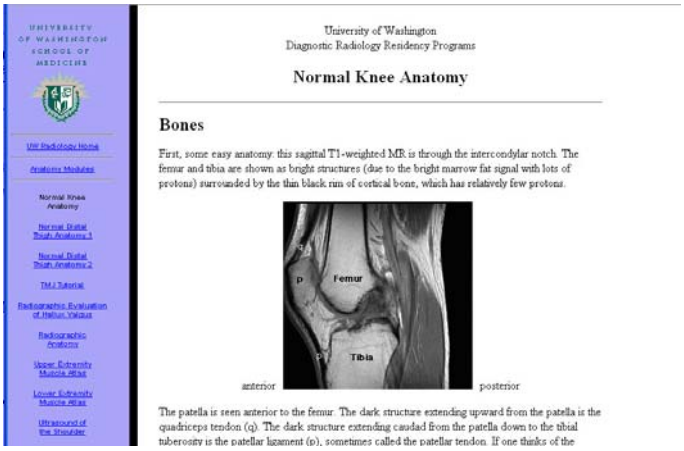


Figure 2-4, Anatomy Modules, "Normal knee anatomy 1"

Anatomy Atlases, Digital library of anatomy information (Curator: Ronald Bergman, Ph.D.) has an index with a poster of illustrations of regions of the body. Click on one to get a list of

illustrations of that region, and then click on one of the small illustrations for a large illustration. It is a good source for pictorial information.

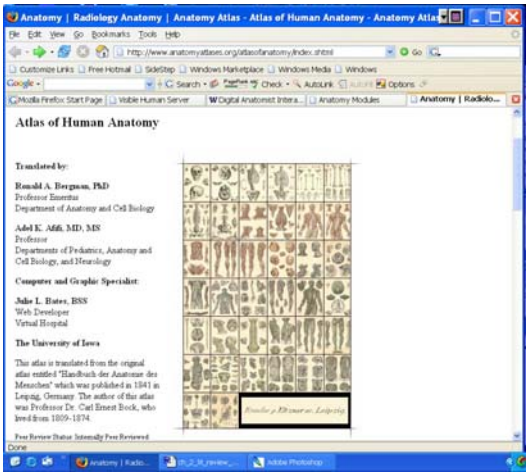


Figure 2-5-1. Anatomy Atlases, index.

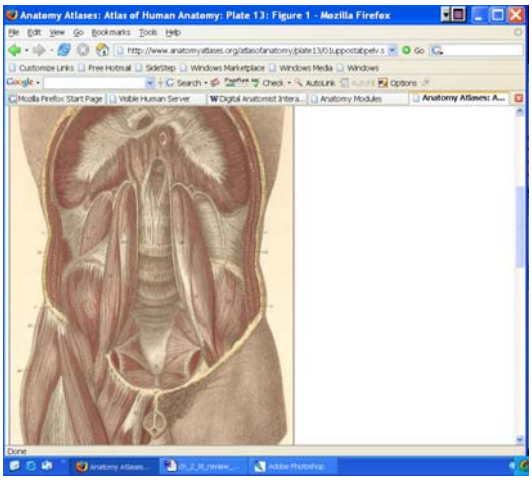


Figure 2-5-2. Anatomy Atlases, body regions with labels.

Gray's Anatomy of the human body (Yahoo Education) is a scholarly atlas of the entire human body with many pages. Figure 2-6 is one page of a discussion of the bony anatomy. A search engine at the top allows you to search any other anatomical structure found in Gray's Anatomy. Or you can navigate to some other field of science. It reads like an encyclopedia.

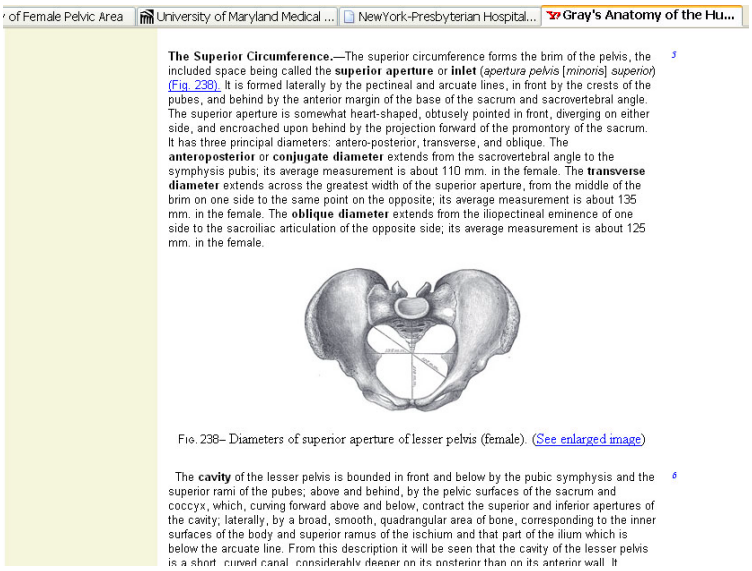


Figure 2-6. Gray's Anatomy of the human body.

Female Pelvic Anatomy: Basic Organization and Clinical Considerations (Ohio University) is a web site with 14 pages and 13 illustrations from Netter with no discussion.

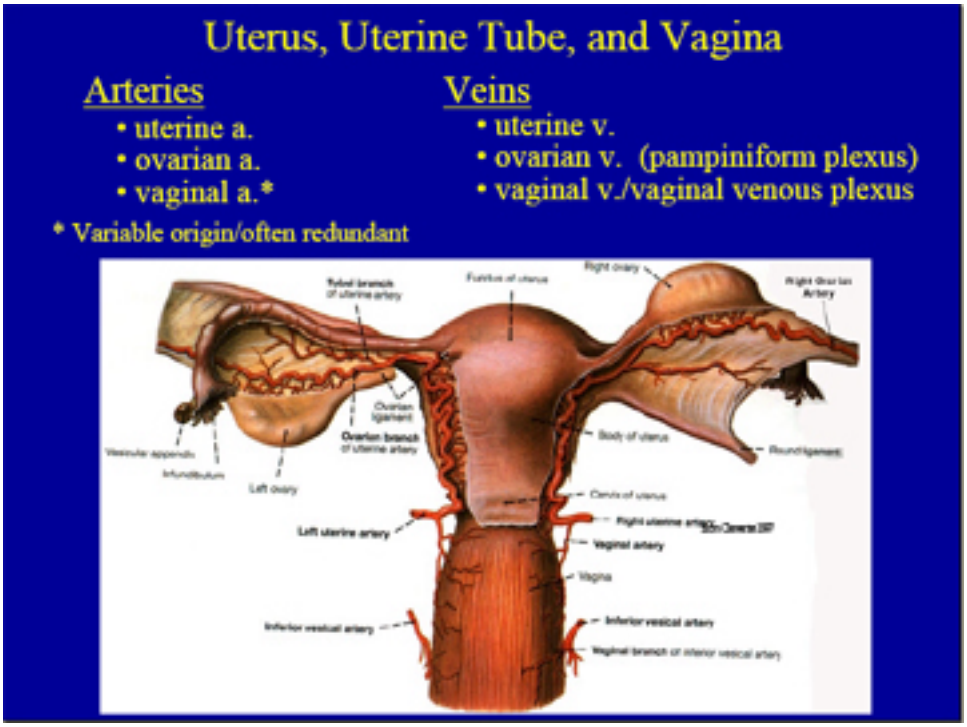


Figure 2-7. Ohio University with Netter images, no discussion.

Curriculum Aids

Core Curriculum Syllabus, Review of Anatomy (Bobby Alford) was much like a book posted on line: a person had to scroll down the text to read it all. There were some illustrations interspersed in the text, but they were simple line drawings and had no interactivity.

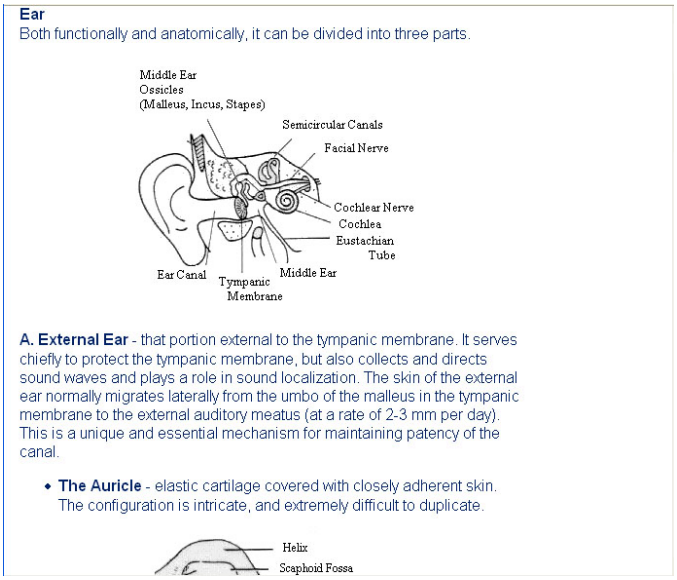


Figure 2-8. Core Curriculum Syllabus, "Ear."

Patient Information Websites

HON, Health On the Net Foundation (Economic and Social Council of the United Nations) is an international interface connection for patients to research health and medical webs. Click on a topic like medical illustrations, encyclopedia, or medical literature and follow links to

the topic. One link was Anatomy of Reproduction, containing several pages with simple illustrations and text (which are protected from being copied).

Health Information, Other Health Topics, Gynecological Health, Anatomy of Female Pelvic Area, (Ohio State University Medical Center) is an informative and thorough site for patient education about the female pelvis, showing one illustration with terms and definitions (Figure 2-9). Links to gynecological health topics are listed down the left, which link to many pages with discussion. It has links to hospitals, research studies, etc.

Figure 2-9. Ohio State University Medical Center.

Gynecological Oncology (University of Maryland Medicine) consists of one page with an illustration and definitions, which serves much like a directory. There is a link to a glossary of cancer terms and links to the university, clinics, doctors and other related places (Figure 2-10). This site is for patient education.

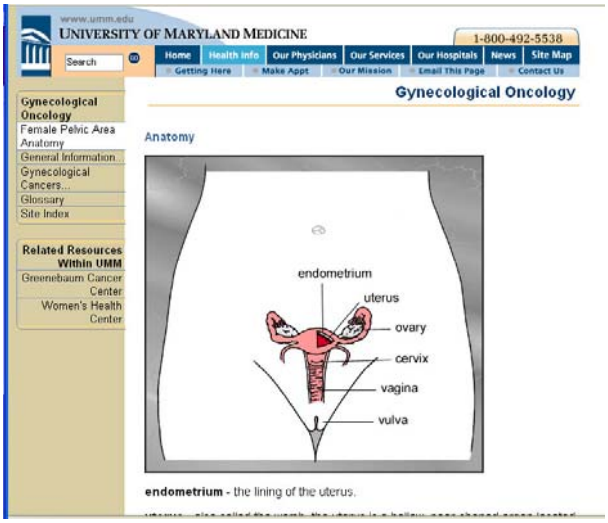


Figure 2-10. University of Maryland Medicine.

Gynecological Health (University of Utah) is typical of the previous two sites with one page, a basic illustration and links to a university and clinics.

The Anatomy of the Female Pelvic Area (New York-Presbyterian Hospital) is one page with definitions and no illustrations; the links along the left side are an index and glossary, and along the right links to many different associations.

Online Journals and Articles

"Contemporary views on female pelvic anatomy" (Barber, Matthew) is a scholarly article in the Cleveland Journal of Medicine. It has the quality of illustrations and the thorough type of discussion planned for the Interactive Female Pelvic Anatomy project. It is formatted as an article with no interactivity or links.

