3D HUMAN ANATOMY LEARNING
Demonstration of 3D Tools used in Teaching: 3D Videos, Podcasts, PDF

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Abstract: Human anatomy courses are based on 3D technology since 2006 in Lyon 1 University. The major instructional tools will be presented: 3D Video animation –some of them integrated into podcast – and PDF. Every PDF file contains one 3D image of an anatomical structure that can be moved and turned in space or zoomed. We can even hide or show parts of an anatomical structure and name them, make cut sections, move apart a joint or bones and then put it together. All these 3D images of anatomical structures can be assembled in a portfolio or integrated and animated in a PDF. 3D instructional tools help the students in creating mental images of the anatomical structures, make them rotate in space and better understand their spatial organization which is essential in learning anatomy. An instructional design using this 3D technology is implemented in an online server called Spiral. Our educational evaluations show that students give very positive feedbacks our teaching method using 3D technology.

1 INTRODUCTION

Lyon 1 university encourages lecturers to produce and use multimedia instructional tools. A big funding, probably one of the biggest of all French universities, is dedicated to this purpose. The ICAP department has the mission to create instructional tools on lecturers' demand. Higher education ministry and French universities are financially supporting this project through the French-speaking numerical university of sports and health sciences (UNF3S). Producing 3D tools has been one of the major priorities of Lyon 1 university (since 2006) and UNF3S (since 2010). One of the main projects is enhancing human anatomy teaching. Students who have to learn human anatomy encounter difficulties in regards to the anatomical vocabulary as well as understanding the spatial orientation of an anatomical structure. Using 3D instructional tools seems to bring an adequate solution to these difficulties. An instructional design is implemented using technological innovation. The 3D tools that we created are used at the first undergraduate level in kinesiology and other paramedical courses. Lyon 1 university is the only one in France offering this type of teaching.

2 THE INSTRUCTIONAL TOOLS

Producing 3D images of anatomical structures enabled setting up a publishing chain for teaching human anatomy. These document model images were re-adapted in order to be used in various contexts:

2.1 3D Animated Videos

Videos are played during lectures. Using Quicktime player enables to show a slow motion forward or backward playing or to play different videos simultaneously.

Free online access to our videos: http:// anatomie3d.univ-lyon1.fr/.

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Figure 1: Screen of the online access.

2.2 Podcasts

With the aim to enhance this project, we used our 3D videos commented by a teacher to create podcasts.

Free online access to our podcasts (two last lines in the bottom): http://anatomie3d.univ-lyon1.fr/

Figure 2: Screen of a podcast.

2.3 3D Adobe PDF

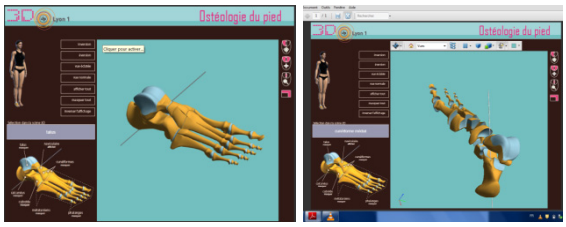
We also embedded 3D model images into PDF files. Thus the latest version of Adobe Acrobat Reader enabled us to move, turn in space, zoom, hide and make cut sections of anatomical structures.

The portability of these PDF files associated with their small size make them easy to send and load through emails. We can even turn around an anatomical structure while it is moving as well as integrating text information, thus assembling illustrations comments and captions into the same PDF. Furthermore different PDFs can be assembled in one electronic portfolio.

An application enables us to create different animations of 3D objects, a teacher can thus create his own screenplay instead of using the predefined fixed screenplay of our 3D videos.

Free online access to our PDF: http:// anatomie3d.univ-lyon1.fr/

These instructional tools are also available in the French-speaking university of health science and sports (UV2S) web site: http://www.uv2s.fr/ index2.php? page=nouveautes



Figures 3 and 4: Example of PDF 3D.

NB: At that time, these PDF cannot show a change of shape of an anatomical 3D object, e.g. showing how a muscle can lengthen or shorten during contraction. A new software called Unity will have this feature from June 2011.

2.4 Integrating 3D Images into other Educational Purposes

- Multiple choice questions for students' assessment via the E-learning server Spiral,
- The Quicktime format enables the integration of 3 images into a Word file document or Multiple choice questions by simply using the copy/paste function:

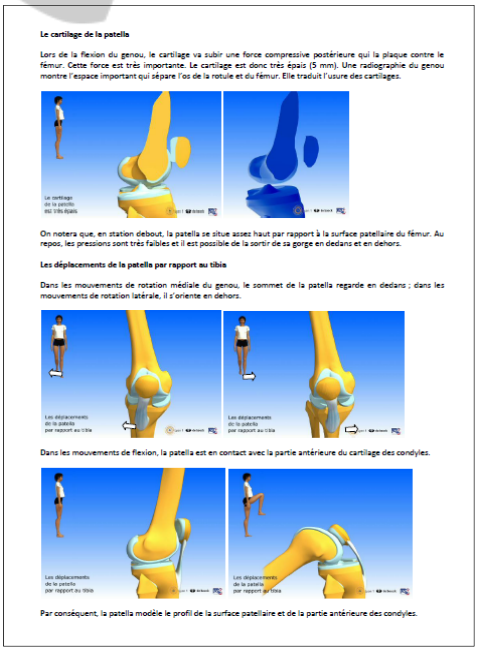


Figure 5: Integration 3D images into a Word file document.

