Introduction

Virtual and alternative labs came to a forefront as a result of the expansion of Open SUNY and the Seamless Transfer Initiative. The Open SUNY initiative focused on providing increased access to students through quality courses and degree programs offered in a fully-online and blended environment. A limitation to STEM & Health Science degree programs moving to an online format is availability of required laboratory courses. During the Seamless Transfer initiative, faculty participated in discipline-specific discussions to determine which courses should be included in each proposed transfer path. In the STEM and Health Sciences discussion boards, extensive debate occurred to determine whether or not fully-online labs would be accepted as part of the transfer path; some disciplines chose to adopt them, other did not.

While each individual campus has the right to determine the parameters for accepting transfer credits, many felt that opposition to virtual and alternative labs may stem from inaccurate preconceived notions, lack of knowledge on developments and expansion in technology, and a very narrow definition of what ‘online’ labs consist of and the quality associated with them.

Given the adamant opposition of some fields to virtual and alternative labs, why should SUNY as a system bother to try to convince its faculty and institutions to reconsider their position?

- Increase access for students

  Many students work full-time, both inside and out of the home, and cannot attend a classroom-based laboratory because of the location of the school or the offering times for the course. Other students may have disabilities that prevent them from being successful in a traditional laboratory environment.

- Replication

  Literature states over and over again that one of the biggest benefits to non-traditional labs is the ability for the students to replicate the lab over and over again until they master technique and understand the associated theory. Very few students completely comprehend a laboratory activity the first time perform it, having the ability to go back and try again and again helps them to understand and retain the material. Additionally, if they have the ability to change the parameters of the experiment each time they perform it, the students are then more likely to understand the concepts behind the experiment.

- Exposure to techniques/principles students would not have access to in a student lab

  Budgets are tight and equipment and reagents are expensive. It is not possible for most schools to buy the biggest and the best with respect to new methodologies and equipment. This provides exposure to those methods where they otherwise wouldn’t have it.

- Alternative labs can still provide ‘hands-on’ experience

  Again the assumption is alternative is online simulation, but that is not always the case. If a hands-on manipulation technique is required, there are alternatives to simulation that still provide the student with the experience and access to the course.
• Cost

As courses are now part of a mandatory transfer path, schools may not be able to afford the cost or the space to provide the course, which means they would not be able to provide that particular major. Additionally, as more and more students apply for particular programs, there may not be the physical laboratory space to educate those students, virtual and alternative labs are another option to increase access.

As a result the FACT² Advisory Council approved the development of the Virtual and Alternative Labs Task Group as one of three areas of focus for the 2015-2016 academic year.

Membership

• Rachael Hagerman – SUNY Broome Community College, Chair*
• Mary Mawn* – Empire State College
• Ken Charuk – Empire State College
• Karen Pearson* – Fashion Institute of Technology
• Ryan McCab – Finger Lakes Community College
• Craig Capria – Nassau Community College
• Thomas Fernandez – Nassau Community College
• Joshua Altemoos – Student Assembly
• Phil Ortiz – SUNY System Administration Liaison
• Dan Knox – SUNY System Administration Liaison
• Carey Hatch – SUNY System Administration Liaison

Stakeholders

• SUNY Faculty
• SUNY Seamless Transfer faculty in the Sciences
• Campus Chief Academic Officers
• The SUNY Provost
• Associate Provost for Academic Technologies and Information Services
• Open SUNY

Goals

• Collect and document information on virtual labs and their current use within the SUNY System and higher education in general
• Raise the level of understanding of the use, effectiveness, and various modes of implementation of virtual labs among SUNY STEM faculty
• Establish mechanisms for SUNY STEM faculty to assess learning gained through virtual labs
• Establish quality standards for faculty to use when selecting or developing virtual labs

Expected Outcomes/Deliverables

• A set of tools and frameworks for faculty to use when assessing credits earned with virtual labs
• A set of tools and frameworks for faculty to use when selecting or developing virtual labs
• A set of vetted and recommended virtual labs to align with seamless transfer courses
• A community of practice supporting STEM faculty in ongoing communication around the topic of virtual labs

Challenges

In forming this workgroup, FACT² was trying to address four areas surrounding Virtual & Alternative labs.