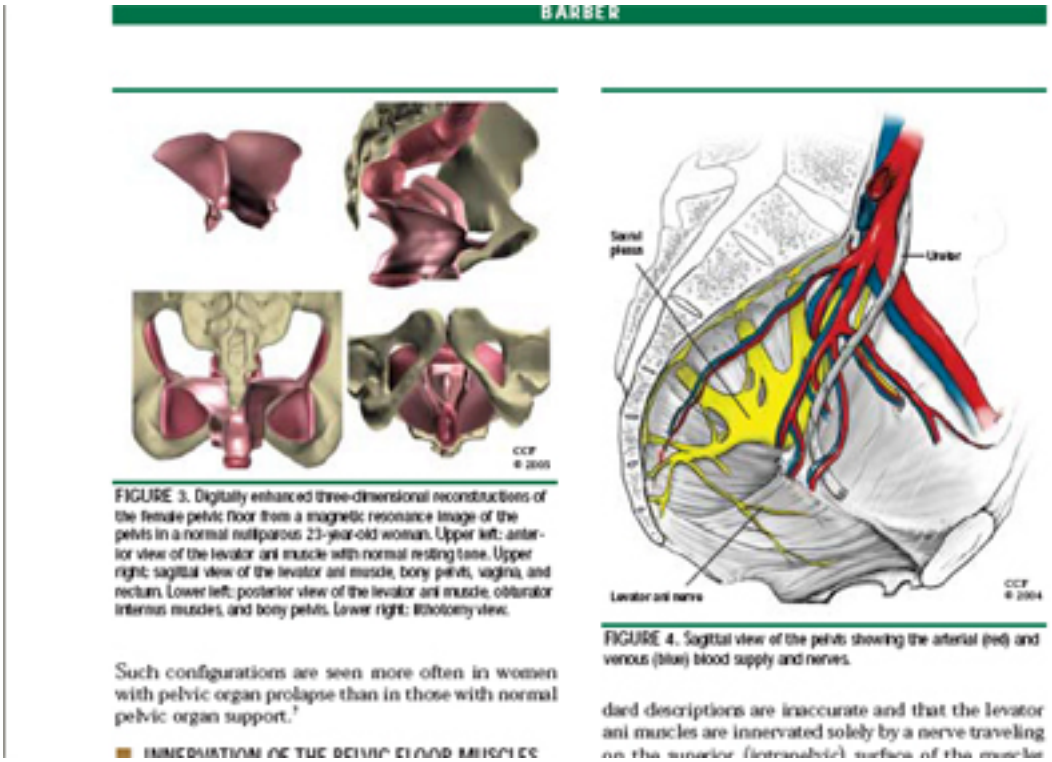


Figure 2-11. Page from an article (Barber, Cleveland Journal of Medicine).

Electronic Media on Computerized Disk

CD-ROM included with textbooks and syllabuses

Fundamentals of Anatomy and Physiology (Simon & Schuster) included a disk with the textbook. “Contents” took you to chapters coordinating with the textbook. “Tutorials” held 3d animations. “Cases” offered a pretest with immediate feedback and then a case with more questions to answer. “Tools & Techniques” gave additional diagnostic information. “Glossary” contained definitions, links to text and audio pronunciation.

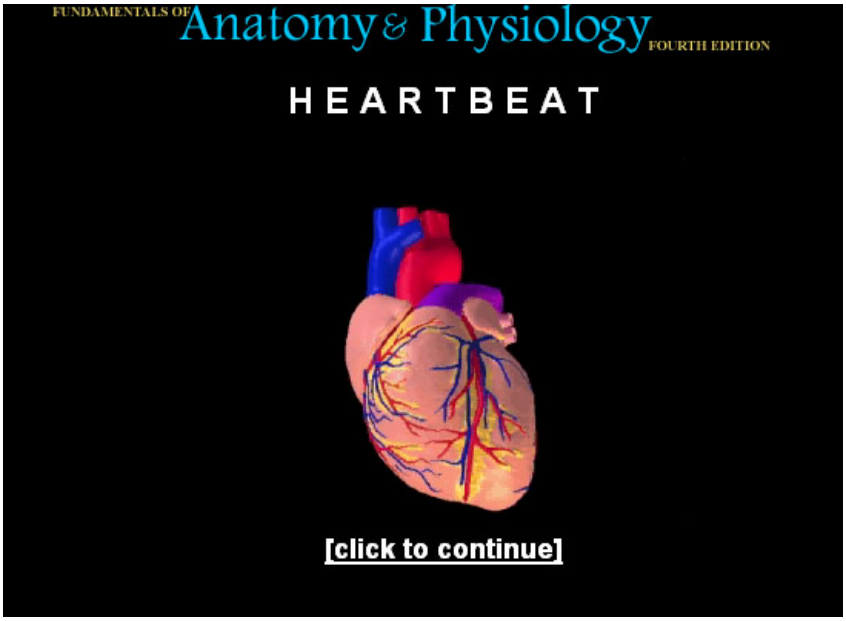


Figure 2-12-1. Heart animation. (Anatomy & Physiology, Martini).

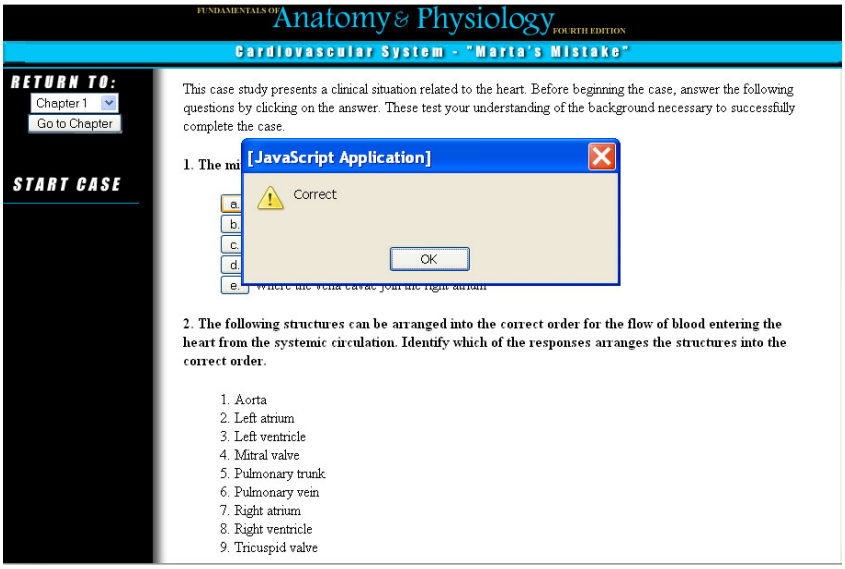


Figure 2-12-2. Pretest with immediate feedback (Anatomy & Physiology, Martini).

The textbook, Biology (Campbell, Reese) includes a CD that has several interactive quizzes: pretest, activity and chapter quizzes which are graded by a "Results Reporter," and "Essay Questions" which are accessed on their website. Most of the available activities are accessed on their website and require the student to sign in with a password. "Activities" requires the student to download a plug-in, Macromedia Shockwave® Player, which doesn't work on every computer. Features available only by logging onto the book's website are "Chapter Review," "E-Book," "News," "References," "Art," "Videos" and "Instructor Resources". Case studies could be studied and essay questions answered but they would have to be e-mailed to students' teaching assistants to be graded.

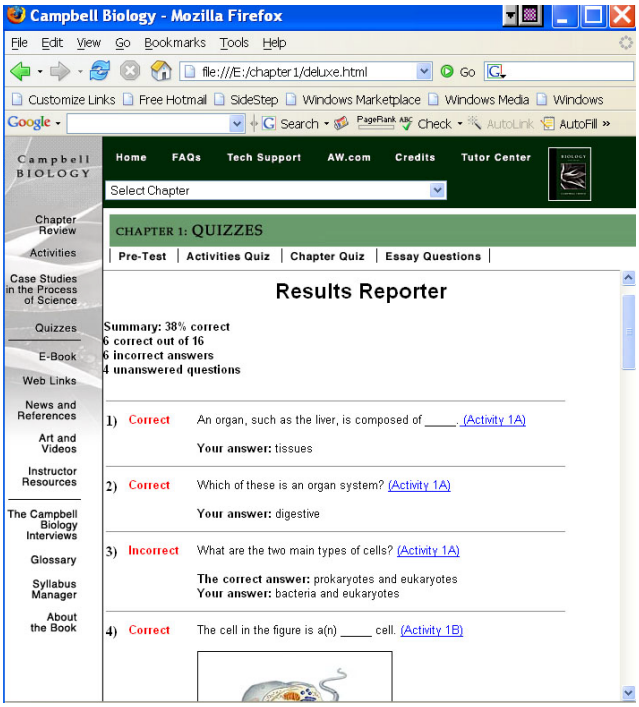


Figure 2-13. Biology, Campbell and Reese, CD-ROM.

The Pathology course at University of Texas Southwestern Medical School at Dallas used a syllabus (Nature of Disease, McConnell) that had a CD with the text, lectures written word for word, notes, glossary, and “ANATPHYS” with additional slides and discussion. It had no interactive modules or online quizzes.

CD- ROM as the complete self-paced course

The embryology course (Medical Embryology, Web Curriculum Group) at UTSW Medical School at Dallas existed entirely on CD-ROM. A student could study text, look at the images, take an interactive self-test with immediate feedback or read a section on past questions and answers about the course.

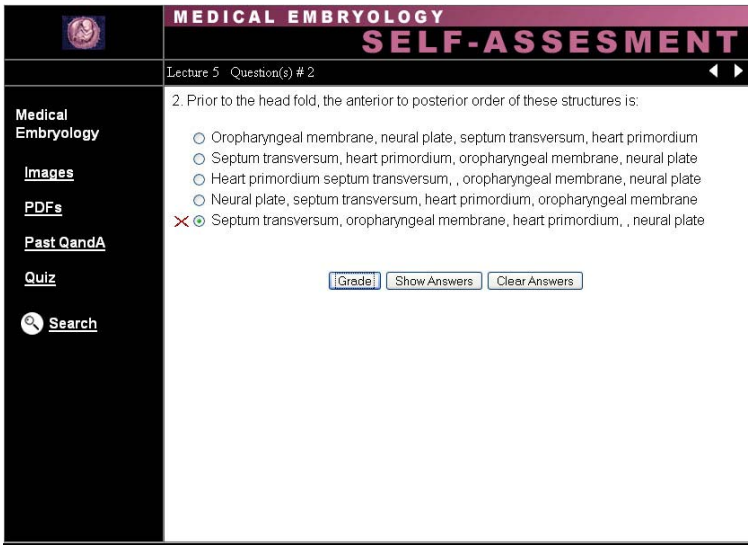


Figure 2-14. Embryology quiz with feedback, CD-ROM.

BENEFITS OF SEARCH

Many of the CDs found in the literature search had the kind of interactivity that was going to be put in the new Interactive Female Pelvic Anatomy training aid. The interactive quizzes were good examples of what was planned for the training aid. Linking to other sites was not going to be used. Text that interacted with an illustration to show topographical features did not seem to be in any of the existing training aids or sites. Terms in the literature were usually explained in a separate page or in a glossary rather than linking with the illustration. Animation was also going to be in the program. Having to download a plug-in to view animation as in some media was a disadvantage in that not everyone could successfully install it or use it.

The literature search provided a wealth of ideas. Electronic media is being used as part of educational training for many audiences and for many branches of science, but there was not yet a computerized program generally available to teach female pelvic anatomy in any depth.

CHAPTER THREE
Methodology

THE PROCESS

Planning

A computerized training aid to teach female pelvic anatomy had been in the planning stages for about ten months. A preliminary design had already been done in Microsoft Front Page®. Front Page® is a software program that uses frames to make websites. The preliminary design consisted of three frames, one down the left side containing the navigation system, one frame across the top containing the banner, which would remain visible no matter which page was open and the largest frame containing the content, allowing the student to access pages of text and illustrations linearly or by hyperlink. Each frame had a scroll bar taking up space and detracting from the appearance.

The intended target date for completion was July 31, 2005 in order to satisfy the terms of a grant procured for the project. The committee consisted of an animator, Dane Bettis, a medical illustrator for the drawings, Lianne Krueger Sullivan, a programmer, Charles Richards, the author, Marlene Corton, M.D., who initiated the project, Lew Calver and Kim Krumwiede as advisors, and Connie Tilden, who would design the interface.

Choosing the software

The first decision was to choose the software. The project had begun with Front Page®, because it was easy and quick for the programmer to make a prototype to supply to the grant committee. Dreamweaver MX® is another program that has many design capabilities. Front Page® was available very inexpensively ($10), but was being discontinued by the campus bookstore and replaced by Dreamweaver®, the software that was beginning to be preferred by designers. It was the software of choice for the Biomedical Illustration Graduate Program.

Comparison of Web Design Software

To help decide between Front Page® and Dreamweaver® I studied the pros and cons to see what I could find about the two programs.

Advantages with Front Page® are:

- Inexpensive.
- Easy to use.

Drawbacks with Front Page® are:

- Needs other software programs loaded on the server that are not included in package.
- Adds extraneous code more often than other programs.
- Is part of MS Office® and works better with text than graphics.
- Is frame based and template based.

- Has each of three frames (usual design) as a separate page, so if someone is trying to print a page, they have no idea which frame they are really on and end up printing the wrong one.

Advantages with Dreamweaver® are:

- Seldom produces extraneous code and has a command to clean up code.
- Makes a clean, simple page without separate frames or scroll bars, although there is a frames option.
- Easily integrates Flash®, Fireworks® and Shockwave®.
- Quickly produces many types of interactivity and layouts without someone having to learn code.
- Is better suited to use graphics such as Adobe Photoshop®.

Drawbacks with Dreamweaver® are:

- More Expensive.
- Longer learning curve.

Dreamweaver® was the best choice for designing the interface. The drawbacks did not have anything to do with the performance.

