

How Librarians Can Positively Impact STEM Students: Active Learning Design & Video Resources

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2018 STEM Librarians South

Today's presentation will:

- illustrate how interactive pre-work, like streaming videos, helps improve student engagement and performance
- illustrate the value of librarian expertise in the design of pre-class and in-class activities
- illustrate how librarian involvement in student-centered course design offers a scalable way to include information literacy competencies in STEM instruction

Presentation Outline (45 minutes)

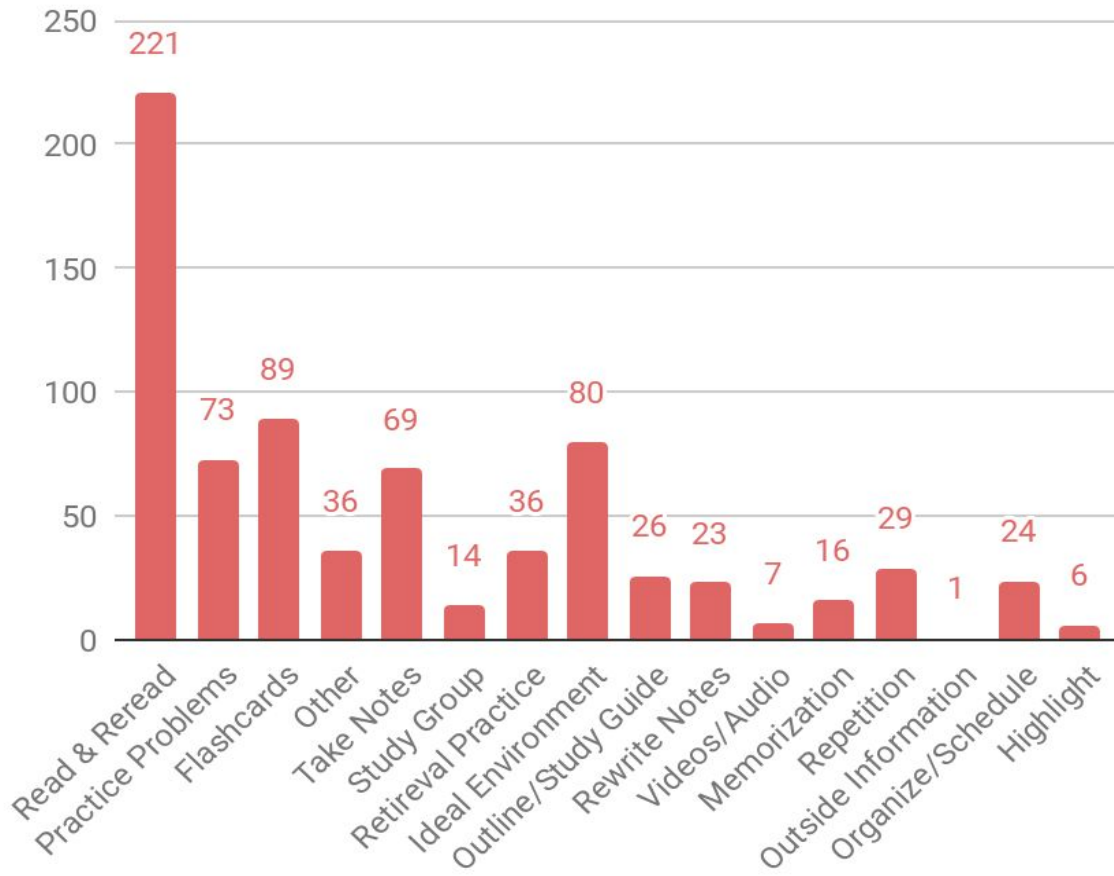
Librarian support of student-centered learning curricula in STEM education
(McGowan): 15 minutes

Active Learning Activity: 10 minutes

How streaming videos improve student performance (Ostrosky): 10 minutes

Q&A: 10 minutes

How do students approach learning?