• Increase access.

More and more students (both traditional and non-traditional) are seeking fully-online options to complete their education. A limiting factor for fully-online and blended programs is the availability of laboratory courses. Often labs are limited to the physical campus and tied to specific timeframes. This is an enormous limitation for those potential students who cannot travel to the campus or attend during the times the labs are offered; one that some students are not able to overcome.

• Transferability

Multiple programs in the Seamless Transfer initiative specifically stated that online labs would not be accepted for transfer, specifically Biology, Chemistry, Environmental Science, and Nursing. By creating this stipulation, it limits the number and types of institutions that students can take the required classes, creates a bottleneck at each institution because of limited laboratory space, and contributes to the problem of access as students are now required to take a specific set of courses, but they may not be offered in a time and place where they are able to attend.

• Resistance to Change & Combating Assumptions

Many professors feel that the classroom lab is the only way for the students to learn the material. There is a broad assumption that any alternative lab must mean that it is a simulation and that the simulation is inferior to the classroom laboratory. The reality is that in many student laboratories, the equipment and methodologies are old, outdated, and inefficient because that is what the institution can afford and have the space to accommodate. Virtual and alternative labs are often a better quality and provide more accurate representations of concepts than a traditional lab and can be offered in a variety of formats, not just simulation.

• Communication

Part of the reason people hold fast to long-held assumptions is because they may not be aware of the innovative and unique offerings available for virtual and alternative labs. There is also the previously mentioned assumption that virtual and alternative labs are all simulation. Without an effective means to communicate new developments, best practices, and success of virtual and alternative labs, there will be no change these assumptions. Another piece of communication is the type of student population that might utilize a virtual and alternative lab. A blanket assumption is made that if a virtual and alternative lab in a particular course or discipline is developed, than all populations can and should utilize it, which man not be the case.

Outcomes & Deliverables

After extensive discussion on the goals of the task group and our own experiences and frustrations with the outlined challenges, the group decided to address the challenge in four separate foci. Each will be discussed and include the associated deliverable.
1. Identification of Modalities & Learners

**Identification of Modalities**
Before tackling any of the challenges, the group decided that a common working definition of virtual and alternative labs needed to be developed that we would base all our other work off from.

A lab offered anywhere except the traditional student laboratory classroom, including:

- **Virtual Labs**
  - Online Simulation
  - Publisher’s software
- **Alternative Labs**
  - Purchased Kits
  - Utilization of household items
  - Alternative location (hospital or industrial site)
  - Alternative environment (park, yard, civic project)

While most associate laboratories with the traditional sciences (and that was the focus of this group), this definition can be expanded across the disciplines, including but not limited to foreign languages, social sciences, art, and music.

**Identification of Learners**
To help us address the rest of the foci, develop the deliverables and address one of the communication challenges, we determined that a vital first step is breaking down what types of learners may actually utilize the virtual and alternative laboratory environment, these are the categories we determined.

The reason we decided this was an important piece was because, again, there was a general assumption of what population of student was completing laboratories online. We also wanted to use the information to look and see where we might increase in access. We used these categories later in our survey to determine the breakdown of learners.

- Traditional Students
- Non-Traditional Students – We did not provide definitions of traditional vs. non-traditional students; allowing the survey respondent to use their own campus designation
- Major
- Non-Major
- Non-Matriculated
- Seeking entrance into another undergraduate program
- Seeking entrance into another graduate program

2. Examination of Current Campus Practices

The second task was to develop an instrument to analyze current campus practices. We based the brief questionnaire (less than five minutes) on our previous discussions of what was lacking in knowledge and frustrating with the generalized assumptions about Virtual & Alternative labs, hoping that it would provide us with the information needed to overcome those issues. The survey link was sent to the chairs of FACT2, Doodle, FCCC, and SUNY UFS and requested that they send the information (along with an explanation of the survey) to their representatives. In addition, presentations were made to FACT2 Representatives and the COTE
Community, requesting survey responses. Despite our best efforts and multiple extensions, we have received 20 responses. Survey results are found in the Survey Results attachment.

