



# METHODS OF APPLICATION OF VIRTUAL SLIDES IN MODERN HISTOLOGY PRACTICAL TEACHING

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## Abstract

In history, technical developments in light microscopy had always been reflected in teaching methods of histology and pathology. During the last five years, several universities introduced a new method of virtual microscopy in teaching, research and diagnostic activities at morphology departments. For scanning classical glass histology slides into a digital format of virtual slides, several commercial optical scanning systems have been developed up to date. In order to use virtual histology slides successfully in practical sessions a suitable database system has to be developed, that enables students to orientate themselves in the learning contents of the practical quickly, and also that allows to open attached supplementary text- or picture-based documents easily. This database system should have a student-friendly graphical user interface, as well as it should allow teachers a simple access to the database for adding, organizing and editing of teaching documents. At our Department of Histology in Olomouc, we have developed our own system of application of virtual slides in e-learning format of practical sessions. In this communication, we refer about various nationally and internationally used methods of application of virtual slides in histology practical teaching; we also compare their features.

**Key words:** histology, virtual microscopy, practicals

## Introduction

Virtual microscopy has already been established as a new tool for delivery of histology slides for teaching and diagnostic purposes. Several slide-scanning systems have been developed and manufactured by well known brands of optical companies like Leitz [1], Nikon [2], Zeiss [3], Hamamatsu [4], Olympus [5] and others. During the last five years, several universities introduced a new method of virtual microscopy in teaching [6, 7, 8, 9, 10, 11] research and diagnostic activities at morphology departments. Virtual slides provide many benefits over observation of classical glass slides. They ensure a long-term and safe archiving of important slides without losing their original



staining quality. They can be studied with simple computers locally or computers connected to departmental websites. Several professionals can observe and discuss virtual slides simultaneously during teleconsultations or conferencing over internet. Since the resolution and magnification of digital slides is well defined and calibrated, the slides can be used for quantitative analysis of sizes, distance and areas of structures observed. Screen shots of important parts of virtual slides can be saved and directly used in professional reports and presentations.

## **Methods of application of virtual slides in histology practical teaching**

Virtual slides can be delivered to histology students in different ways depending upon budgetary and equipment possibilities of teaching departments.

### **1. Observation of virtual slides in PC-equipped and intranet-networked classroom.**

This solution requires a set of computers connected to an intranet network with a server running a database of virtual slides and logging rights for several clients to access the contents. Databases of virtual slides are commercially available. Olympus NET IMAGE SERVER SQL [12] database accepts virtually unlimited number of virtual slides and provides simple graphical user interface to organize and search virtual slides according to given criteria. For student's observations, the contents of this database can be accessed directly from Olyvia viewer installed on PC connected to the server. In order to organize and update this database and to insert annotations to virtual slides a special application software OLYMPUS dotSlide (or dotSlide desktop) is required with administration rights. A graphical user interface of this database is simple and requires some knowledge of management of SQL databases.

Another example of well designed database of virtual slides is the Leica Slidepath Digital Slidebox [13]. The Digital Slidebox allows academic tutors to build extensive libraries of slides for review by students using the web. Virtual slides, pre-annotated cases, MCQ tests, course notes and multimedia content can all be integrated into the digital Slidebox, creating a flexible digital slide resource accessible from the classroom or the dormitory. This database has well designed graphical user interface and provides many teacher-friendly features like visibility control that allows the administrator to sequentially release content to learners. Administrator can also define custom access to



virtual slides for individual learners or class groups. Student's performance can be tracked using dynamic statistics and heat-mapping technology. A group examination results can be exported into spreadsheets for analysis. Separate access permissions can be given to students, teachers and IT Administrators.

These examples of ready-made and commercially available databases are available at certain costs that may exceed budgetary possibilities of some teaching departments. In our Department of Histology and Embryology in Olomouc, we have developed a histology practical teaching system in a classroom of 30 student's PCs (clients) and one teacher's PC as a server [14]. This system is locally networked with limited connection to the faculty intranet. The teacher's PC runs our own database of histology practical designed in MS Excel format that contains virtual slides organized into sessions that systematically follow syllabus of General and Special Histology. In each session the virtual slides are complemented with supporting documents and other explanatory visuals. According to our two year long testing experience the system runs flawlessly and it is easy to be used by students, teachers and database administrators.

## 2. Observation of virtual slides on a dedicated website

In their full resolution, virtual slides cannot be displayed in an ordinary website as their files have very large capacities that would make their distant observation difficult. This is why manufactures of virtual slide scanning systems provide a possibility to compress digital data of virtual slides and export them for web application. The quality and some annotation features are reduced in these web-exported virtual slides but they can be viewed easily even over a long distance internet connections. This application of virtual slides is useful for distant learning histology courses or self-learning and revision activities.

### **Virtual slides versus classical light microscopy**

From the point of view of traditional histology teaching style, the histology labs are supposed to be equipped with self illuminated light microscopes and sets of glass slides, ideally available to each student in the session. These basic observation tools are usually complemented with a photo slide projector, overhead projector, or a light microscope with a photo camera connected to a data projector and, not to forget, the traditional blackboard and color chalks. With the advent of virtual microscopy the format of histology practical labs is changing towards the use of virtual slides viewed by individual students on their PCs. In the earlier-equipped histology practical labs the



availability of both classical light microscopes and virtual slides is maintained up to date to give students a possibility to observe histology slides in both ways. According to survey of Drake et al. 2009 [15] regarding the laboratory experience, of the 45 respondents, 13 reported that their laboratory used microscopes, 20 reported that their laboratory used virtual microscopy only, and 12 reported that their laboratory used a combination of microscopes and virtual microscopy. The authors conclude that microscopic anatomy lends itself to approaches that are more independent study friendly. This is especially true with the continued increased usage of virtual microscopy systems that students can access anywhere by computer.

## Conclusion

Virtual microscopy is a vital new teaching tool, an educational enhancement and very big improvement in how microscopic material is presented to students. The virtual microscope program allows students to work with slides as a team that is very cumbersome with traditional microscopes.

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