RESOURCES

Originally there would be eleven modules, with animation, videos, two quizzes each, illustrations (approximately two for each module) and text. To begin organizing this material, I created a site map. (Figure 3-1) A little work had begun. Some text had been written, but

needed revision. The animations were in production. Some footage from the video of a few previous projects could be used in this project. There was one sample of an unfinished illustration.

July 31, 2005 was the deadline stated in the grant, but it was not a firm deadline because dates for testing or publishing were not planned. The project had been in production about ten months and July 31 represented the end of the twelve-month period allotted to finish the project as part of the terms of the grant. A committee was formed to begin work in earnest.

All the money from the grant had already been allocated, which was enough to produce two modules as prototypes. The focus was put on one module, Module 7, because it would utilize the animations as well as two of the illustrations, to finish in July. The inclusion of the animations would make the best impression on the grant committee, showing them what a unique, innovative and interactive training module this would be and the desirability of finishing it. Since all of the committee members worked other jobs, it had taken nearly a year since the project was begun to produce that much.

THE INTERFACE

The Site Map

The second decision was planning the interface. The site map provided the organization. Starting with the first design in Front Page®, the Dedication, Table of Contents and Credits

as the secondary pages would go under Home Page. Eleven modules would be accessed from the Table of Contents as tertiary pages. Pretest, Procedures, Posttest and References possibly would go in the fourth level or be imbedded in the pages.

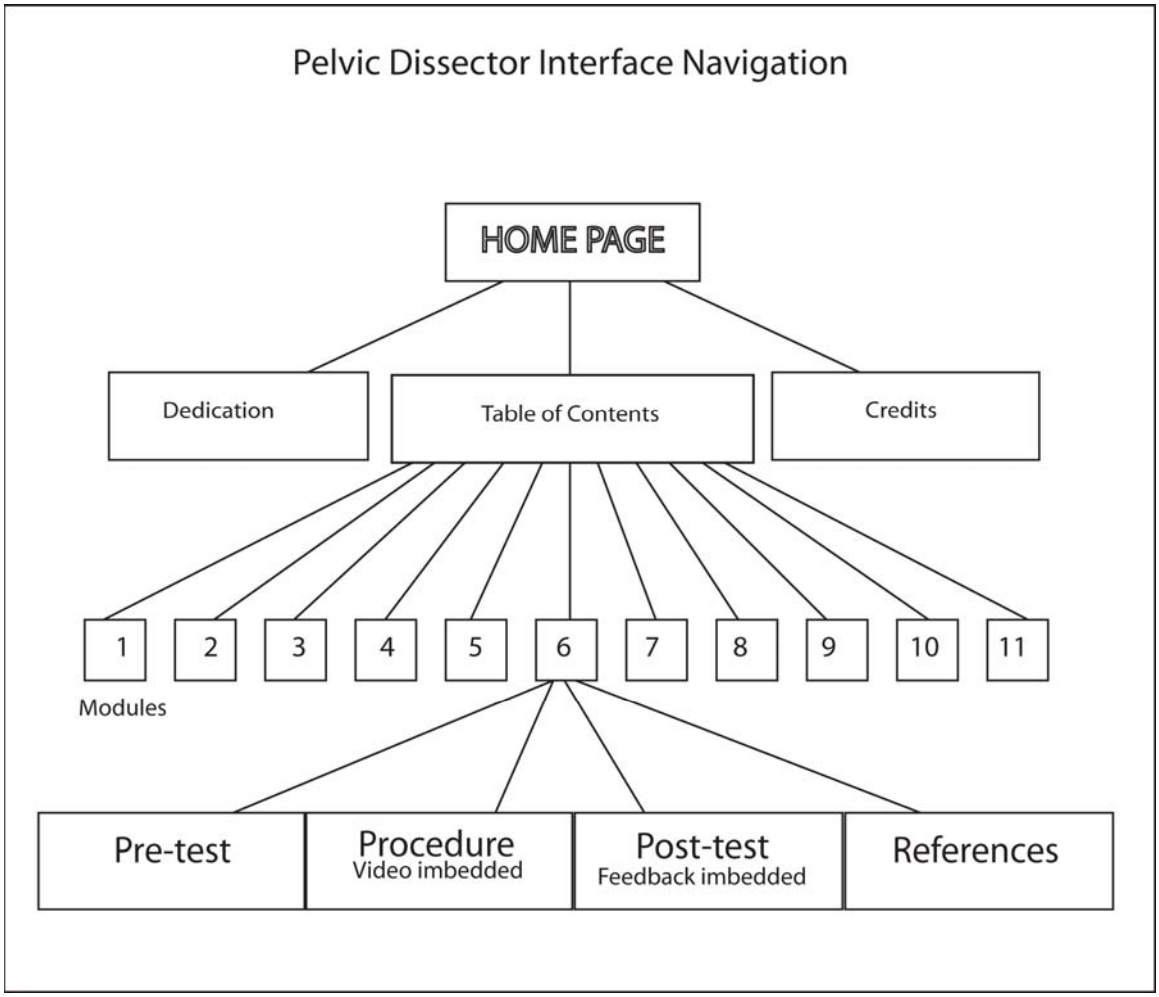


Figure 3-1. Site map: The site map shows one way to navigate through the training aid.

Development of the Interface

Two modules were combined, reducing the number to ten. Videos, animations and illustrations would be imbedded in the pages. Four sample layouts were presented to the committee (Figure 3-2).

Suggested changes to the site map were that the table of contents link to the pretest, to discourage the students from not taking the pretest; a way should be provided to skip the test and go on to the text; and that the video be imbedded on a page where it was referenced. References and the posttest would be at the same level as the rest of the pages. Drop down menus would help to conserve space.

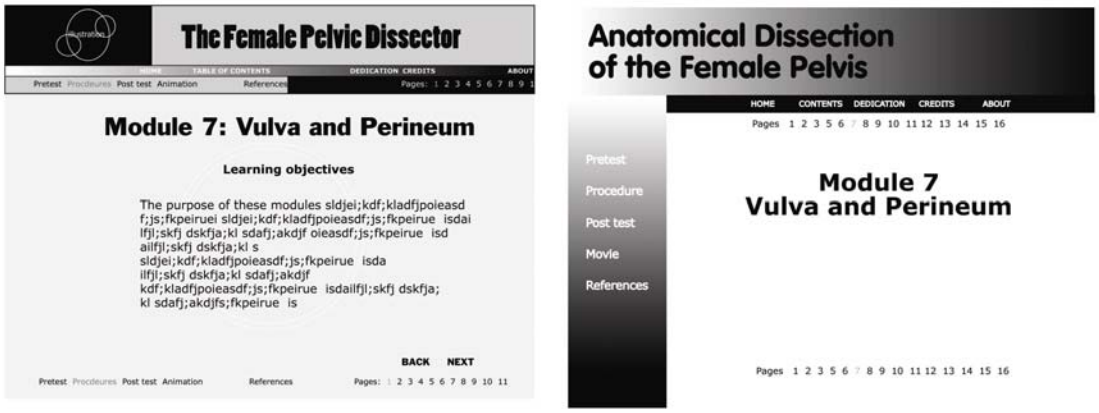


Figure 3-2-1. Two of four initial layouts for the modules.

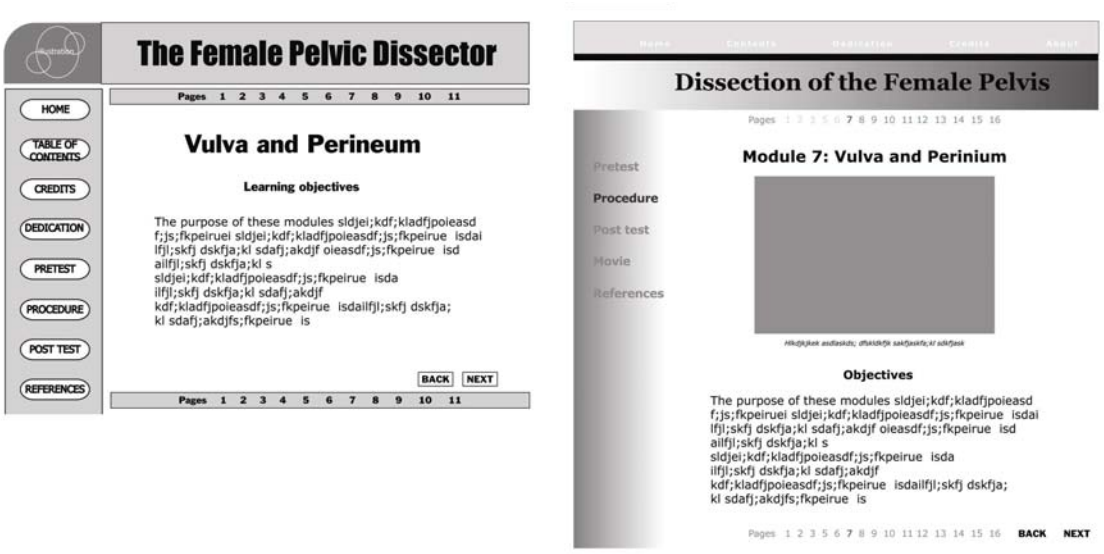


Figure 3-2-2. Two of four initial layouts for the modules.

Three of the home page designs were inspired by the Front Page® layout, but they took up too much real estate on the page, space that was needed for text, illustrations or imbedded video, and navigation buttons. A clean and simple design would work best, plus helped give it a medical-institutional feel, like a laboratory where studying cadaver structures took place. The left layout, figure 3-2-1, looked like it would provide the most room for the necessary data and looked the cleanest. The first design used gold, silver blue and black in the banner (Figure 3-3), which was inspired by the colors used around campus at the University of Texas Southwestern Medical Center at Dallas. Some type for the links was reversed into color blocks; but using reverse type turned out to present a problem: the code for links only allowed for one set of colors for the text links, so white on white or black on black type would not show up. Also many computers override the color choices for links. The colors of

the links were chosen to complement the rest of the colors, provide a contrast to the banner colors, and not look too brash embedded in the text.

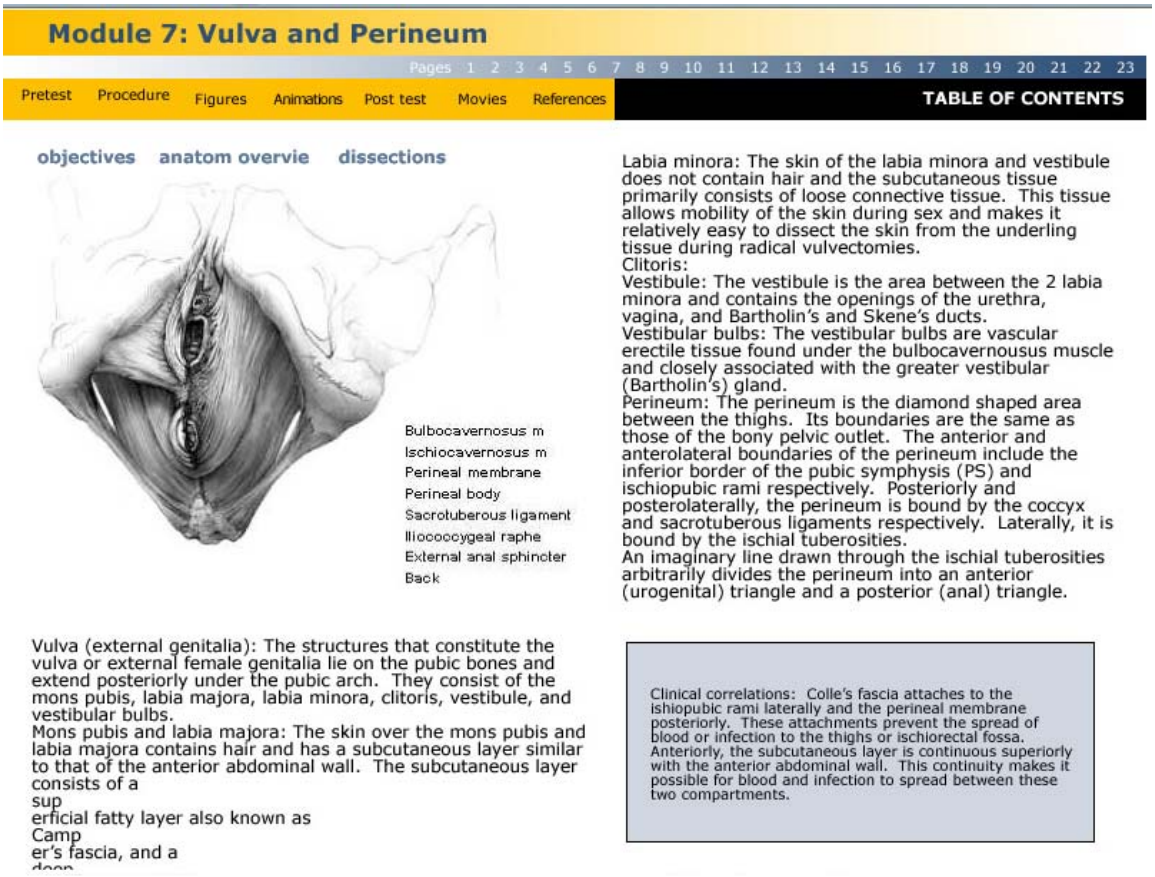


Figure 3-3. First fully developed layout for the home page.