Preferred Learning Strategy

964 Purdue undergraduates reported their first approach to learning

Designing Pre-Work Assignments: Dunlosky’s Review of Effective Learning Techniques

Practice Testing: Self Testing	Very effective over a wide range of situations
Distributed Practice: Implementing a schedule of practice that spreads out study activities over time	Very effective over a wide range of situations
Interleaved Practice: Implementing a schedule of practice that mixes different kinds of problems or materials within one study session	Especially effective for math and concept learning
Elaborative Interrogation: Generating an explanation for a ‘why’ question	Promising, but needs more research
Self-Explanation: Explaining how new information is related to known information or explaining steps taken during problem solving	Promising, but needs more research
Summarization: Writing summaries of to-be-learned information	Helpful, if done correctly
Keyword Mnemonic: Using keywords and imagery to associate verbal materials	Helpful for learning languages, but short-lived benefits
Rereading: Restudying text material again after an initial reading	Time could be better spent practicing other strategies
Highlighting: Marking potentially important portions of to-be-learned materials	Not particularly helpful
Imagery for Text: Attempting to form mental images of text materials while reading or listening	Very limited benefits

Student-centered learning includes creating content and curriculums that move students towards more effective learning techniques.

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Three ways I promote student-centered learning as an information specialist at a large STEM-focused university:

1. IMPACT
2. Embedded Librarianship meets Active Learning
3. Student-centered instruction in my courses and one-shots

Instruction Matters: Purdue Academic Course Transformation (IMPACT)

IMPACT seeks to achieve a greater student-centered learning environment by incorporating student-centered teaching and learning practices and technologies into large enrollment foundational courses.

Faculty meet weekly, over 13 sessions, to first determine student-learning outcomes and then work with a program team to create an assessment map to measure the effectiveness of student learning in their courses.

Participants gain new knowledge about teaching strategies and learn about pedagogical and technological resources available on campus to support them.

Instruction Matters: Purdue Academic Course Transformation (IMPACT)

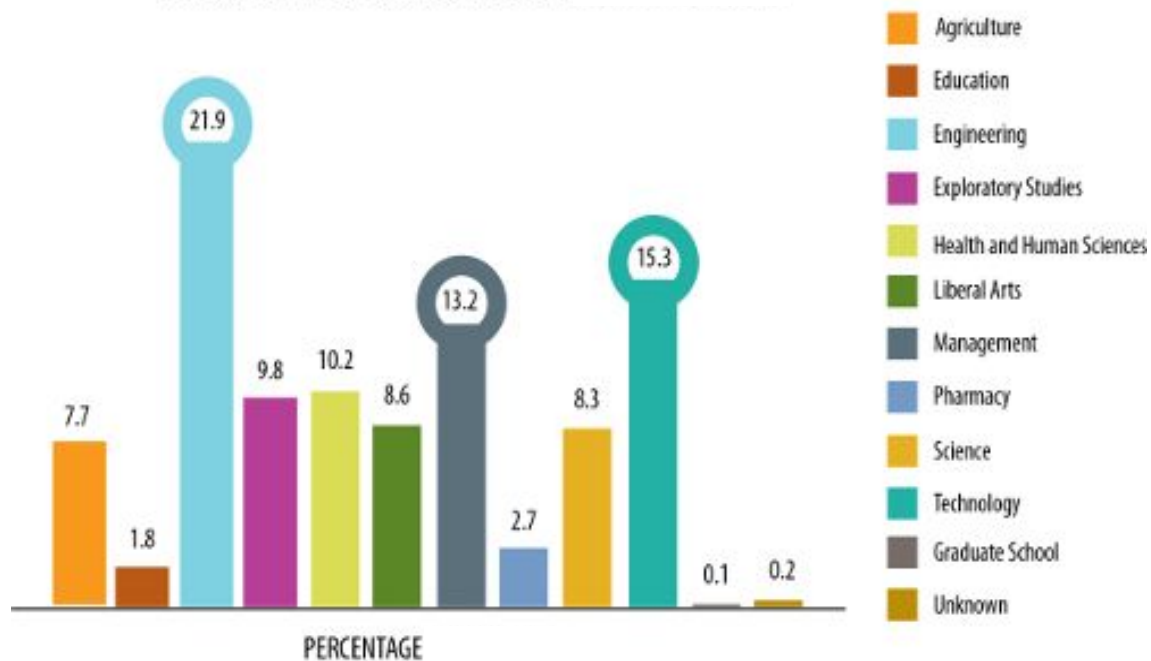
IMPACT Goals:

