Large Introductory Science Courses & Digital Libraries

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ABSTRACT
Student self-assessment survey results indicate that a virtual lab experience improved understanding of many key laboratory learning objectives and that the Materials Digital Library (MatDL) has potential value in supporting a virtual lab.

Categories and Subject Descriptors
H.3.7 [**Information Storage and Retrieval**]: Digital Libraries – *collection, dissemination, user issues*; J.2 [**Physical Sciences and Engineering**]: Engineering.

General Terms
Measurement, Experimentation, Human Factors.

Keywords
Digital Library, Virtual Laboratory, Introductory Science courses.

1. INTRODUCTION
Engineering program accreditation requires demonstrated effectiveness of laboratory training. Yet, providing meaningful physical lab experience in large introductory undergraduate science courses can prove to be a practical impossibility. Virtual lab experience may offer a viable alternative. The ABET/Sloan Colloquy identified 13 lab objectives (e.g., *experiment, data analysis, design*) [1]. Only three of which (i.e., *instrumentation*, *psychomotor*, and *sensory awareness*) require a physical lab presence [2]. Goals of the NSDL Materials Digital Library (MatDL) include providing content (e.g., scientific data) to support virtual labs and offering students new opportunities to experience the creation of scientific information. *Solid State Chemistry Virtual Laboratory* was offered as a pilot project to a small group of MIT students who designed and conducted three virtual experiments, preparing detailed written and oral reports for each. By making resources available to these students and enabling them to archive class projects, MatDL started to explore the role that a digital library can play in supporting a virtual lab.

2. METHOD & RESULTS
To evaluate perceived impact of *Solid State Chemistry Virtual Laboratory*, eight students completed a self-assessment survey of "change in understanding" (1 = significantly worse, 3 = no change, 5 = strong improvement) on the 13 ABET lab objectives. Three students also completed a survey of MatDL's potential value (1 = very valuable, 3 = somewhat valuable, and 5 = not at all valuable) in accomplishing eight educational objectives.

Results of change in understanding of lab objectives ranged from 3 to 5. *Safety* was rated lowest (M = 3.0). Means were below 4.0 for p*sychomotor*, *sensory awareness* and *instrumentation* (3.14, 3.63, 3.63, respectively) which is consistent with the recognized difficulty in accomplishing them outside of a physical lab [2]. More perceived improvement was obtained for *design*, *models*, *analysis*, and *creativity* (Means 4.0, 4.13, 4.13, 4.25, 4.25, respectively). *Experiment*, *teamwork*, *ethics in research*, and *communication* showed most perceived improvement (Means 4.50, 4.50, 4.63, 4.75, respectively) suggesting that class emphasis on completing team projects and producing written and oral research reports had a strong positive impact. Three objectives associated with most perceived improvement (*teamwork*, *ethics in research*, and *communication*) have been identified as essential objectives of the laboratory experience [2].

Students expressed positive opinions (i.e., from 1 to 3) regarding MatDL's potential value in accomplishing eight educational objectives. They expressed very positive opinions of MatDL's potential to support a virtual lab experience (M = 1.33) and similarly positive opinions regarding its potential to give students practical experience licensing and publishing their work; to support interaction with students at other institutions; and to increase student awareness of applications in MS (all M = 1.33). They were also quite positive about MatDL's potential to give students access to classmate's work; increase student interest in research; and make courses more interesting by making available related research data (Means 1.66, 2.0, 2.0, respectively).

3. DISCUSSION & ACKNOWLEDGMENT
Student survey results indicated that the virtual lab improved their understanding of many ABET lab objectives, suggesting that virtual lab effectiveness may approach that of a physical lab on some objectives. Students also expressed positive opinions of MatDL's potential value in supporting a virtual lab and in accomplishing additional educational objectives.

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4. REFERENCES
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