3. Seamless Transfer Concerns

The issues associated with seamless transfer came from both faculty and student concerns. To address the faculty concerns, we contacted Dan Knox and Phil Ortiz to get feedback from the discussion boards from those areas that would not accept online labs for their transfer pathway. While we were not allowed to review the boards themselves, Phil provided a summary of the concerns. There were four main issues raised:

- Lack of definition of what is an online lab.

  We addressed this by creating our working definition and various categories and identified the different types of students that would be interested in taking virtual & alternative labs. With clear communication, it will be easier for campuses to assess the laboratories and consider them for transfer.

  In addition, we created a flow chart that advisors could use to determine whether a virtual and alternative lab would be acceptable for transfer based on the student type and the requirement type. The flow chart is found in the Online Lab Flow Chart attachment.

- Safety in moving from online labs to a face-to-face setting.

  To address the safety concern, we made an attempt to collect data in two categories: Students who took the first course in a sequence in an online version, then transferred to a campus-based section for the second course in the sequence (Example: General Chemistry I online, General Chemistry II in the classroom); second we wanted to look at students who took an online version of an entry-level course, then transferred to a higher level campus-based section (Example General Chemistry I & II online, Organic Chemistry I in the classroom).

  We were unable to collect the data for either group both at a system level or an individual college level because each campus lists the labs slightly differently in the Banner system, the campus does not always identify the type of modality used by the lab, and it was very difficult to get down to an individual course level on the Open SUNY website. While the online labs are more easily identifiable via DLA or DLO designation, the alternative labs may not be labeled/report as consistently or reliably. While there may be pockets of data available to prove student success, it is often in very different populations of students and different environments. For example, the Clinical Laboratory Technician program at SUNY Broome has reliable and consistent data that shows students who took entry-level courses (like General Chemistry and Anatomy & Physiology) online were retained and performed as well or better in higher level courses, those students tended to take the higher-level labs in an alternative environment, so we are not sure that is a fair comparison.

- Quality

  The concern here again was that if a lab was offered in an alternative environment, it would not be the same quality as a lab offered to a student in campus-environment. We addressed this two ways. First, was in the development of a definition of virtual and alternative labs. As mentioned previously, there is an underlying assumption that all alternative laboratory versions were computer simulations, which is not the case. We hope that with further communication and discussion more and more professors and intuitions will become aware of all of the different alternative laboratory options. The second way to address and prove quality is through assessment. This piece we will discuss more in the next section, Assessment of Student Learning.
• Certain courses were too costly for an institution to develop

A frequently mentioned concern was the requirement of certain laboratory courses in transfer pathways that may be too costly for certain institutions to develop or that may not have enough students enrolling at one institution to warrant running a section. While it was not directly related to accepting of online labs, we hope that through our work institutions would be willing to develop virtual or alternative laboratory options for these courses.

From the student perspective, the main issues, again, were associated with accessibility.

• For certain pathways, the required courses chosen had limited availability, both with regard to the number of institutions offering the course and the number of sections available.

• Students would not be able to graduate without the course, but they did not have access to take it.

• At the Spring meeting in Saratoga Springs on April 16th, the Student Assembly passed resolution 1516-121 Expansion of Distance Learning Across the State University encouraging the expansion of online offerings and ease of the cross-registration process.

We hope that by addressing the concerns of the faculty, there would be support for expanding online offerings; by doing that we would address the student concerns as well. The only area we did not specifically focus on was courses being too costly for an institution to develop, because again, we were hoping to encourage online or alternative course development.