Some experimentation was done with Flash® footage for interactivity with the figures so their labels would pop up when a structure or a term was rolled over by the curser. This was a preliminary test to see what method would fit our needs. The Flash® would eventually be eliminated. It turned out to be easier to put "swap image" files in the web pages themselves, and it was easier to edit or change them there.

More designs and images were tried for the home page. One suggestion was to make a more feminine design. In Figure 3-4, a flower was used because the shape seemed symbolic of the female pelvis and mimiced the organic flow of the illustrations.

Figure 3-4. Banner with flower.

An informal test was made to two fellows in the Obstetrics and Gynecology School, who were shown this design and they tried out the interactivity. They didn't understand the reasoning for having a flower in the banner and it confused them. The navigation seemed good.

Another plan for the home page was to have interactivity on the home page, showing a list of terms next to one of the illustrations. When the curser rolled over the term, color would highlight the structure in the illustration (See figure 3-5).

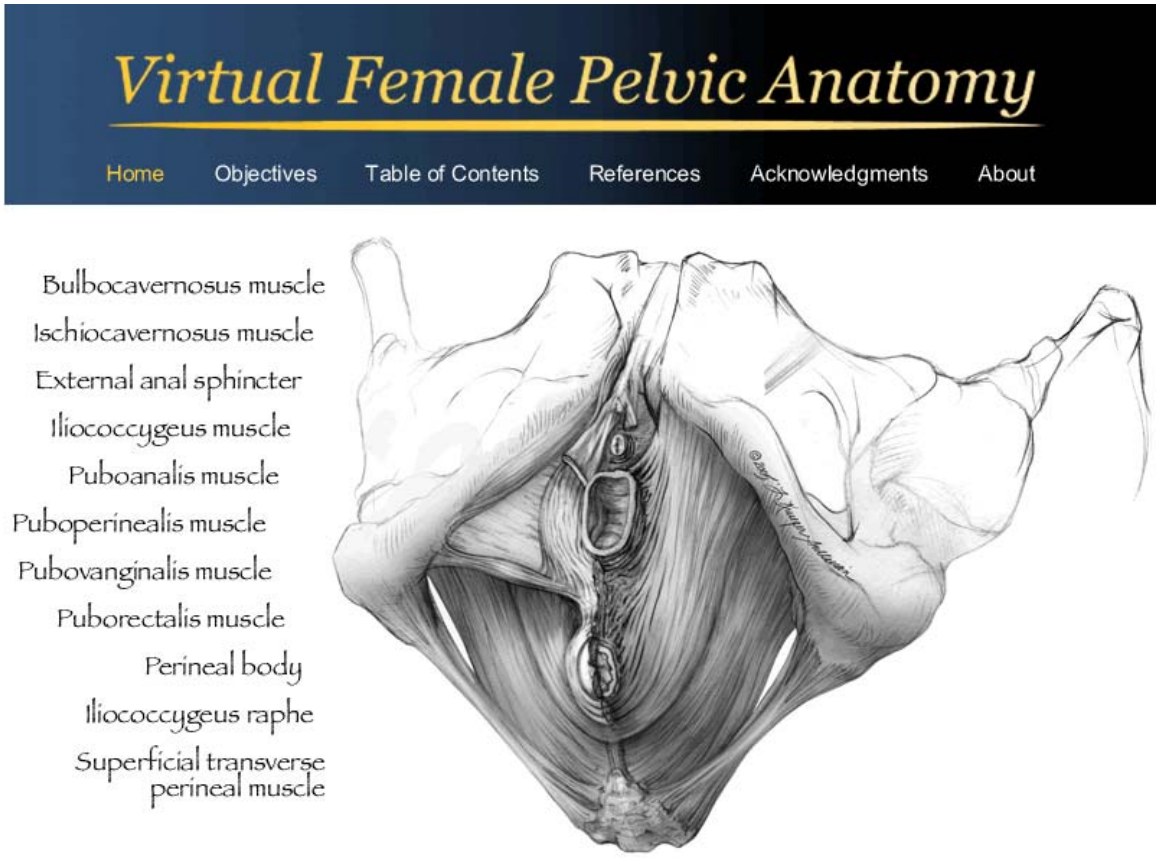


Figure 3-5. Home page with interactive illustration: One of the illustrations and list of terms that highlight the structures when the mouse rolls over them.

Using the one illustration didn't represent all of the modules so wasn't used. A new name for the project was chosen, Virtual Female Pelvic Anatomy, and the dark blue banner with gold type was accepted. It was quite simple to change the banner with the new name by replacing the slice in Dreamweaver®. Navigation buttons in the banner were created in Fireworks®

and change color when clicked. A new swap image design is seen in Figure 3-6 with all the parts of the home page near finalization.

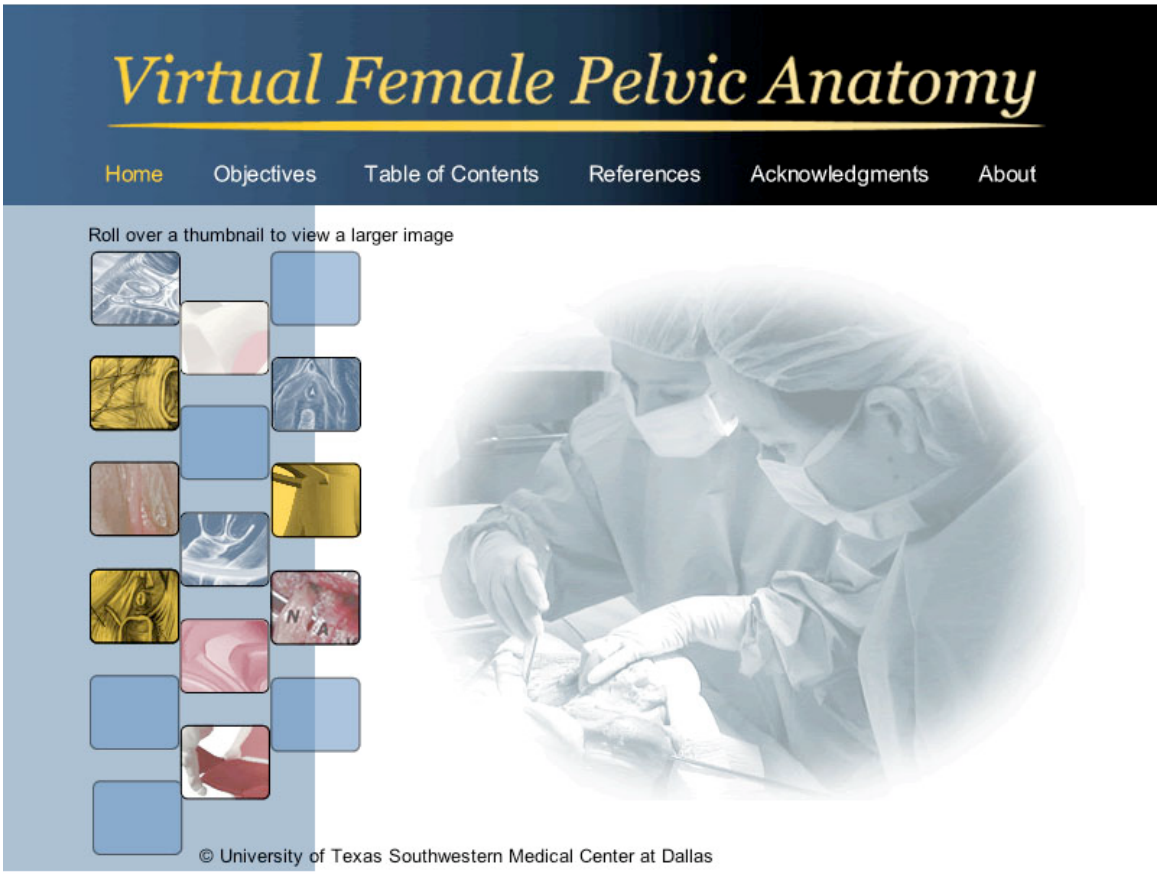


Figure 3-6. Semi-final design for the home page: The windows to the left change color and swap images with the large picture on the right.

The previous and following home pages have small windows with a sample of each type of graphic, left of the larger picture. When the cursor rolls over a small window, it changes to full color and a larger picture swaps places with the vignette. Ten windows were to allow places for ten pictures of modules.

The buttons for the secondary pages were reduced from six to five. The name of the instructional aid was changed to Interactive Female Pelvic Anatomy and the typeface was

updated. The new title more accurately describes the function. These were the final changes (Figure 3-7).

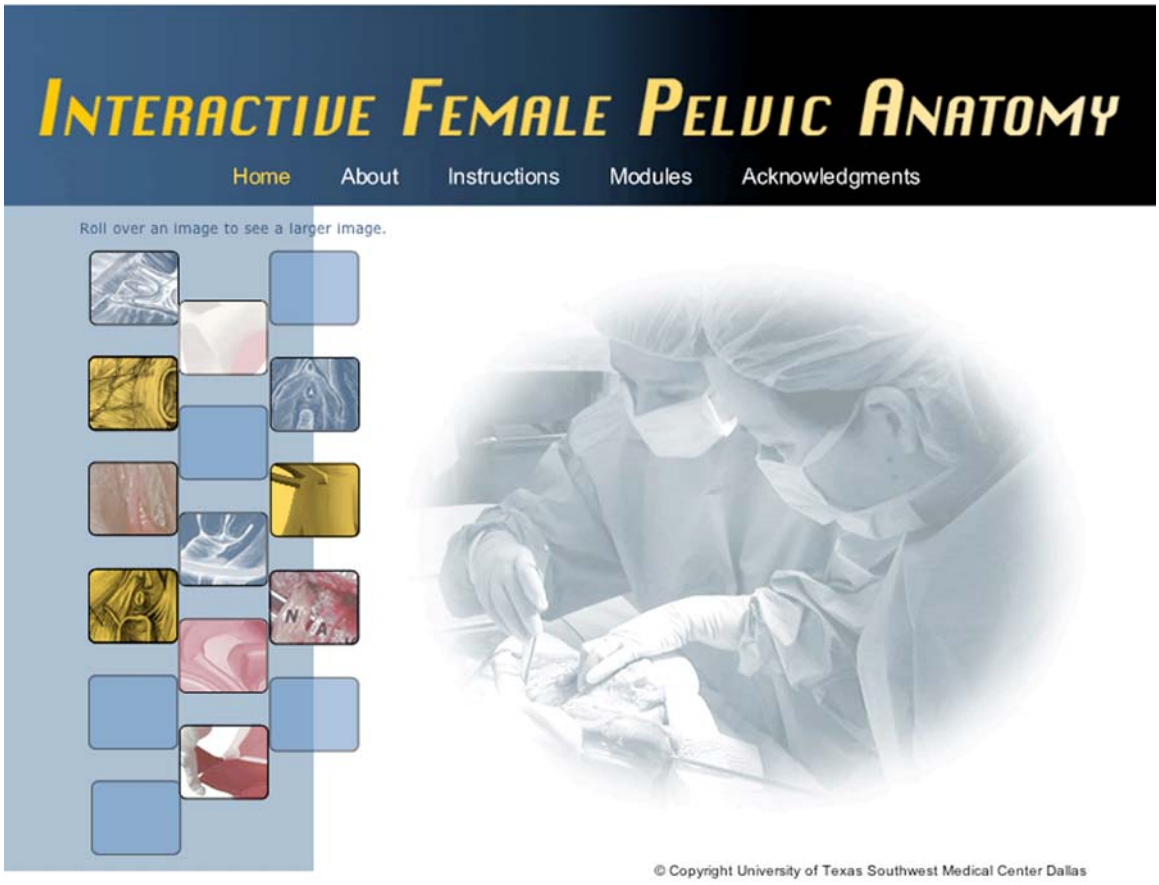


Figure 3-7. Final design of home page: The same interactivity as the previous design.

Components

Home Page

The home page auto opens when the disk is inserted into the computer on most PCs. The auto run only works on PCs; newer Mac operating systems have been programmed to prevent auto run. The Mac user must click on the index or the icon on the desktop and use the "open with…" command in the file and choose their Internet browser. The home page allows the user to access the rest of the program.

Parts of the home page

Banner: The title "Interactive Female Pelvic Dissector" has a distinctive color and typeface, which is used on the secondary pages. The type color is a gradient from gold to pale gold in a blue gray background, which also is a gradient. The design was kept uncomplicated and "clean" to avoid confusion of too much unnecessary clutter and give a simple professional appearance.