The use of these teaching tools justifies the fact that our courses of practical skill are held in a

computer classroom. In addition to our electronic teaching tools we provide a skeleton for every student, in order to make possible the relationships between the image and the actual anatomical structure:

Figure 6: Practical skill lessons in a computer classroom.

2 PEDAGOGICAL BACKGROUND AND HYPOTHESES

Our teaching design aims at providing courses in human anatomy to undergraduate students, kinesiology, physical and psychomotor education, occupational therapy and kinesiotherapy.

Our main aim is to help students at better understanding the verbal and graphical knowledge of human anatomy. As all scientific fields, human anatomy requires learning a specific vocabulary and competence. Although, teaching this vocabulary and enhancing these specific competences in novice students is not systematically included in official teaching programs nor in the instruction methods used by lecturers.

Furthermore, the new students' generation is being more and more reluctant to human anatomy. On the other hand, they are accustomed to using digital technologies in daily life activities. The French Ministry of National Education noticed that if marketing, advertising, gaming and cinema are at the edge of social manners, education will stay aside.

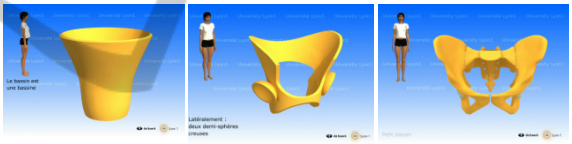
Using a specific vocabulary, human anatomy describes geometrical shapes in a three-dimensional space. These are often described statically or dynamically. Thus, ownership of such knowledge requires creating mental images based on a well structured space perception. In France, learning anatomy is not however preceded by specific spatial ability training, thus making anatomy a highly theoretical discipline, requiring a lot of memory. Even though, the difficulties encountered by students are well known, the number of lectures, teaching tools and equipment are still reduced.

We assume that our 3D instructional tools may in different ways help the students facing their difficulties by providing:

- A better understanding of spatial organization and mental rotation (the ability to imagine an anatomical structure turning in space): Vivid mental images of anatomical structures. This process may start by a simple mental image that is progressively complicated:
- A video screenplay adapted to students' difficulties and constructed upon the student's, expectations and level.

Thus, for novices in anatomy learning, the 3D images can replace the complex verbal vocabulary and make the information smoother to understand.

Figures 7, 8 and 9: Mental rotation (a bone, the femur).



Figures 10, 11 and 12: Simple mental image progressively complicated (coxal bone).

The first arguments in favor of these hypotheses were mainly mentioned in the doctoral thesis of the first author and the supervisor of this project (Thiriet, 1982). He stated that students having bad scores in human anatomy examination had low abilities in spatial representation. He thus concluded that 3D images should take place of verbal explanation. Therefore a research group of the University focused on studying the relationships between spatial orientation and learning anatomy. The studies were conducted in collaboration with the "ICAP" department specialized in 3D technologies, web-based and computer supported education. All our 3D based teaching tools were developed by ICAP team.

Our first experimental results confirmed the main conclusions underlined in the thesis by P. Thiriet. Several publications showed that scores in human anatomy is correlated with scores on spatial tasks on the one hand (mental rotation, field dependence…) and that training in mental rotation may enhance

anatomy understanding (Guillot et al. 2007; Hoyek et al. 2009).

3 THE PROJECT CHRONOLOGY

The first 3D video was designed in April 2005 for students in kinesiology. In September 2006, the first 3D videos were displayed during lectures. Then, the videos were immediately uploaded on the online server (Spiral). Alternatively, our practical lessons were conducted for the first time in a computer room. In February 2007, the first PDFs were created, used during lectures and uploaded directly from the Spiral wbsite. In September 2008, our teaching design was implemented in psychomotor education and occupational therapy programs. In November 2008, we published a book with a DVD assembling all our 3D videos. (Thiriet & Rastello, 2008, De Boeck Editions: http://universite.deboeck.com/livre/?GCOI=28011100121510&fa=description).

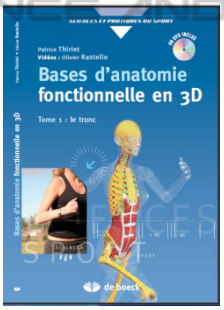


Figure 13: Book with a DVD edited by De Boeck.

4 EVALUATIONS

Since 2008, our students completed two evaluation questionnaires. The first one was completed before starting the lectures during which the students did not know that they will attend a 3D-based learning. The second questionnaire was an evaluation conducted at the end of the courses. A total number of 346 students completed the questionnaires. This is a brief overlook at our main results:

- 94% of the students confirmed the interest of using 3D in human anatomy
- 95% of the students confirmed the interest of using colored images.
- 91% of the students confirmed the interest of using a skeleton simultaneously with 3D-images.
- 92% of the students confirmed that 3D-videos helped them at better understanding what the lecturer was aimed to teach, especially when the delivered information required spatial ability.

REFERENCES

Guillot A., Champely S., Batier S., Thiriet P., Collet C. Relationship Between Spatial Abilities, Mental Rotation and Functional Anatomy Learning. *Advances in Health Sciences Education 2007*; 12, 491-507.

Hoyek N., Collet C., Rastello O., Fargier P., Thiriet P., Guillot, A. (2009). Enhancement of Mental Rotation Abilities and its Effect on Anatomy Learning. *Teaching and Learning in Medicine*, 21 (3), 201-206.

Thiriet P. 3D basis of functional anatomy (Bases d'anatomie fonctionnelle en 3D). *Editions De Boeck*. 2008.

Thiriet P. (1982). La formation scientifique des professeurs africains d'éducation physique. Contribution à une didactique de l'anatomie et de la physiologie. *Université Lyon II. Thesis on line*.