- Refocus the campus culture on student-centered pedagogy and student success.
- Increase student engagement, competence, and learning gains.
- Focus course redesign on research-based pedagogies.
- Reflect, assess, and share results to benefit future courses, students, and institutional culture.

Instruction Matters: Purdue Academic Course Transformation (IMPACT)

IMPACT involves support from the President's Office and the Office of the Provost and collaboration between the Center for Instructional Excellence (CIE), Information Technologies at Purdue (ITaP)--Teaching and Learning Technologies, and Purdue University Libraries.

COLLEGE REPRESENTATION



Instruction Matters: Purdue Academic Course Transformation (IMPACT)

The impact of IMPACT

- Most faculty reported significant increases in student activity and engagement in their redesigned classes.
- Faculty perceived an increase in students' critical thinking skills.
- Significant decreases in the average D/F/Withdraw (DFW) rates have been observed in IMPACT courses, from percentages in the mid-twenties, to about 12-15 percent.

Detailed IMPACT annual reports are publicly available at www.purdue.edu/impact

Involvement in a program like
IMPACT is not possible for
me. What else can I do?

Embedded Librarianship Meets Active Learning: A Case Study

Redesigning Nursing 223: Foundations of Research and Evidence Based Practice

- About the Course:
 - Required for all undergrad Nursing students as part of the outcomes-based core curriculum
 - teaches information literacy, data management, and scholarly communication competencies to Sophomores
 - students learn the principles of the research process and learn to identify strengths and limitations of research articles in relation to EBP in Nursing

3 Challenges

1 Adjust for Sophomores

The Nursing curriculum shifted and students now take NUR 223 as sophomores instead of as seniors. The original course objectives remain at a high level, though students are less experienced.

Heavy course load at sophomore year

2 Navigate fixed course objectives

Course objectives are fixed to ensure program accreditation and can not be easily changed.

3 Improve Student Engagement

Many students failed to complete the required readings, leading to diminished effectiveness in class and in group participation.

About those objectives...

1. Describe the principles of research and the process of EBP
 2. Use information and information technologies ethically, legally, and proficiently
 3. Explain the purpose and methodology of various types of quantitative and qualitative research designs
 4. Evaluate the quality of research evidence to determine scientific merit, strengths, and limitations relevant to clinical practice
 5. Examine the economic, legal and ethical issues related to conducting research
 6. Discuss the process of translating research evidence into practice
 7. Demonstrate the characteristics of an innovator that are necessary for EBP, including leadership, a sense of inquiry, flexibility to change, awareness of self and the environment, effective communication, critical thinking, lifelong learning, and professionalism.
- * Pre-req: ENGL 101 or similar

Preparation

1 | Understanding Assessment

Considered best assessment options, particularly gamified assessment and course assessments

CIE

2 | Selecting Appropriate Technology/Space

iPad for improved mobility when navigating around groups, Solstice and HotSeat apps

+

Moved class to Wilmeth Active Learning Center

3 | Collaborating

Worked closely with Nursing instructor

Worked with IT@P for Solstice and HotSeat Training

Action

1 | Assignment Redesign

Reduced the number of assignments

Distributed practice approach resulted in a course capstone, a poster presentation at the undergraduate research symposium

2 | Interactive Learning + Readings

Supported readings with videos and supplementary materials--JoVE Video Library, Twitter, NurseLogic 2.0

Integrated low-stake quizzes into pre-work assignments--The Point

3 | In-Class Interactions and Assessments

Emphasized group work

Used HotSeat and Solstice for quiz points and class participation points

Active Learning During One-Shots: Searching as Strategic Exploration Activity

Does hand washing among health care workers
reduce hospital acquired infection?