Navigation bar: Five secondary pages are accessed through the navigation bar: Home, About, Information, Modules, and Acknowledgments. It is located on the bottom line of the banner. The navigation buttons change color when the cursor rolls over them and are not affected by the link colors.

Ten small images: Ten illustrations and still images taken from the videos, illustrations and animations were planned to represent the ten modules. Two modules became the final version. When the curser rolls over one of the images, it changes color, to signal that the window will cause a change somewhere.

One large image: The general concept of a course teaching female pelvic anatomy is represented by an image of students in a dissection lab. This is the window where images swap to reveal the larger image found in the small windows. The idea of interactivity is introduced on the home page to indicate what will come in the following linked pages.

Pretest

The pretest is a quiz the user takes on the computer for each module, which measures the knowledge the student already has on female pelvic anatomy. A score is tabulated giving the percentage of correct responses, but no indication is given as to which ones were answered correctly. This is to prevent the student from memorizing the answers instead of studying the module.

Posttest

The posttest is a quiz found in each module, which the user takes after studying the module. This test provides feedback after each question and gives the student a chance to learn from mistakes. If the wrong answer is selected, an explanation pops up.

Modules

Ten modules are planned for the computerized training aid, with a different subject covered in each module. Two modules have been written at this time.

Parts of the modules

Text: The largest component is the written document, which contains several linked pages, so that the student can navigate through them in consecutive order. Type is set on the left side of the page because readers in the western world are accustomed to begin on the left when reading and move the eyes right. Links are imbedded in the type so that when the curser rolls over an anatomical term, an overlay highlights the structure on the illustration and a label appears, as a visual definition and an aid to memorization. The links are in italics. Colors are assigned to the links, but individual computer default settings will override the programmed colors.

Clinical Correlations: When a passage on the page is apropos to a clinical procedure, it is called a correlation and is set apart in a colored box. Things that can go wrong because of the anatomy in a clinical procedure are explained and how injury can be prevented. A border was added to the box because some browsers did not support the tinted background.

Illustrations: A series of illustrations were created unique to this dissector that we could copyright and would be realistic and comparable to actual anatomy. In this way locations of structures that are hard to find on an actual cadaver can be shown in the figure. The sketches were executed by hand in graphite and then placed in Photoshop® to be finished with tone and labels. The sketches were given figure numbers for purposes of building the program, but do not display figure numbers when in the page. Color overlays were created in Photoshop® to highlight the structures. The figures were sized to fit in a 500 pixel wide by 412 pixel high window. A labeled figure forms the base, and when an italic term is rolled over in the text, the picture is swapped to show the topographical structure with the color overlay and its label in the figure. The artist provided labels with the illustrations and more labels were added as needed. Since more labels were needed than the space on the illustrations permitted they cannot all be displayed at the same time. The typeface was standard on a Mac but not on a PC and so had to be edited on a Mac. Since the original figures were reduced by different percentages to fit the space, the label type was adjusted to be the same size on each page.

3d Animation: Four animations are used in Module 7, produced in Maya®, which plays in QuickTime®. Procedures to download QuickTime® onto their computers are given on the instruction page. One other animation that was created was an interactive model of the female pelvis as the pelvic floor moved. When a curser was placed on the figure it could be turned in every direction to study the movement of the muscles. It was decided that the animation was too difficult to use. A special plug-in had to be added to the computer to be able to use this animation and as we would learn, even getting QuickTime® to work was

difficult for some students. The procedure to add the animation plug-in was slightly different on different computers. Another complication was that if the user was able to add the plug-in, other keyboard procedures had to be performed to get it to look right on the screen each time it was used. For instance, you had to press the space bar eleven times to remove the background grid. Since a preliminary test showed the students liked clean and simple, we decided the students would not like using a complicated plug-in. This type of interactive animation is on the cutting edge of animation, but not yet ready for the audience of this training aid. I also found that when I tried to copy a disk on the Mac using Roxio Toast, a disk burning program, it would abort every time if that plug-in was included.

Videos: Two videos were produced in Premier Pro® 1.5 by Dr. Corton. She video-recorded the footage of the dissections using fresh cadavers in the dissection lab. The first video is The Perineum, which is narrated. The second is the Femoral Triangle, which is not narrated, but uses labels instead.

CHAPTER FOUR
Results

METHOD OF TESTING

Test Run

The training program was tested on medical students, residents and fellows in the Obstetrics and Gynecology department. Forty-one students began the trial, but only thirty-nine finished. A randomized trial was done by giving all of the students both modules, but half were given "Module 7" in CD and half were given the written paper form. The groups were reversed for "Module 8"; the group that had the former in CD got the latter in written paper form and the rest got the CD. The students with the printed form of the module did not have the animations or videos that went with it. None of the participants had seen either module before studying them. They were tested with a printed test before studying the modules and were tested again after studying the modules and later given a follow-up quiz to measure retention. The interactive quizzes on the computerized versions were disabled, so all of the students received the written quiz without seeing the questions. Only the content of the text, illustrations, animations and videos, and interactivity were distributed.

When asked what kind of computer they used, twenty-one respondents said that they used a PC to work the program and none said they used a Mac. Seventeen did not name their type of

computer. Of those that named the Internet browser they used, two used Yahoo and three used Internet Explorer.

Each participant who finished the program and the evaluation was given a $50 gift certificate. The test scores were not a part of their semester grade, so the incentive to learn and memorize the material for a grade was not there. Those with the paper-based aid had the illustrations in black and white in static 2d form with labels.

Division into Groups

The sample consisted of forty-one participants: ten medical students with three or four year's study, twenty-eight post-graduate level (three at one year, ten at two years, five at three years, ten at four years), and three female pelvic reconstructive surgery fellows. They were randomly placed into two groups: half were given the "Pelvic Support" module in paper format and the "Vulva and Perineum" module in computer-based format; the other half was given them in reverse format. Thirty-nine of the forty-one students finished the study.

Testing Conditions

All students were given a 20 and 36 question-based quiz (the pretests) before studying the modules. Then they were given three to five days to study the material. They were again tested (the posttests) after finishing the study material. Close-ended questionnaires with a 5-step Likert-type scale that went from Strongly Agree to Strongly Disagree were given after the test to assess their impressions of the format of the computerized modules. Finally they

were tested three to four weeks later to evaluate their retention rate (the follow-up tests). Questionnaires were also sent to the students to assess their satisfaction with the study aids.

Test Results

Test scores could be evaluated based on level of training and which format of training module was received. Students' t-tests were paired by the testing period and results were analyzed by repeated measures analysis of variance. Figure 4-1 shows overall pretest results for the group as a whole and for individual levels of training.

Scores on the posttest improved for all groups, regardless of which format or which module they received. Figure 4-2 compares the pre- and posttests and shows the change in test scores by overall group and by level of training for each instructional format. There were significant differences in some of the groups from pretest to posttest. There is a significant difference between the paper format to the computerized format for the medical students and first year PGY group, with the computerized format being less. When averaged overall, there is not a significant difference between the two formats.

Differences in paired posttest and follow-up tests scores are shown in Figure 4-3. The group with the fellows learned the most under both formats and retained the most. The medical students and post-graduate level learned more with the paper format and retained less with the paper format. Overall satisfaction results with the computer format are generally positive.

Test Scores

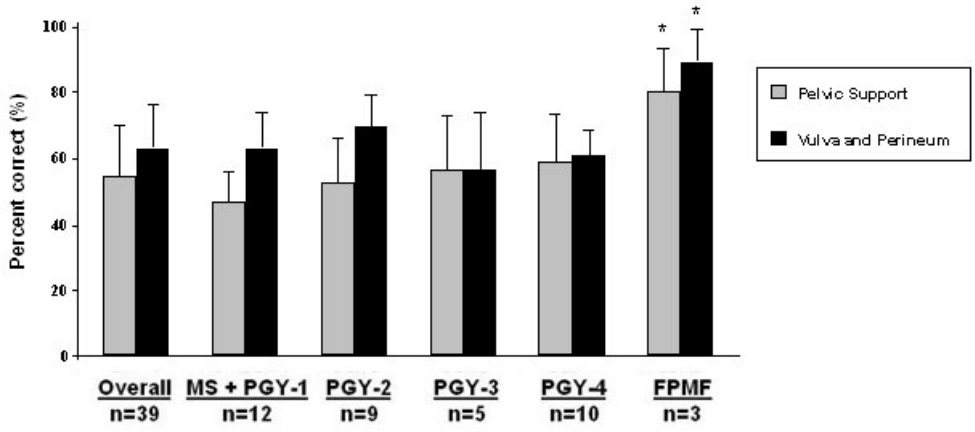


Figure 4-1. Pretest scores: Paired for both anatomy modules. Comparison by overall results and by level of training. MS – PGY = Medical students and Post-graduate level, PGY = Post-graduate level by year, FPMF = Female pelvic medicine and reconstructive surgery fellows, *Significant difference by level of training, (P<0.05). (Corton, Comparison)

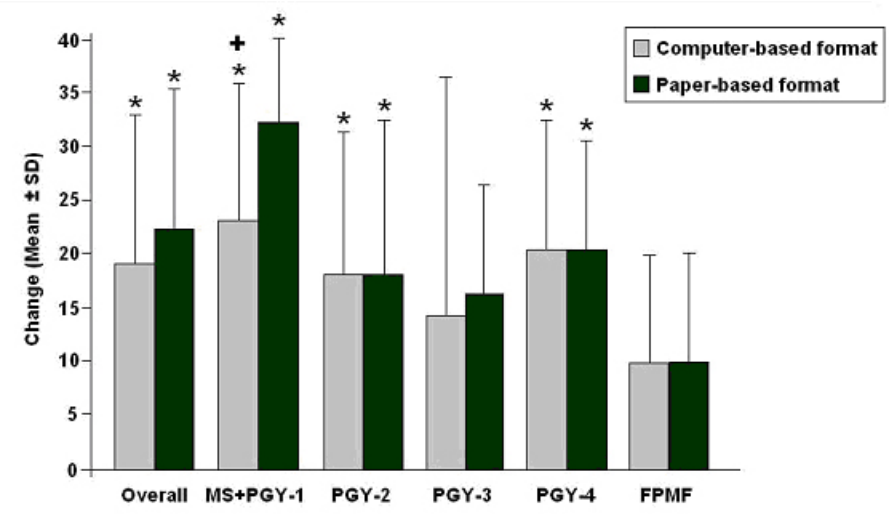


Figure 4-2. Pretest to Posttest changes: Scores by overall group and by level of training for each instructional format. *Significant difference between pre and posttest scores in each instructional format (P<0.05). +Significant difference between both formats (P<0.05). (Corton, Comparison)

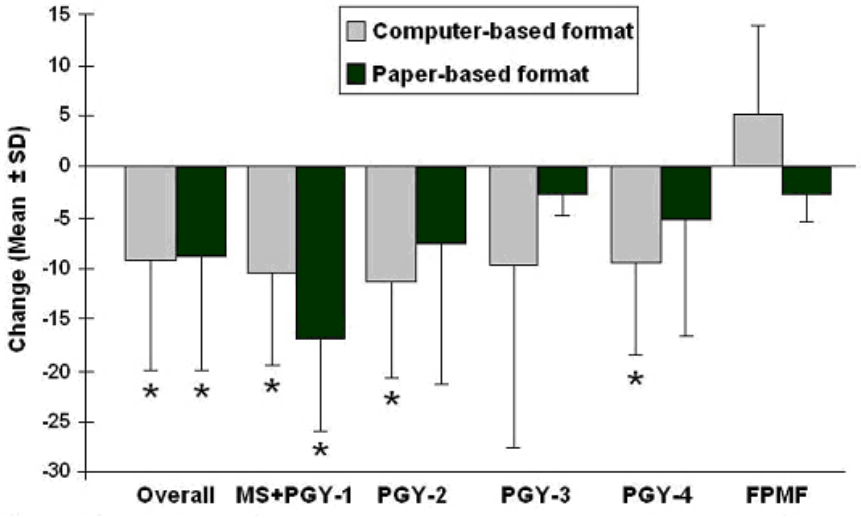


Figure 4-3. Follow-up test result changes: Compared with posttest scores for the group overall and by level of training for each instructional format. *Significant difference from post to follow-up scores (P<0.05). (Corton, Comparison)

Each group studied a computerized module with video or animation and a paper-based module without video or animation. A comparison was made of the scores for those whose answers could have been learned watching the animation or video to those who did not have the video or animation. Three questions that were addressed in video or animation were taken from each module and compared. The changes in learning results are shown in Figure 4-4. The written format appears more successful than the computerized format according to the graph showing changes, but compare the raw scores in Figure 4-5.

