

Expanding Technical Education Opportunities through Distance Learning in Telepresence Classrooms

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Motivating Rationale

- Education programs must seek out opportunities and be ready to partner with other content providers in order to develop viable ways to address the technical workforce knowledge and skills gap.

Normandale's Vacuum Technology program in 2011: Referred program students to various courses offered by other schools in the MN higher ed system (examples, electronics, fluid mechanics, semiconductor processing) so these program students could continue to make progress in their studies when Normandale could not hold program classes due to low enrollment



Vacuum Technology – Challenges and Opportunities

- Vac Tech program est. 1996; A.A.S. and two Certificates
- Local industries need skilled technicians for a finite number of positions BUT the current pipeline is not meeting this demand
- **Challenge:** To maintain the viability of a low-enrollment program that supports an ongoing regional need
- **Opportunity:** Vacuum-reliant industries around U.S. need skilled workers, but have few local education opportunities
- **Solution:** Telepresence Technology, because...
 - Real-time interaction is critical; Vac Tech combines several STEM disciplines and has unfamiliar terminology
 - Vac Tech program can enroll enough (distributed) students to support program longevity



Perspective from the Employer

Lawrence Livermore National Laboratory

- LLNL has approximately 700 engineering technologists
 - Most would benefit from vacuum technology training
 - The current technologist population with vacuum experience is relatively small and mature
- Challenges
 - Attrition rate is expected to increase
 - New hiring is expected to increase
 - Most new employees are not trained in vacuum technology
 - Local schools are not offering vacuum technology coursework
 - Short course seminars are expensive and focused
- Telepresence instruction offers several advantages
 - Classes are interactive real time and on site
 - Relative low cost makes it attractive to LLNL
 - Coursework gives new employees a strong foundation

ReVAMP: Revising Vacuum Technology, an Advanced Manufacturing Program

- NSF ATE Project, 2014-2017, DUE #1400408
- **Project objectives**
 1. **Revise vacuum education curriculum: content update plus Learning Management System (D2L) design**
 2. **Update vacuum equipment trainer systems for hands-on learning**
 3. **Deliver courses via telepresence to industry and academic partners**
- Number of students Summer 2015 – Summer 2017
 - 97 VACT 1292 & VACT 2293 course enrollments: 86 students
 - 43 On-site / 43 Off-site (4 post-sec; 39 industry)

1. Revise Vacuum Education Curriculum

- Vacuum technology curriculum needs to be taught f2f, but industries and students are distributed. *LMS supports distributed learners while telepresence brings faculty and students together.*
- LMS features used in Vac Tech classes
 - Quizzing
 - Links to videos
 - Flipped classroom techniques promote student preparation ahead of class
- **Outcome: Normandale couldn't have done ReVAMP without LMS; ReVAMP promoted better use of LMS.**

2. Update Vacuum Equipment Trainer Systems

- Technicians from local companies participated in the High Vacuum Equipment Trainer (HVET) design process
- Six program students contributed to building and testing HVET systems (Cynthia Garcia)
- Introduced first working HVET system Summer 2015; demonstrated at 2015 ATE PI Conference
- Significant HVET performance upgrade made possible following participation at SVC TechCon 2016; led to Rough Vacuum (RVET) design and construction

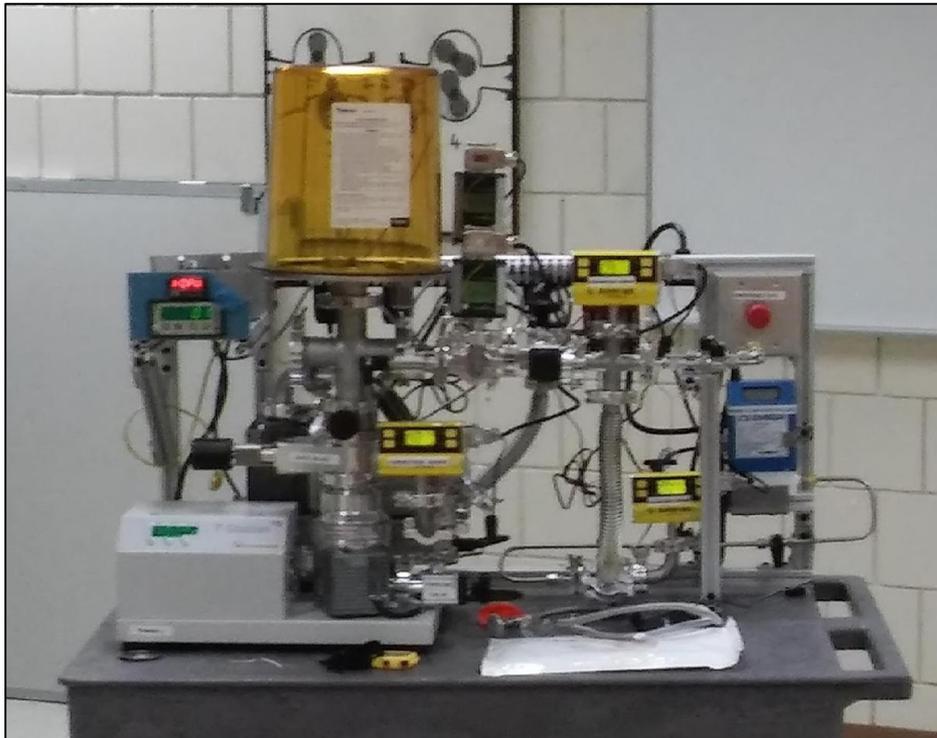
Outcome: Total of 4 HVET and 3 RVET fully constructed systems: systems used at partner sites