Problem: hospital acquired infection

Intervention: hand washing

Comparison: masks, no hand washing

Outcome: reduced infection

Natural language

P = hospital acquired
infection

I = hand washing

Mapped to Controlled
Vocabulary

P = cross infection
[MeSH], cross infection
[CINAHL]

I = hand disinfection
[MeSH], handwashing
[CINAHL]

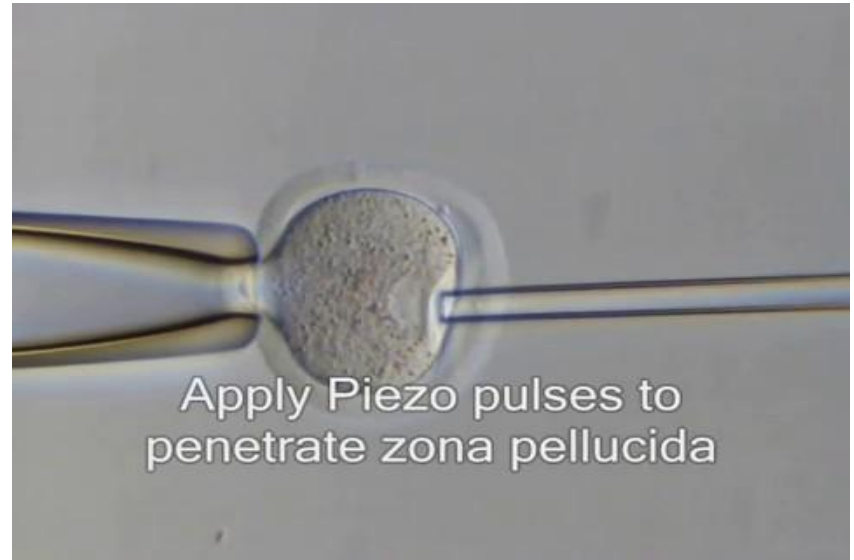
How Streaming Videos Improve Student Performance

The power of video in STEM

TEXT ARTICLE

Position the metaphase spindle at 3 o'clock and hold it with holding pipette. Apply piezo pulses to penetrate the zona pellucida. Touch the metaphase plate with the enucleation pipette. Aspirate the spindle and withdraw the pipette.

REAL LIFE





A CATALYST FOR SCIENTIFIC
RESEARCH AND EDUCATION





jove | VIDEO JOURNAL

Peer-reviewed methods journal
for research



jove | SCIENCE EDUCATION

Teaching / active learning tool
focused on key concepts

Classroom Video Efficacy Study



- **Project Lead:** Karen Mutch-Jones, Ed.D., Co-director of SEEC at TERC
- **TERC** is an independent, research-based organization **dedicated to improving mathematics and science education for all students.**
- For over 50 years, TERC has worked at the frontiers of theory and practice to develop and enhance instruction, curriculum and new technologies.

Goals of the TERC study

Can watching a JoVE video prior to attending a biology laboratory class improve or enhance students'

- **performance** in pre- and post-lab assessments?
- ability to **conduct the lab**?
- sense of **confidence** during lab work?
- comprehension of **concepts** pertaining to the lab?