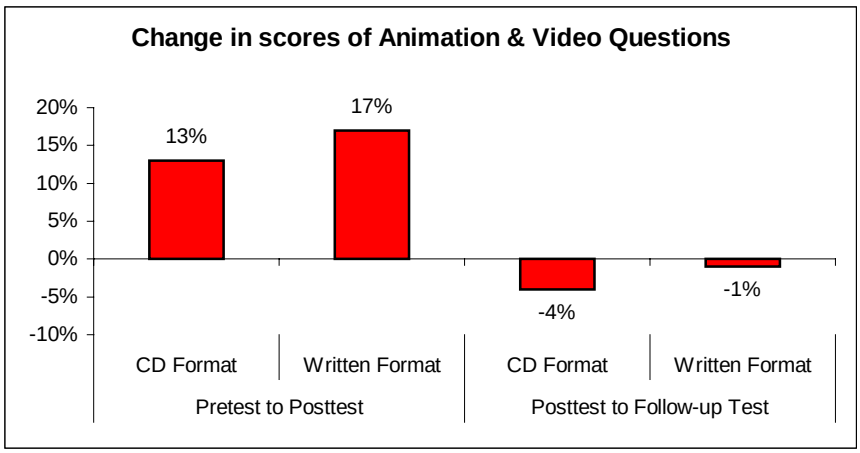


Figure 4-4. Changes, animation & video questions: Changes overall in scores of three questions based on video and three questions based on animations. ($P<0.05$)

The group with the CD format started at a higher learning level. The paper-based group had a higher percentage of increase, but did not catch up to the former group (Figure 4-5).

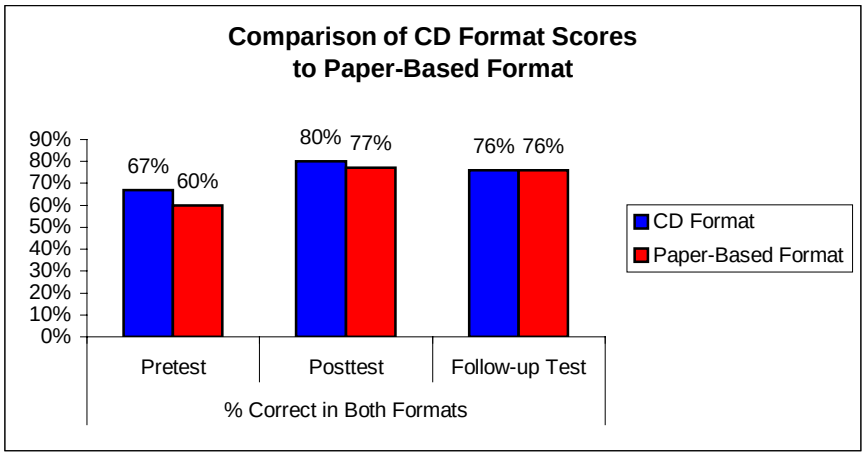


Figure 4-5. Comparison, CD to paper strategy: When the groups took the follow-up test, the scores were equal, whether they had watched the video or animation or not.

Satisfaction

Satisfaction with the training aids was reported on a questionnaire that was mailed to each participant. They reported that the computer-based training aid took longer to go through but they preferred it to the paper-based module.

Satisfaction with the interactivity and design of the computer-based training aid was reported on a questionnaire passed out at the posttest. Students were very favorable towards the computerized training aid. Any criticisms made of the aid have been addressed.

QUESTIONNAIRE ON INTERFACE

The testing sample was happy with the home page. They agreed or strongly agreed that it was understandable and easy to use. No changes were recommended (Figure 4-6).

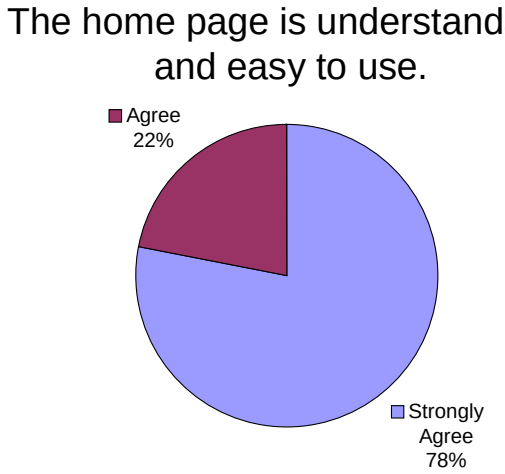


Figure 4-6. Home page: The home page is understandable and easy to use.

The group mostly liked the illustrations and thought they were clear and comprehensible. Six percent had no opinion (Figure 4-7). One wrote “great drawings.”

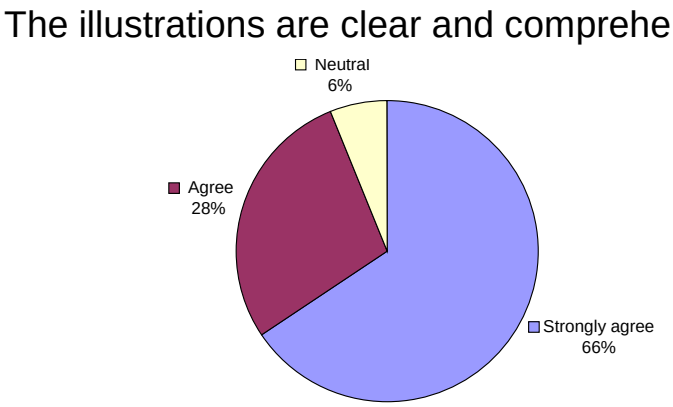


Figure 4-7. Illustrations: The illustrations are clear and comprehensible.

The rollovers were well received (Figure 4-8). There were no criticisms. One wanted to be able to rollover the illustration and turn it to see some three dimensional views. One such 3d animation was produced, but was complicated to use and left out of the project.

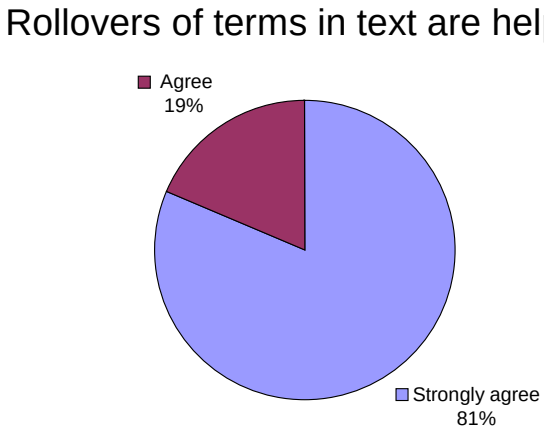


Figure 4-8. Rollovers: Rollovers that highlighted structures in the illustrations were liked.

There was some dissatisfaction with the photo images. Six per cent did not think the images were clear and comprehensible (Figure 4-9). One commented, “Images could use better color contrast to delineate different structures.”

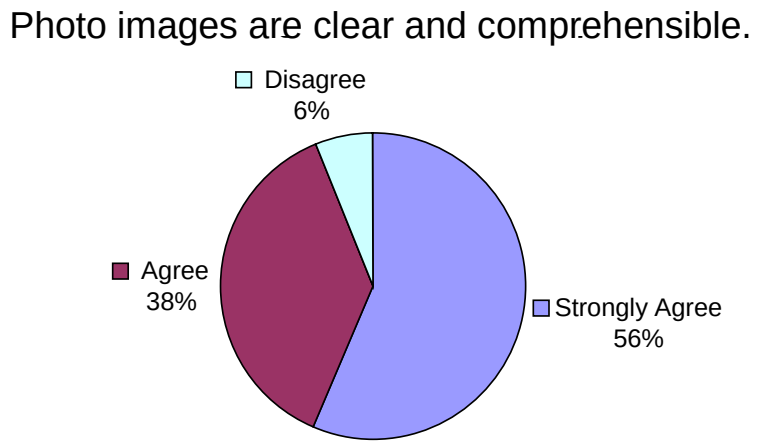


Figure 4-9. Photo images: Photo images were positively rated by 94%.

There was a wide range of opinion about the animations, with 77% agreeing that the animations were helpful to understand the movement (Figure 4-10). In the response to the questionnaire, two in the “other” category wrote “NA”. One who disagreed didn’t explain why. Another thought they would have both video and animation and couldn’t get either to open. A few comments (stated verbally) were that the QuickTime® they were instructed to download didn’t work.

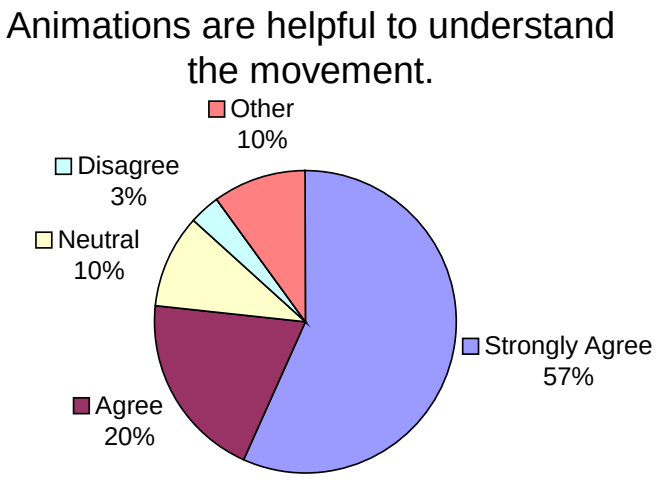


Figure 4-10. Animations: For animations, “Other” category included responses of not applicable, animations wouldn’t open, or took too long to load.

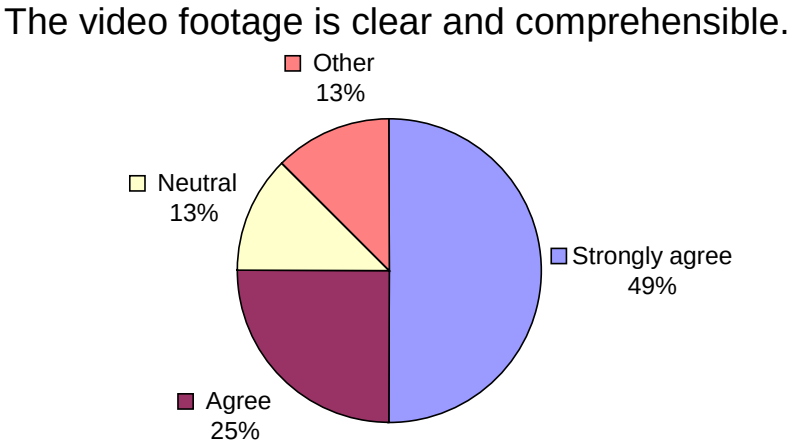


Figure 4-11, Videos: Three quarters were satisfied with the videos.

The students found the content to be well organized. There were no complaints or comments.

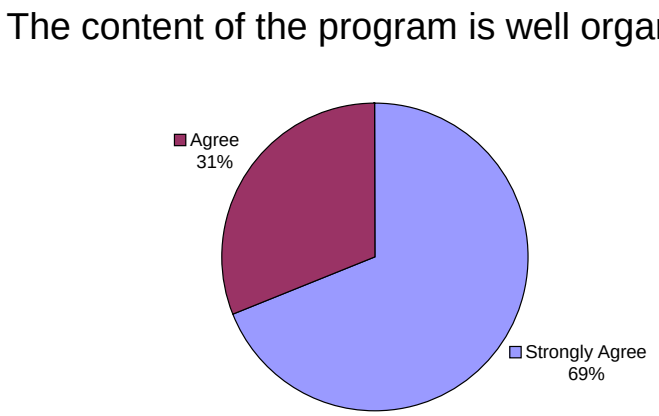


Figure 4-12. Content well organized: The content of the program is well organized.

Most felt that the interactivity was a suitable tool to explain anatomy. 11% had no opinion (Figure 4-13). One said it would help to: Have name of structure pop-up when cursor is placed over the illustration.

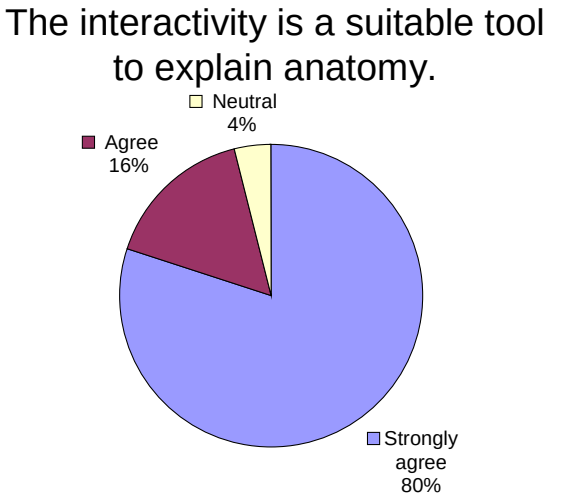


Figure 4-13. Interactivity: The interactivity was well received.

All agreed that the graphic design was visually appealing (Figure 4-14). There was a preference for the computerized version over the paper version.

