Using Portable Document Cameras and Portable Digital Microscopes in Both Virtual and In-Class Historical Geology and Petrology Labs

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ABSTRACT

During the "Great Disruption" of Spring 2020 and the 2020-2021 academic year, we had to conduct labs in virtual, hybrid, and HyFlex learning environments. Initially, some of us used still images of minerals, rocks, sand, and fossils for study materials and for asynchronous online assessments. We were not satisfied with the quality of these images and students often found them challenging to work with because diagnostic features were not always easy to observe. We investigated other ways to present specimens to students during virtual lab sessions. We eventually settled upon using both portable document cameras and portable digital microscopes to demonstrate mineral properties, the compositions and textures of rock specimens and sand samples, and the morphologies of fossil specimens during virtual, hybrid, and HyFlex lab sessions. Portable document cameras and portable digital microscopes can be connected to computers and used as external cameras or with screenshare features within video conferencing software. The primary advantage of using these devices is that specimens can be manipulated live to better show their diagnostic features during both demonstrations and assessments, and in response to students' questions. For example, during a quiz or exam, students could ask to see a streak test or a hardness test on minerals or an acid test on suspected carbonate rocks. Specimens can be rotated to show different perspectives and can be magnified, up to 10x using the portable document camera. Portable digital microscopes can be used to observe sand samples and, at 40x magnification, produce excellent live images of sand grains. Since portable document cameras can be connected to projectors or large-screen televisions during in-class lab sessions, we still use them. The continued use of these technologies and videomicroscopy in our lab classes benefitted from their use in virtual, hybrid, and HyFlex lab sessions during the "Great Disruption".

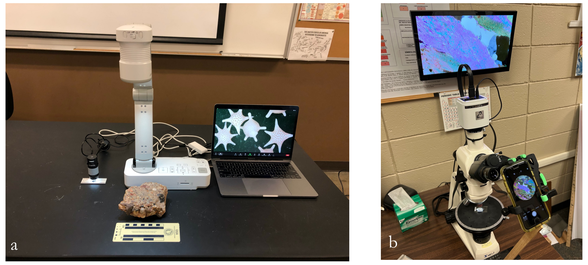


Figure 1. a) Plugable's USB 2.0 Digital Microscope and Epson's DC-21 Document Camera, b) Carson's HookUpz 2.0 Smartphone Optics Digiscoping Adapter

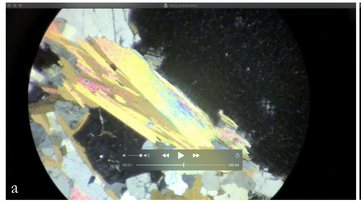
INTRODUCTION

The "Great Disruption" forced us to find ways to engage our students using a variety of virtual (e.g., online asynchronous, and online synchronous) or partially virtual (e.g., hybrid, and HyFlex) modalities. Hybrid modalities often involved teaching lab content virtually and assessing student learning in person (e.g., using traditional lab practical exams) When teaching lab content virtually, we prefer an online synchronous modality using platforms such as Zoom, which seem to best mimic a traditional in person experience in that it allows for students and teachers to interact in real time. However, in both historical geology lab and petrology lab students must learn to identify earth materials (e.g., minerals, rocks, and fossils) using observations. How do you teach students to observe characteristic features of earth materials and test them remotely?

MATERIALS & METHODS

We used Epson's DC-21 Document Camera and Plugable's USB 2.0 Digital Microscope (Figure 1a) for live demonstrations of minerals, rocks, and fossils for both teaching and assessing student learning. Both devices are portable and can be used as external cameras on the Zoom platform. Specimens can be manipulated in real time and in three-dimensions. Epson's DC-21 Document Camera was primarily used to demonstrate hand specimens of minerals, rocks, and fossils in

Figure 2. a) using a portable document camera to display ripples in sandstone, b) using a portable document camera to display a poorly sorted sand, c) historical geology students taking a lab practical exam with photomicrographs of oolitic sand displayed on the screen



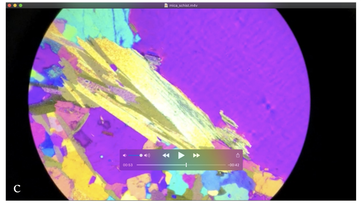


Figure 3. videomicrographs, a) muscovite under cross polarized light, b) parallel extinction of muscovite under cross polarized light, c) length-slow character of muscovite demonstrated with a length-fast accessory plate inserted from the SE, under cross polarized light

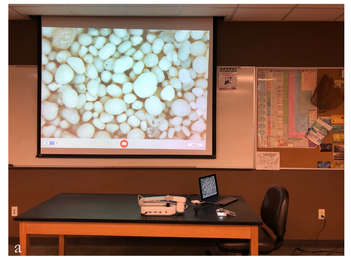


Figure 4. a) using a portable digital microscope placed directly in oolitic sand, b) using a portable digital microscope mounted on a support stand to display polysynthetic twinning in a plagioclase feldspar (labradorite), c) photomicrograph of iron oxide-stained desert sand, d) photomicrograph of quartz beach sand.

MATERIALS & METHODS (cont.)

historical geology lab (Figures 2a, 2b, and 2c) during both teaching sessions and on lab assessments (e.g., quizzes and practical exams). Plugable's USB 2.0 Digital Microscope was placed directly into sand samples to demonstrate sand composition (Figure 4a) or onto micropaleontology slides to demonstrate microfossils (Figure 1a) in historical geology lab. Plugable's USB 2.0 Digital Microscope was used on a ring stand to demonstrate hand specimens of minerals and rocks in petrology lab (Figure 4b). Carson's HookUpz 2.0 Smartphone Optics Digiscoping Adapter was used in petrology lab to record videos of igneous and metamorphic rock thin sections (Figure 1b).

PRESENT & FUTURE

These technologies worked well during the "Great Disruption", and we continue to use portable document cameras and portable digital microscopes in historical geology lab to demonstrate mineral properties, the compositions and textures of rock specimens and sand samples, and the morphologies of fossil specimens for both teaching and assessment for in-class labs. Sometimes we have used Photo Booth rather than Zoom for projecting images for in-class labs (Figures 2a and 4a). We are also now using Accu-Scope's AU-600-HDS camera and a Leica DM EP polarizing microscope for capturing images and recording videos of thin sections in historical geology lab. We plan to continue using these technologies, which we might not have done if not for the "Great Disruption".