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New Equipment Trainer Systems

High Vacuum Equipment Trainer



HVET made possible by NSF DUE #1400408

Rough Vacuum Equipment Trainer



RVET made possible by Minnesota matching funds incentive program



3.a. Deliver Courses via Telepresence...

“For students who are geographically separated but able to meet synchronously, telepresence systems provide an opportunity for authentic social interactions with both peers and instructors.”

Carrie L. Lewis, Qijie Cai, Michael Manderfield, and Jude A. Higdon, "[Student and Faculty Perceptions of Telepresence Courses](#)," *EDUCAUSE Review*, July 20, 2015.

Differences between telepresence and consumer-level tools such as Skype, Google Hangouts, etc.

- Video size via a large screen: **human-sized** vs. reduced size
- Video quality: **high-speed, real-time video with low compression** vs. consumer Internet with high compression
- Access location: **place-bound to telepresence rooms and equipment** vs. available from any consumer-level device with Internet access



Lessons Learned about the Telepresence Classroom

Drawbacks of Existing Space

Conference room

- Limited to a class size of 8
- Screen for displaying distance students was very small

Cisco-immersive classroom (P2842)

- No good spot for instructor to address and see the students in classroom
- Fixed desk arrangement -> difficult to set-up HVET for demonstrations, hands-on work
- Room availability -> competition to use space especially evening classes

Custom Classroom (S1342)

- Accommodates class size up to 20
- Movable furniture
- Cisco cameras, but design customized by Tam Huynh
 - Three large high-def monitors; one is a touch screen
 - Three high-def cameras
 - High-performance microphones and speakers
 - System is controlled by a touch pad at the instructor's location.



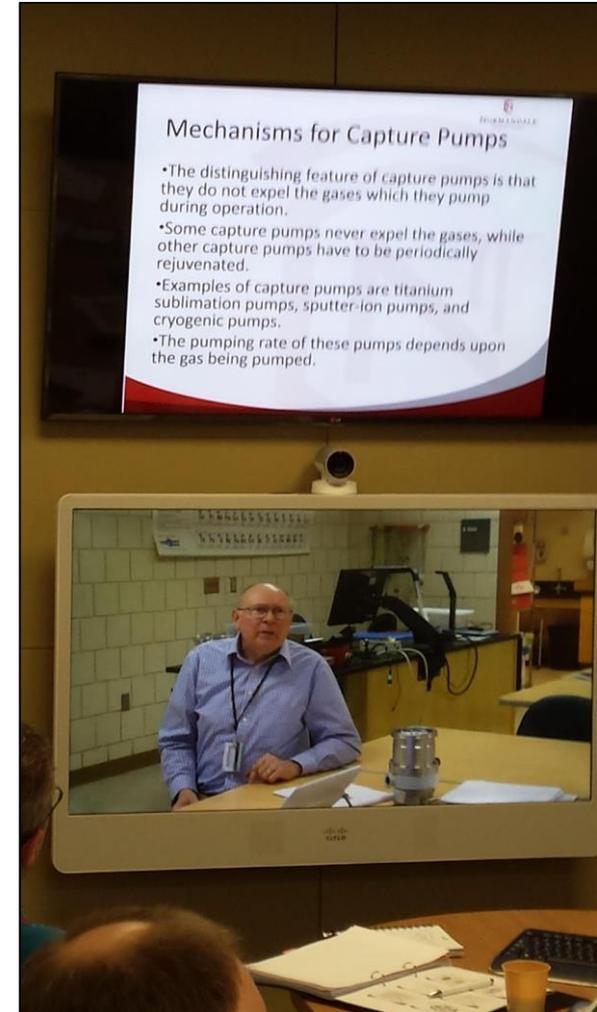
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Spring 2016 – Intro to Vacuum Tech

Normandale – custom classroom



Distance site – conference room





Deliver courses via telepresence...