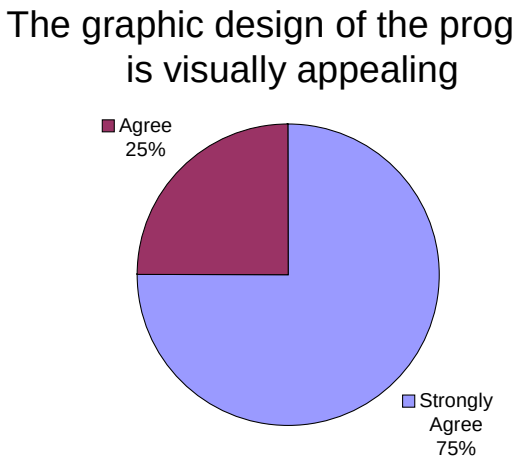


Figure 4-14. Graphic design: The graphic design of the program is visually appealing.

There was strong agreement that it was easy to maneuver through the interface (Figure 4-15).

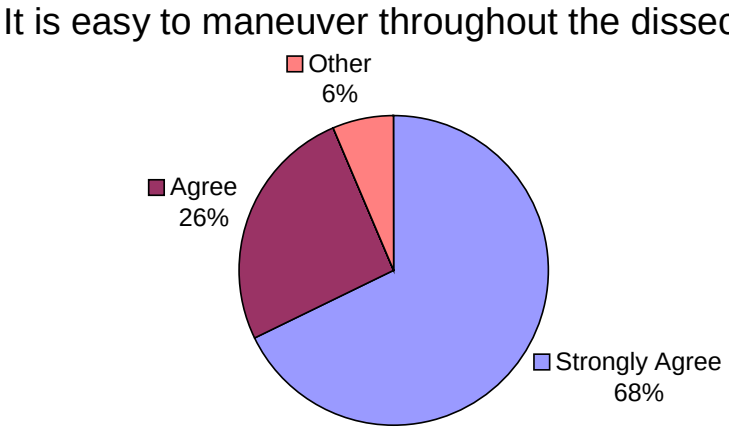


Figure 4-15. Maneuverability: One asked, “what is a dissector?” a comment which fell in the “other” category. Originally this project was thought of as a “dissection manual;” I hadn’t updated the question to match the title, which confused some.

A computerized teaching aid was well accepted (Figure 4-16). One comment was, “They could - probably should - teach 1st year anatomy this way. Much better than trying to sift through another dry text, always having to turn back to earlier illustrations”.

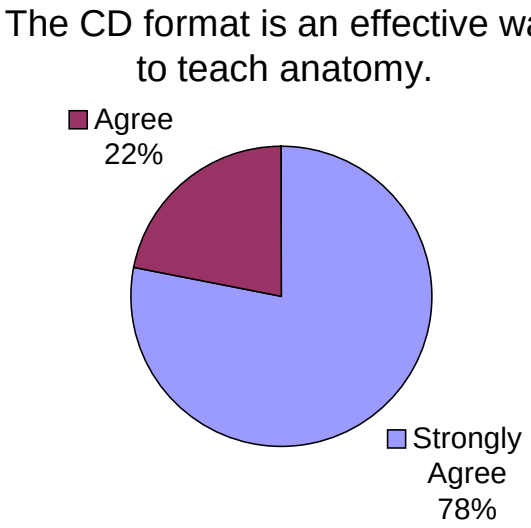


Figure 4-16. Effectiveness: Combining computer animation with cadaver photos, illustrations and anatomical video is an effective way to teach female pelvic anatomy approaches.

Questionnaire Statistics

Responses: 32

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Other
The home page is understandable and easy to use.	25	7	0	0	0	
The illustrations are clear and comprehensible.	21	9	2	0	0	
The rollovers in the text highlighting structures help to explain anatomy.	26	6	0	0	0	
The photo images are clear and comprehensible.	18	12	0	2	0	
The animations of the pelvis are helpful to understand the movement.	17	6	3	1		3
The video footage is clear and comprehensible.	16	8	4	0	0	4
The content of the program is well organized.	22	10	0	0	0	
The interactivity is a suitable tool to explain anatomy	25	6	4	0	0	
The graphic design of the program is visually appealing	24	8	0	0	0	
It is easy to maneuver throughout the dissector.	21	8	0	0	0	2
The computerized training aid is an effective way to teach female pelvic anatomy.	25	7	0	0	0	

TABLE 4-1. Questionnaire Statistics: The statistics used to create the pie charts above.

Platform used by those who responded.

Internet Browser	No Answer	SBC Yahoo	Internet Explorer	
PC	21	2	3	
Operating System		Windows XP-2 Windows 98?-1 (Ibid)	Windows-1	Windows NT-1

TABLE 4-2. Platform used: What type of computer the student used and what Internet browser used.

Additional comments and/or suggestions

“Loved the CD!”

“Some of the Anatomic figures (from cadaver) in handout were confusing without labels. I thought the CD was an extremely effective method to teach the anatomy!”

“Great drawings.”

“I really enjoyed using the program.”

“Cadaver pictures somewhat hard to understand.”

“Images could use better color contrast to delineate different structures.”

“Not all animations opened on CD.”

“It took approximately 10 minutes to load.”

“Difficult to see what program I’m in.”

"Would help to: Have name of structure pop-up when cursor is placed over the illustration."

"I had Module 8 CD – the video of the femoral triangle did not have any voice-over explanation – would have been nice to have."

"It would be helpful if the rollovers also included 3d rotating images of the pelvis structures. It is difficult to visualize the orientation of these structures from different angles in my mind."

"Computer preferable to paper handouts."

Repeatability

The results of this test were similar to the results found by Khalil, Johnson & Lamar when they compared a computerized and paper-based learning strategy on veterinarian students. In that study they found that the computerized strategy was as good as the paper-based.

"The point is that if a hypothesis is correct, anyone and everyone will get the same results when the experiment is performed. If it isn't repeatable, you have to doubt the conclusions even when you have complete confidence in the abilities and integrity of the original investigator." (Martini & Welch, Applications Manual 3).

CHAPTER FIVE
Conclusions and Recommendations

IMPLICATIONS OF TEST SCORES

Evaluation

The computer-based program was completed and tested. It was set up as a web-based platform that could be navigated from page to page linearly or in any order by hyperlink, contained anatomic explanations with illustrations, embedded terms with an interactive link to highlight anatomical structures with color overlays, had video and animation, and two kinds of interactive quizzes. It was distributed on a CD to medical students and then tested with a pretest, posttest and follow-up test. Students studied one traditional written format and one CD for two modules, randomized so each module was tested in each format in different groups.

Pretest Scores

The pretest scores revealed that the highest level of learning, those in fellowship, already had significantly higher knowledge of female pelvic anatomy than the other levels. This was to be expected. The posttest scores indicate that this highest-level group had the least amount of improvement in their scores. This would also be expected from a group that already knew much of what was in the instruction.

Pretest to Posttest

Comparison of posttest scores with the pretest scores also reveals some significant findings. There was positive improvement in both formats presented to the students. One group showed a significant change in scores when using the computerized format over the other: the medical students and first-year post-graduate students.

Follow-up Test

The follow-up testing has more revelations. Overall, about half the group had significant loss of learning in the weeks after the testing. The highest level of learning showed the least amount of loss; in fact the group that had studied by the computer-based format increased their scores, but they were actively studying in the lab and able to reinforce the learning. The lowest level of learning had the lowest rate of retention, with the paper based format having the very lowest rate. The post-graduate levels show a lower rate of retention with the computer-based format, but it is not always a significant difference between the computer-based and paper-based format. The average difference of learning and retention between studying on the two platforms by the group as a whole is extremely close. This is similar in results to a study using computer-based and paper-based strategies for comparative anatomy of the canine skull and digestive system (Khalil, Comparison of Computer-based and Paper-based). It was found that computerized strategies were just as good as traditional strategies and the students preferred the computerized.

IMPLICATIONS OF APPROVAL RATINGS

Overall Approval

The overall approval ratings are high. The home page, graphic design and rollovers of the terms highlighting structures in the illustrations are highly rated. The textual content was also highly rated. The illustrations were not significantly lower in students' rating.

Animations and Video

The animations were found only in the "Pelvic Support" module and the videos were found only in the "Vulva and Perineum" module. Some students could not open the animations or the videos. These two programs were ranked lower in their approval rating as some students marked neutral if they didn't have one or the other.

Reinforces Previous Study

The interactivity and maneuverability throughout the interface of the computerized version was also well accepted. The students liked the computerized version more than the paper version. Because the approval of computerized training aids and self-directed learning aids was the same as the previous comparison of computer and paper-based strategies (Khalil, Comparison of Computer-based), it is believed that students would continue to approve and want to use computerized strategies.

RECOMMENDATIONS

Success Means Continuation

The creation of a computer-based training aid has been successful in its functioning. It was as beneficial as the more traditional paper-based way of learning in conveying knowledge. More students preferred the computerized program. The students were able to navigate through the interface and find the sections that they needed easily. It is possible to include animations and video when a training aid is computerized. The students liked being able to read anatomical explanations and have a labeled illustration on every page, without having to go back and find the figure that goes with it, like in a book. Although there is a limit to space or storage on a CD or DVD, it is not expensive or wasteful of space to include an illustration on every page. Development should continue.

More Study Needed

One learning level group gained more using the paper-based format. That was the third- and fourth-year medical students and first-year post-graduate level. What could there be about the paper-based strategy that increased their learning dramatically? Ironically, the same group with the paper-based aid also had the most decrease in learning three to four weeks later. Since each group studied one paper-based module and one computerized module, different learning preferences based on media as a factor were eliminated between the populations.

Each group experienced both learning strategies. More study is needed to find what would train different learning levels better and their differing needs.

Requests were made to expand the use of computerized training aids for teaching anatomy. More types of interactive animations were wanted, especially a 3d that could be rotated by the cursor. Illustrations that would pop up a label when the cursor rolled over the structure were also requested to serve as a self-test. More design and research into innovative and cutting edge animations and interactivity should continue.

Testing of the computerized learning strategy has shown it to be as good as the traditional paper-based strategy. The students expressed a preference for the computer-based strategy. That is reason enough that computerized training aids should be incorporated into the study material of a course. It is also a way that self-directed learning can take place.

Further testing in larger groups, in different universities, and with other audiences should also be done. Audiences such as post-graduate schools training nurses, researchers, and physician assistants could be tested. This research was conducted with a group of students who got a gift certificate as an incentive. It would be helpful to test the training aids on students who were working for a grade in a course, to see if test results would be the same.

Project was a Prototype

Although this training program had two finished modules, eight more were originally planned. The rest of these modules could also be finished, adding the suggestions that the test group of students have given.

APPENDIX A
Pelvic Support Anatomy-Pre-test

1. Which of the following structures is NOT considered part of the pelvic diaphragm

   a. Perineal membrane
   b. Levator ani muscles
   c. Coccygeus muslces
   d. Superior and inferior fasciae of the levators

2. The “active floor” of the pelvis is provided by the normal resting contraction of which muscles

   a. The obturator internus
   b. The bulbocavernosus
   c. The levator ani
   d. The coccygeus

3. Which muscle fiber type is recruited during reflex contraction of the levator ani muscles

   a. Type I (slow twitch) fibers
   b. Type II (fast twitch) fibers
   c. Type III fibers
   d. Type IV fibers

4. During voiding and defecation, the pelvic floor muscles generally

   a. Contract
   b. Relax
   c. Remain contracted
   d. Remain relaxed

5. Which of the following muscles is NOT considered part of the levator ani muscle complex

   a. Pubococcygeus
   b. Puborectalis
   c. Coccygeus
   d. Iliococcygeus

6. Fibers of the pubococcygeus muscles attach to all of the following structures EXCEPT

a. The urethra
b. The vagina
c. The anus
d. The perineal body

7. Which of the following actions best describes the normal response of the levator ani muscles during sudden increases in intraabdominal pressure, i.e. coughing

a. Reflex relaxation
b. Reflex contraction
c. Remain the same
d. ???