4. Assessment of Student Learning

As mentioned in the previous section, common underlying assumptions are that online and virtual labs are not quality and that students will not gain the appropriate experience in a virtual and alternative laboratory environment. In order to most adequately address this concern, it was important to focus on the assessment of student learning in these courses. We could best address this two ways, first by developing quality standards for virtual and alterative laboratories and using those stands to evaluate online courses, and by making an effort to encourage assessment of virtual and alternative laboratories, communicate assessment results, and develop a community to share effective assessment practices.

**Quality Standards**

The use of a rubric along with consistent reliable assessment data would show the quality of online courses. Using literature review, discussions with Open SUNY, and our own experiences, we developed a set of quality standards that, while similar in some aspects to an online lecture, definitely possessed unique qualities that should be present. We also evaluated a General Education Assessment Rubric used by Empire State College for their Natural Science General Education assessment and recommend that it be used in conjunction with the quality standards. Using them together, an instructor can evaluate both the modality and the content, if desired.

I. Understanding the Methods & Tools in the Laboratory.

A full explanation of how the virtual/alternative lab is representing the same theory principles and theories as a traditional lab should be provided. It is important for the instructor or the representative software/simulation to explain how the tools and techniques used in the virtual/alternative assignment
are equivalent to the traditional environment; or if the experiment is different, how the tools and techniques still represent the same theory in how it is applied.

II. Presence of a course equivalency rubric: comparing the traditional and virtual/alternative environment

Provide evidence that the course is meeting the same student learning outcomes (SLO) as the traditional format. Again, reinforces that the course is not only quality, but equivalent. This helps the instructor to focus the laboratory activities to ensure that all SLOs are met.

III. Instructions on how to operate/perform/document results in the virtual/alternative environment

Complete instructions should be provided to the student at the start of the course that will clearly explain how to use the provided materials; this can include proprietary instructions, but also should include:

- Platform-specific indicator
- FAQ
- Explicit documentation of all help desk information
- Step-by-step instructors on operating the V&A lab and reporting the results

If a student cannot use the software or materials necessary for the lab, they will never be able to learn the theory or tie it back to the original experimental design and they are also less likely to finish the course and persist in the program.

IV. Evidence of Course Information folder that indicates

- Modality
- All required equipment
- Syllabus
- Relationship to the lecture course (is it combined with the lecture for one grade or is it a stand-alone grade)

V. Evidence of Instructional Design evaluation

While evidence of an instructional design evaluation is good practice in any online offering, it is more so in a laboratory portion where the course usability and the appropriate instructions are vital to ensuring that the student only needs to spend time learning the theory and now how to operate the software or determine how to report the results.

VI. Evidence of regular and rigorous assessment of modality along with SLO

VII. Accessibility

VIII. Evidence of student input & evaluation on the course throughout the offering
While we were developing our quality standards, we began working with COTE and will eventually help them develop a section of the OSCQR rubric that will specifically address online laboratories; work is expected to be completed in August.

**Encourage Assessment**

Quality cannot be proven without assessment. By communicating assessment data from virtual and alternative laboratories, the issues surround quality can be resolved and the anecdotal experience of so many instructors can be validated. While assessment is a requirement of Middle States and SUNY, it is rarely communicated outside of the institution and may be inconsistent in virtual and alternative environments. To address this issue, the group developed a COTE Community Group call Virtual & Alternative Labs, in the hopes that individuals who use these modalities will not only provide their own assessment data, but also examples of quality assessments for others to use. We hope this will also encourage the communication that we found to be lacking regarding the advancements in the field.

**Future Work**

While we have accomplished quite a bit this year, there are still items we would have liked to address, but did not have time.