Study Design

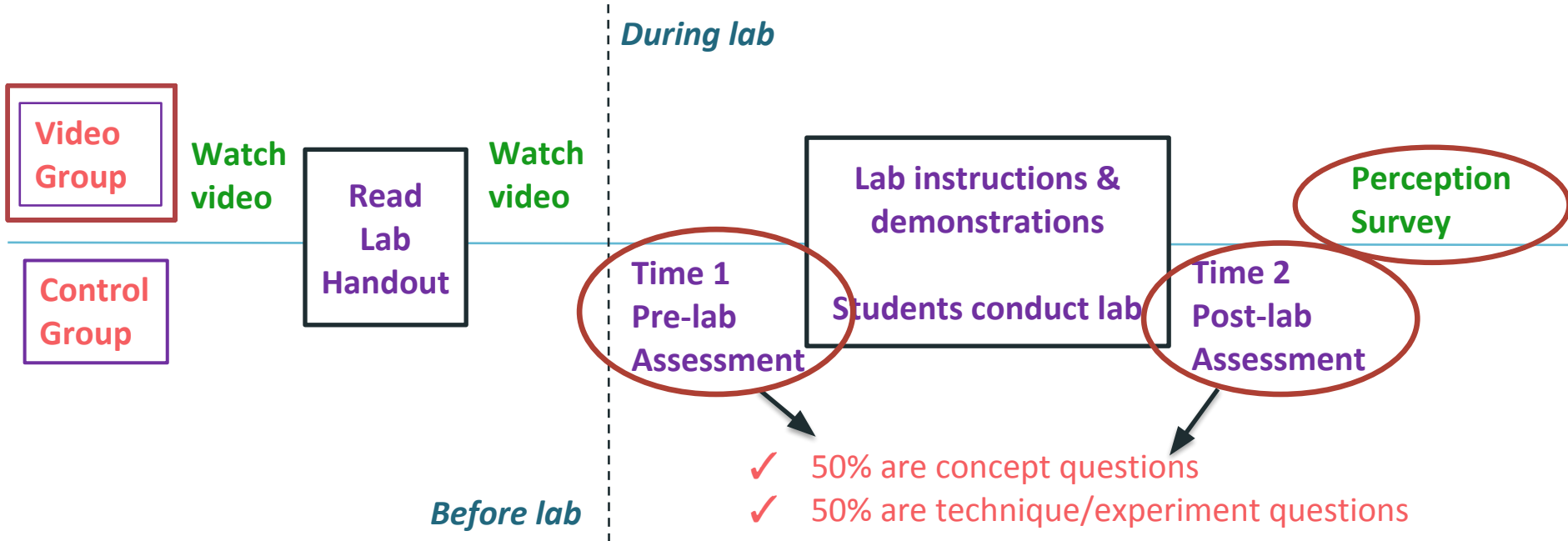
DeSales University

- Molecular Biology course, mostly sophomores and part of an accelerated PA program
- 94 students, 4 sections, same professor
- Lab / Video intervention:
 - Labs: GFP Protein Denaturation, and DNA and Enzymes
 - Video: ~ 5 minutes of SDS Page, and Plasma Purification in SE2