3.b. to industry and academic partners

Early Assumptions:

- Partner with vacuum-reliant industries *and* academic institutions
 - Higher priority: academic institutions because of alignment (interests, administrative structures, and student populations)
- Pursue a financial and administrative model where partner institutions register students / employees in Normandale courses
 - Enrollment increases viability of the Vacuum Technology program
- Pursue a teaching and learning model where students / employees register for a semester-long vac tech course and a vacuum trainer system is shipped to offsite participants
 - Hands-on learning is always a top priority



What We Learned about Partnerships

List of issues developed from interviews with partners.

1. Getting Buy-in
 - 1.1. Motivations for establishing a partnership
 - 1.2. Stakeholders in establishing a partnership
2. Demonstrating Telepresence Technology in the classroom
3. Course Delivery Logistics
 - 3.1 Course & Class Schedules, Meeting Space
 - 3.2 Pedagogical Approach, Learning Management Systems, Textbooks
 - 3.3 Expectations and Etiquette
4. Staffing the Telepresence Classroom
5. Telepresence System & Room Design
6. Telepresence Technology Cost
7. Vacuum trainer system
 - 7.1 Liability
 - 7.2 Managing offsite
 - 7.3 Ratio of Students to vacuum trainer systems
 - 7.4 Cost

Perspective from a Telepresence Partner

- Evaluated Vacuum curriculum against the needs of the laboratory.
 - Visited Normandale and met with school stakeholders
- Obtained LLNL management and employee buy-in
 - Presented proposal to senior management
 - Surveyed laboratory program needs
- Staffed the telepresence classroom
 - Technologists are from diverse educational backgrounds
- Specified and costed Telepresence equipment
 - Engaged LLNL and Normandale IT.
- Classroom location and space
 - Customized location and space
- Vacuum trainer system
 - Shipped and certified to LLNL standards
- **Planning and preparing for the next phase**
 - Cohort 2

Engaging industry in telepresence classes

Industry Factors

- Many businesses have space(s) with telepresence technology
- Some sites have different technology configurations -> may not be optimum but workable
- Incumbent workers benefit from classes
- Industries were willing to provide access to class onsite for employees

Normandale Response

- Provided extra support to managers, HR and employees (e.g., advising via telepresence or at business' location)
- Made registration process easy, promoted registration choices (i.e., register as visiting student, audit or for-credit)
- Accepted registrations through the first week of class

Lessons: Proved that telepresence is a viable model for delivering education. Established workflow processes for onboarding remote students.



Engaging post-secondary institutions in telepresence classes

Post-secondary Factors

- Establish equivalent credit
- Who gets course revenue?
- HVET trainer system: personal danger, school liability?
- Who pays for instructor time?
- Synchronizing class time and duration
- Local telepresence, student response
- Shared LMS

Normandale Response

- VACT 1292 = NANO 110
- Project ReVAMP covered cost
- RVET and HVET systems survive shipping
- Project ReVAMP covered cost
- Small, but very critical unanticipated detail
- Regular “social” troubleshooting
- Maintain two systems

Lessons: Start working with academic business office early. Course enrollment at across sites needs to be at least 15 people to approach viability. Realistic timeline for collaboration from first conversations to course delivery may take a few years.



Questions for the Audience

- Going forward do you think this hybrid model of remote yet synchronous classes is feasible, scalable, applicable in other disciplines?
- Do you have examples of institutions partnering to deliver courses?
- What are key elements to making partnerships work?



Summary: Project ReVAMP Outcomes

Objective 1: Deliver updated vacuum technology curriculum

- Delivered 7, semester-length vacuum technology courses in a telepresence classroom (2015 – 2017)

Objective 2: Design, build and use vacuum trainer systems

- Built 3 RVET systems, used in “Intro to Vacuum Technology” course
- Built 4 HVET systems, used in “Vacuum Analysis and Troubleshooting” course

Objective 3: Deliver classes in a telepresence classroom

- Engaged 4 industry partners that rely on vacuum technology systems
- Engaged 1 academic partner (4-yr university)
- Engaged 1 national lab partner

*60% of students were offsite/40% of students were at Normandale



Final Reflections on teaching and learning in the telepresence classroom

Successes

- Concept – distance partners deliver the student numbers
- Technology / Classroom Space
 - Mobility and flexibility in the space: maintain sense of f2f
 - Encourages natural social interactions

Challenges

- Scaling the arrangements
- LMS: Academic site using a different LMS make partnerships challenging
- Managing and maintaining the trainer systems
- Identifying the pipeline of instructional talent



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Thank you for attending our presentation!

For more information about Normandale's
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Learn more about our program:

www.normandale.edu/vacvideo