- After the adoption of the online laboratory piece to the OSCQR rubric, it should be tested and vetted with instructors who have extensive experience in a variety of laboratory offering to ensure it meets the needs of faculty and students.
- Ensure that the Online Lab Transfer Flow Chart is communicated, tested, and vetted with multiple program types at multiple institutions to ensure it meets the needs of faculty, advisors, and students.
- Develop the Virtual & Alternative Labs COTE community group, communicate its existence widely, and encourage participation.
- One of the last questions on our survey asked what challenges were faced in offering a virtual and alternative labs. We received quite extensive answers. We would have liked to further evaluate these responses and see if there were ways to either address the challenges or communicate them to a larger audience to have them addressed at a system level.
- We received feedback after our presentation at CIT that campus-based instructors utilize virtual and alternative methods in their campus-based labs, but would not have answered the survey as it was distributed; a broader scope may be needed moving forward. Also, that there are other types of labs outside of the STEM fields that are developing innovative virtual and alternative labs and they should also be included in the discussion.

**Recommendations**

Based on our experiences through the year, the group has some recommendations if this initiative is to be further developed on a system level.

- **Enhanced Data Collection**
  There is virtually no way to efficiently collect data on the virtual and alternative laboratory offerings within the System. Uniformity in any aspect of an identifying course characteristic to show it as a virtual and alternative lab would help to more easily identify what courses utilize these modalities, the types of students enrolled in these courses, the instructors, and offering institutions. With this information, we could delve far more deeply and generate quality data that could lead to enhanced communication and future development. We could also more easily communicate with the instructors to understand the unique nature of their lab, collect assessment data, and more efficiently create a
community of practice that could lead to greater laboratory developments and generate partnerships across the system.

• Changes to the Open SUNY Navigator
In our desire to collect some of the data we were missing, we made multiple attempts to utilize the Open SUNY Navigator. We tried to use it to search for online laboratories in the STEM field. We found it to be very cumbersome, confusing, and not user-friendly; this is among Open SUNY Power Plus campus users who have knowledge of the system. A student with no familiarity with the system would become easily frustrated at the lack of usability, particularly with regards to registering for a course. The search does not list the whether or not a laboratory is required, the modality of the laboratory requirement, or instructor. It takes three additional clicks to retrieve this information and when you attempt to register for the course (to find out the instructor and book information) it takes you to a generic registration page on the campus' website; often with very little information on how to register. Given the plethora of institutions offering online courses, create a system that is as easy as possible for the student is critical. It clearly has to impact the number of fully-online students we bring (or do not bring) into the System.

Reference Articles
A complete list of the reference articles can be found here:
https://drive.google.com/open?id=1M8yb9WxcAktlyRmJylM8J-GHi0M0n9pjkNiAGW1ND3Q
Rubric Indicating Quality of Virtual & Alternative Lab

General Characteristics

Indicators:

I. Understanding the Methods & Tools in the Laboratory: a full explanation of how the virtual/alternative lab is representing the same theory principles and theories as a traditional lab

II. Presence of a course equivalency rubric: comparing the traditional and V&A environment
   a. Provides evidence that the course is meeting the same SLO as the traditional format

III. Instructions on how to operate/perform/document results in the V&A environment
   a. Can include proprietary instructions, but also should include:
      i. Platform-specific indicator
      ii. FAQ
      iii. Explicit documentation of all help desk information
      iv. Step-by-step instructors on operating the V&A lab

IV. Evidence of Course information folder that indicates
   a. Modality
   b. All required equipment
   c. Syllabus
   d. Relationship to the lecture course (is it combined with the lecture for one grade or is it a stand-alone grade)

V. Evidence of Instructional Design evaluation

VI. Evidence of regular and rigorous assessment of modality along with SLO

VII. Accessibility

VIII. Evidence of student input & evaluation on the course throughout the offering

Natural Science Course

Indicators

I. Understanding the Role of Observations in Science
II. Understanding Scientists’ Use of Hypotheses
III. Understanding Measurement and Data Collection
IV. Understanding Experimentation *
V. Understanding Methods of Analysis and Evaluation of Data
VI. Application of Scientific Concepts Appropriate to the Discipline
VII. Understanding Methods and Analysis in the Laboratory