8. Which component of the levator ani muscles contributes most significantly to the anorectal angle

a. The puboanalis
b. The iliococcygeus
c. The puboperinealis
d. The puborectalis

9. The levator plate is formed primarily by the midline attachments of which muscles

a. The puborectalis
b. The pubococcygeus
c. The iliococcygeus
d. The coccygeus

10. The levator plate forms a supportive shelf upon which the rectum, the upper vagina, and the uterus rest away from the urogenital hiatus. Which of the following best describes the orientation of the levator plate in a woman with normal support in the standing position

a. Parallel to the horizontal plane
b. Perpendicular to the horizontal plane
c. 45 degrees to the horizontal plane
d. 80 degrees to the horizontal plane

11. Which of the following physical exam findings is most likely due to previous neuromuscular injury to the levator ani muscles

a. Positive Q-tip test
b. Absent bulbocavernosus and anal wink reflexes

c. Lengthening or widening of the urogenital hiatus
d. Poor contraction of pubococcygeus muscles

12. The levator ani muscles are primarily innervated by

a. Sympathetic fibers from the superior hypogastric plexus
b. Parasympathetic fibers from the inferior hypogastric plexus
c. The pudendal nerve
d. Direct somatic efferents from S 2-5

13. Which of the following statements best describes endopelvic or visceral fascia

a. Consists of organized arrangements of collagen
b. Consists of loose arrangements of collagen, elastin, and adipose tissue
c. Can be easily dissected or separated from the underlying tissue
d. Provides attachment of muscles to bones

14. Which of the following layers has NOT yet been identified by histologic examination of the tissue found between the vaginal lumen and the bladder or rectal walls.

a. A mucosal layer consisting of nonkeratinized squamous epithelium
b. A muscular layer consisting of smooth muscle, collagen, and elastin
c. An adventitial layer consisting of collagen and elastin.
d. A separate layer of fascia consisting of collagen

15. Which of the following structures represent the lateral points of attachments of the anterior vaginal wall

a. Arcus tendineous levator ani (ATLA)
b. Arcus tendineous fascia pelvis (ATFP)
c. Coccygeus fascia
d. Inner surface of the sacrum

16. The terms pubocervical fascia and paravesical fascia are commonly used to describe the layers that support the bladder and urethra and the tissue that is used for reconstructive pelvic surgeries. Based on histologic examination of this tissue, more appropriate terms include all of the following EXCEPT

a. Vaginal adventitia
b. Vaginal muscularis
c. Vaginal wall
d. Vaginal fascia

17. The main support of the vaginal walls comes from the interaction between which two components

    a. The bony pelvis and the visceral connective tissue
    b. The levator ani muscles and the visceral connective tissue
    c. The perineal membrane and the visceral connective tissue
    d. The perineal membrane and the levator ani muscles

18. Cervical or post-hysterectomy vaginal vault prolapse is believed to result from failure of which connective tissue component

    a. The cardinal-uterosacral ligament complex
    b. The mid portion of the paracolpium
    c. The perineal membrane
    d. The perineal body

19. Failure of midvaginal connective tissue support can result in all of the following clinical findings EXCEPT

    a. Anterior vaginal wall descent
    b. Posterior vaginal wall descent
    c. Stress urinary incontinence
    d. Perineal descent

20. Which of the following structures does NOT directly attach to the distal third of the vagina

    a. Perineal membrane
    b. Urethra
    c. Perineal body
    d. Arcus tendineous levator ani

APPENDIX B
Vulva & Perineum MCQ

1. Colles' fascia of the perineum is continuous with which anterior abdominal wall layer?
   a. Camper's fascia
   b. **Scarpa's fascia**
   c. Tranversalis fascia
   d. Rectus sheath

2. Which structure represents the superior boundary of the perineum and separates the perineum from the pelvic cavity?
   a. Perineal membrane
   b. Inferior fascia of the pelvic diaphragm
   c. Colles' fascia
   d. Superior fascia of the pelvic diaphragm

3. Where do the Bartholin's gland ducts most commonly open?
   a. Posterior surface of labia minora
   b. Posterolateral walls of distal vagina
   c. Posterolateral portion of the vestibule
   d. Skin of the posterior part of labia majora

4. The inferior or superficial surfaces of the vestibular bulbs are partially covered by which anatomic structures?
   a. Ishiocavernosus muscles

b. Perineal membrane

c. Bulbocavernosus muscles

d. Bartholin's glands

5. Which of the following structures is most likely to be responsible for the significant bleeding that can be encountered during excision of a Bartholin's gland?

a. Perineal branch of the internal pudendal artery

b. Clitoral branch of the internal pudendal artery

c. Venous plexus contained in the vestibular bulbs

d. Dorsal vein of the clitoris

6. Which of the following structures is contained in the superficial space of the anterior perineal triangle?

a. Compressor urethra muscle

b. Perineal membrane

c. Camper's fascia

d. Bulbocavernosus muscle

7. Which of the following structures is **NOT** considered part of the vulva or external female genitalia?

a. Mons pubis

b. Vestibule

c. Compressor urethral muscle

d. Labia minora

8. Which three muscles attach to the perineal body at a superficial or distal level?
   a. Superficial transverse perineal, bulbocavernosus, and external anal sphincter
   b. Superficial transverse perineal, ishiocavernosus, and external anal sphincter
   c. Superficial transverse perineal, bulbocavernosus, and levator ani
   d. Compressor urethra, bulbocavernosus, and external anal sphincter

9. Which three structures attach to the perineal body at a deeper or superior level?
   a. Posterior vaginal wall, obturator internus muscles, and perineal membrane
   b. Posterior vaginal wall, levator ani muscles, and perineal membrane
   c. Posterior vaginal wall, obturator internus muscle, and levator ani muscles
   d. Posterior vaginal wall, levator ani muscles, and compressor urethrae muscles

10. The perineal membrane attaches the lateral walls of the distal vagina and urethra to which structure?
   a. Ischiopubic rami
   b. Obturator internus fascia
   c. Sacrotuberous ligaments
   d. Colles' fascia

11. Which term is now used to describe what used to be known as the urogenital diaphragm?
   a. Urogenital membrane
   b. Perineal membrane

c. Inferior fascia of pelvic diaphragm
d. Colles' fascia

12. Which two muscles used to be called the deep transverse perineal muscles in females?

a. Compressor urethra and urethrovaginal sphincter
b. Striated urethral sphincter (rhabdosphincter) and compressor urethra
c. Urethrovaginal sphincter and rhabdophincter
d. Circular and longitudinal layers of smooth muscle in urethra

13. Which of the following best indicates the average length of the perineal body from its superior to inferior extent?

a. 1-2 cm
b. 3-4 cm
c. 5-6 cm
d. 7-8 cm

14. Which of the following best indicates the average length of the perineal body from its anterior to posterior extent?

a. 1-2 cm
b. 3-4 cm
c. 5-6 cm
d. 7-8 cm

15. Which of the following structures is found between the perineal membrane and inferior fascia of the pelvic diaphragm?

a. Compressor urethra

b. Ishiocavernous

c. Vestibular bulbs

d. Clitoris and crura

16. Which nerve provides the primary sensory and motor innervation to the perineum?

a. Posterior gluteal

b. Ilioinguinal

c. Genitofemoral

d. Pudendal

17. Which two muscle attachments are severed during a routine midline episiotomy?

a. Ishiocavernosus and superficial transverse perineal

b. Bulbocavernosus and superficial transverse perineal

c. Bulbocavernosus and ishiocavernosus

d. Bulbocavernosus and external anal sphincter

18. Which is the most common origin of the internal pudendal artery?

a. Anterior division of the internal iliac

b. Posterior division of the internal iliac

c. External iliac

d. Femoral

19. Which structure does the middle rectal vein drain into?

a. Internal pudendal vein
b. External iliac vein
c. Internal iliac vein
d. Inferior mesenteric vein

20. Branches of which structure carry the parasympathetic innervation to the erectile structures of the perineum?

a. Superior hypogastric plexus
b. Inferior hypogastric plexus
c. Inferior mesenteric plexus
d. Pudendal nerve

21. Which branch of the pudendal nerve provides the bulk of the innervation to the ishiocavernosus, bulbocavernosus, and superficial transverse perineal muscles?

a. Inferior anal (rectal)
b. Dorsal nerve of clitoris
c. Posterior labial
d. Muscular branches of perineal

22. Which nerve provides the bulk of the innervation to the external anal sphincter muscles?

a. Inferior anal (rectal) branch of pudendal nerve
b. Dorsal nerve of the clitoris

c. Nerve to the levator ani muscle

d. Posterior labial nerve

23. Which nerve structure supplies the internal anal sphincter?

a. Pudendal nerve branches

b. Superior hypogastric plexus

c. Middle rectal plexus

d. Uterovaginal plexus

24. The pudendal neurovascular bundle exits the pelvis through which foramen?

a. Obturator foramen

b. Greater sciatic foramen

c. Lesser sciatic foramen

d. Sacral foramina

25. The pudendal neurovascular bundle passes behind the ischial spine and enters the pudendal canal after coursing through which foramen?

a. Obturator foramen

b. Greater sciatic foramen

c. Lesser sciatic foramen

d. Sacral foramina

26. The pudendal (Alcock's) canal is formed by a splitting of the fascia of which muscle?

a. The levator ani
b. The ishiocavernous
c. The superficial transverse perineal
d. The obturator internus

27. Palpation of which bony structure is most useful prior to administering a pudendal nerve block?
a. Ischial tuberosity
b. Inferior ishiopubic ramus
c. Ischial spine
d. Pubic tubercle

28. Which of the following structures is **NOT** found in the posterior perineal triangle?
a. Ischio-anal fat
b. Ishiocavernosus muscle
c. External anal sphincter
d. Inferior rectal branch of pudendal nerve

29. Which of the following structures is **NOT** considered part of the anal sphincter complex?
a. Pubococcygeus muscle
b. Internal anal sphincter muscle
c. External anal sphincter
d. Puborectalis muscle

30. The internal anal sphincter is formed by

a. A thickening of the longitudinal layer of smooth muscle of the anal wall
b. A thickening of the circular layer of smooth muscle of the anal wall
c. The superficial portion of the striated external anal sphincter muscle
d. The deep portion of the striated external anal sphincter muscle

31. A third degree extension of a midline episiotomy extends into
a. The anal mucosa
b. The external anal sphincter
c. The superficial portion of the perineal body
d. The puborectalis muscle

32. The structures of the vulva drain primarily into the
a. Superficial inguinal lymph nodes
b. Deep inguinal lymph nodes
c. External iliac nodes
d. Internal iliac nodes

33. The deep inguinal nodes are found within which triangle
a. Hasselbach's triangle
b. Femoral tringle
c. Anterior perineal triangle
d. Posterior perineal triangle

34. The deep inguinal nodes are found inferior to which fascia

a. Fascia lata

b. Rectus fascia

c. Colles' fascia

d. Scarpa's fascia

35. The saphenous opening is also known as the

a. Femoral ring

b. Femoral canal

c. Fossa ovalis

d. Cribriform fascia-Membranous layer of the subcutaneous tissue that spans the opening of the fossa ovalis

36. The femoral canal is the space within the femoral triangle that is located

a. Lateral to the femoral nerve

b. Medial to the femoral artery

c. Lateral to the femoral vein

d. Medial to the femoral vein

APPENDIX C
Questionnaire

Questionnaire for CD-ROM by Connie Tilden

Please return to Dr. Corton

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The home page is understandable and easy to use.	○	○	○	○	○
The illustrations are clear and comprehensible.	○	○	○	○	○
The rollovers in the text highlighting structures help to explain anatomy.	○	○	○	○	○
The photo images are clear and comprehensible.	○	○	○	○	○
The animations of the pelvis are helpful to understand the movement.	○	○	○	○	○
The video footage is clear and comprehensible.	○	○	○	○	○
The content of the program is well organized.	○	○	○	○	○
The interactivity is a suitable tool to explain anatomy	○	○	○	○	○
The graphic design of the program is visually appealing	○	○	○	○	○
It is easy to maneuver throughout the dissector.	○	○	○	○	○
Combining computer animations with cadaver photos, illustrations and anatomical video is an effective way to teach female pelvic anatomy approaches.	○	○	○	○	○

Please tell us what platform you used, PC or Mac and what version of browser you used

Additional comments and/or suggestions

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VITAE

Constance Gulbrandson Tilden was born in Minneapolis, Minnesota, on October 13, 1946, the daughter of Lucille Glasow Gulbrandson and Emmort Arthur Gulbrandson. After completing her work at Hopkins High School, Hopkins Minnesota, in the fall of 1964, she entered Augsburg College in Minneapolis, Minnesota for two and a half years. In the fall of 1975 she entered Texas State Technical School and earned an unaccredited Associates of Arts degree in Commercial Art and Advertising in February 1977. During the following ten years she was employed as a commercial artist for Amaco Products, Cox's Department Store, Sagebrush Publishing, T-Shirts Plus and Lux Packaging, all in Waco, Texas. In the summer of 1997 she began her accredited associates degree at Cedar Valley College, Dallas, Texas, completing it in May 2000. In the fall of 2000 she enrolled in the University of Texas at Arlington, and earned a Bachelor of Art in Art in May 2003. That same month she entered the Graduate School of Biomedical Communications at the University of Texas Southwestern Medical School at Dallas. She was awarded the degree of Master of Medical Illustration in June 2006, at the age of 59. In 1967 she married Robert Bell and had two children, Christopher Robert Bell and Deanna Katherine Bell. They were divorced in 1978. She married Gilbert Lynn Tilden in November 1980.

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