Clemson University

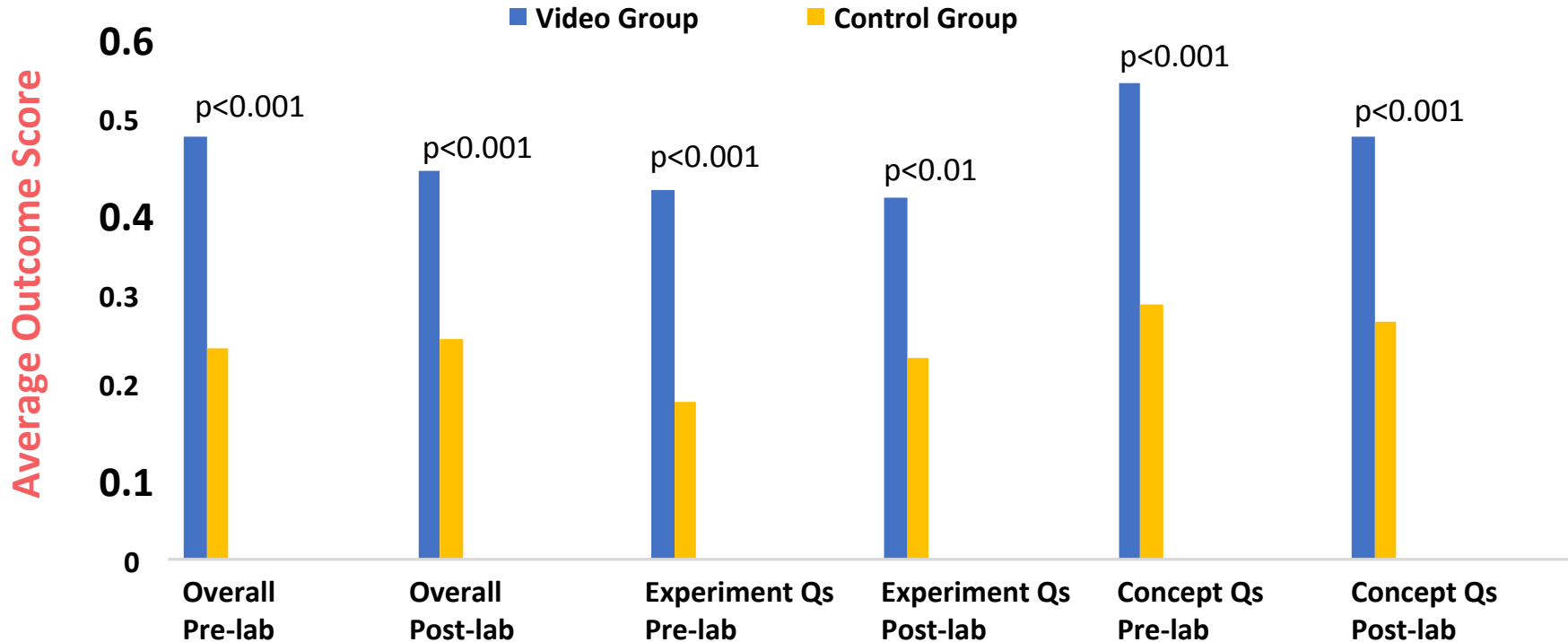
- Intro Biology course, no science majors but core requirement, freshman - seniors
- 252 students, 14 course sections, 4 TA's, 1 professor
- Lab/Video intervention:
 - Labs: Microscopy, and Quantitative Biology
 - Video: ~5-6 minutes of Introduction Light Microscopy, and Spectrophotometer in SE1

Study Design



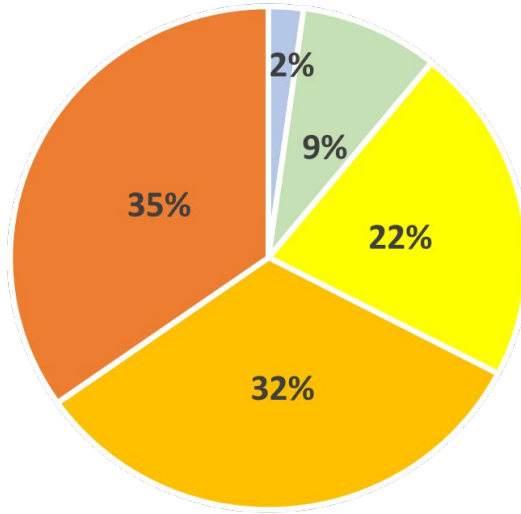
**Even a small amount of video
watching had a BIG impact...**

Video group students scored significantly higher with almost “2-fold” difference, in **Plasmid Purification Lab**

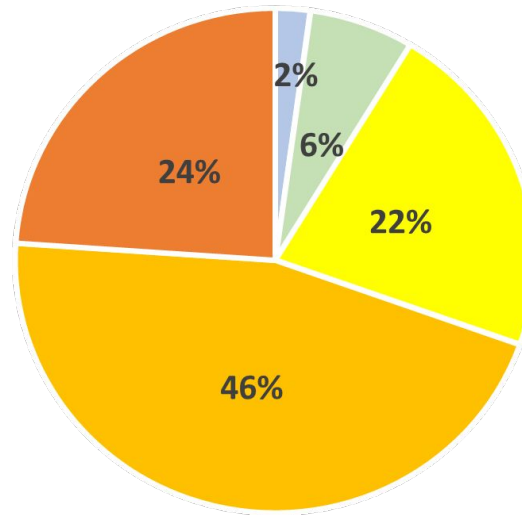


Almost ALL students had a positive perception of the SDS PAGE video

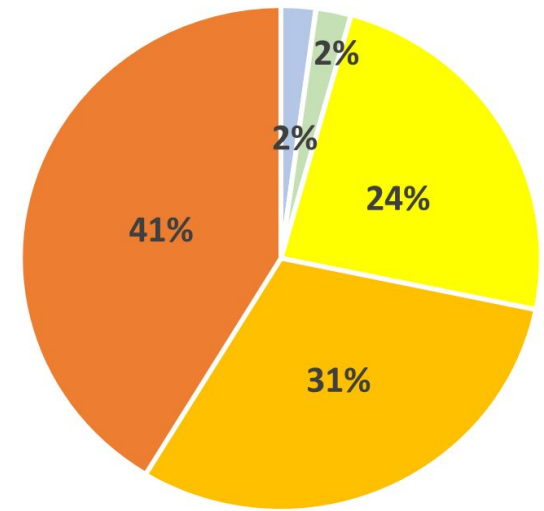
89% reported
increased **confidence**



92% reported
better **understanding of lab**



96% reported better
comprehension of **concepts**



■ not at all ■ a little ■ a fair amount ■ a moderate amount ■ a great amount

Key findings

These positive results were not by chance – we confirmed with statistical modeling.

- **DeSales:**

- Science majors benefited significantly
- Up to **2x** better performance
- **More confident (90+%)** and better understanding

- **Clemson:**

- **Support students** with limited science interest and background
- Help students develop a greater understanding of experimental techniques and processes, and work **more efficiently** during lab
- Use complex lab equipment with **greater confidence** and care

Video and the STEM Student Journey

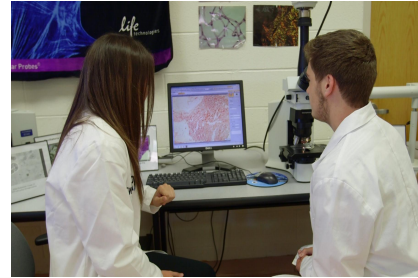
Pre-class
Assignment



Classroom
Resource



Lab
Resource



Research
Outreach



Video streaming resources enrich users through their career

How should we measure value of videos?

- UCLA: Effects of JoVE videos in classroom during chemistry education (ongoing)
- Dartmouth: Modeling the macro effects of video-based learning over several years in a student's career (ongoing)
- University of Statale of Milan: Bringing JoVE videos into the classroom as full-time curriculum support (Fall 2018)

Takeaways

1. Even if you don't have IMPACT, you can incorporate active learning activities during your embedded librarianship outreach, and during one-shot and workshop instruction.
2. Practice testing, distributed practice, and interleaved practice approaches are particularly effective in STEM education.
3. Video is an effective active learning resource
4. Video boosts STEM students confidence and performance in the lab

References / Resources

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), 4-58.

IMPACT at Purdue University: <https://www.purdue.edu/impact/>

Video Efficacy Study Report: <https://www.jove.com/wp-content/uploads/2018/04/Efficacy-Study-Full.pdf>

JoVE Science Education Videos: <https://www.jove.com/science-education-library>

Getting Started with Scholarship of Teaching and Learning: <https://guides.lib.purdue.edu/impact/sotl>

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Thank You!
Any Questions?