FAU

IMMERSIVE INTERACTIVITY IN ONLINE SCIENCE LAB COURSES: DESIGNING EFFECTIVE EDUCATIONAL ECOSYSTEMS

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FLORIDA ATLANTIC STEM RESEARCH GROUP FOR DIGITAL LABORATORY LEARNING

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Our Purpose. Increasing agency and empowering effective STEM laboratory and technical learning through faculty for students, building and disseminating the evidence-base for best practices in digital and virtual laboratory learning.

ROADMAP

- Learning Objectives
- Immersive Online Content (IOC) Approach
- Quality Connection
- 360° Virtual Reality (VR) Labs
  - Demos
  - Your Turn!
- DIY Toolbox
- Conclusion

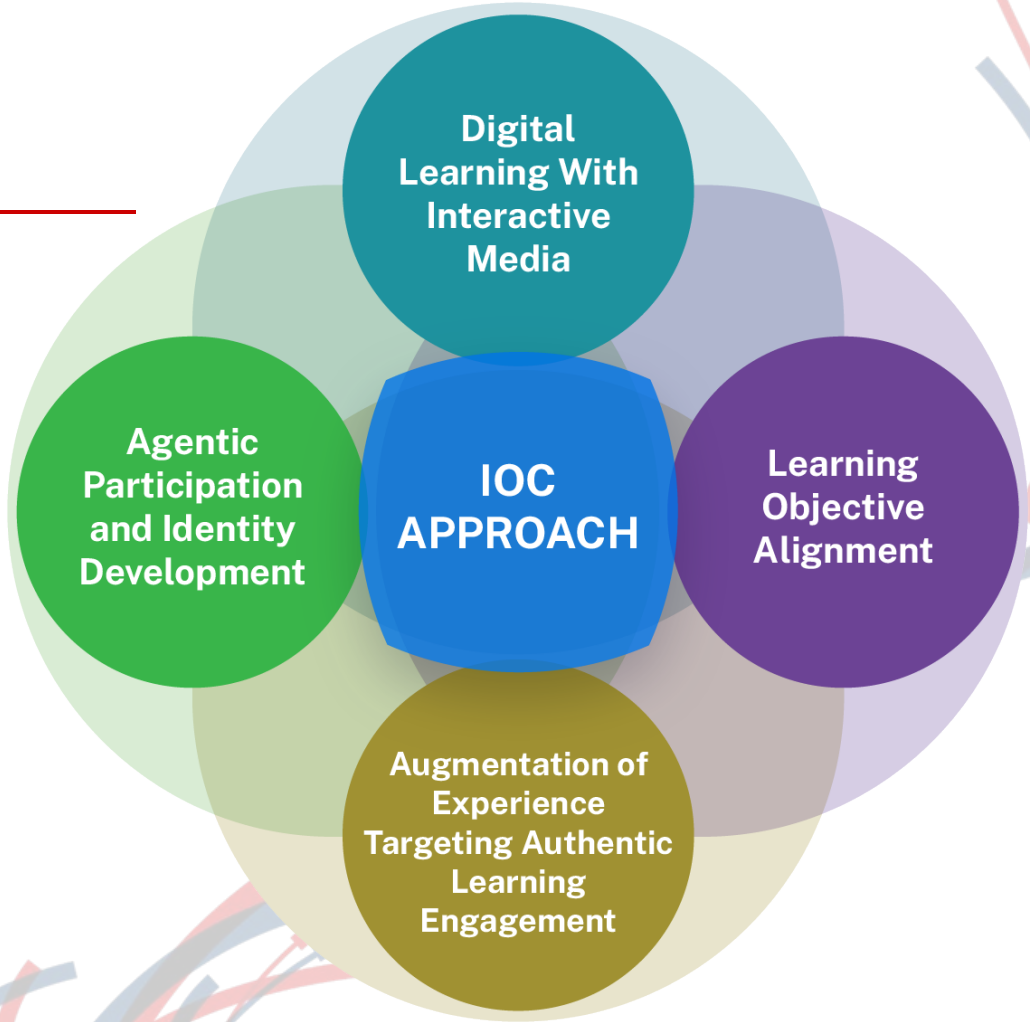
LEARNING OBJECTIVES

LO1: Discuss instructional design of the Immersive Online Content (IOC) Approach in order to consider application into course(s).

LO2: Explore Virtual Reality IOC science labs in order to plan for IOC implementation in STEM or non-STEM courses.

LO3: Identify Do-It-Yourself resources of several tools in order to empower decision-making on IOC application for course(s).

IMMERSIVE ONLINE CONTENT?



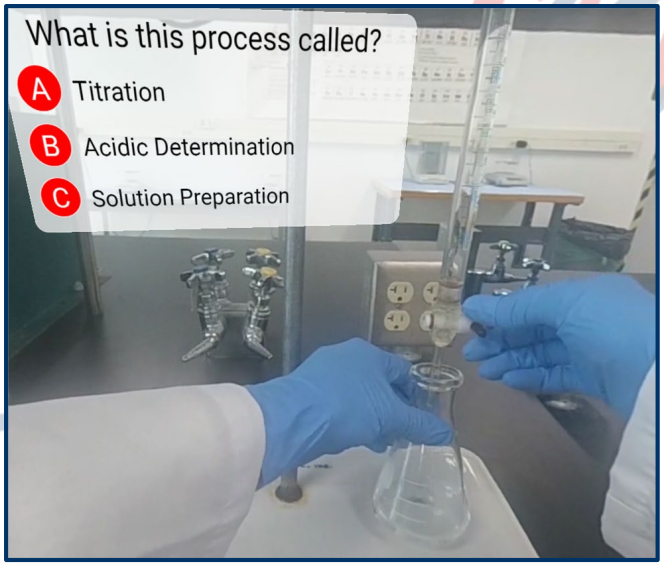
IMMERSIVE ONLINE CONTENT APPROACH

Ecosystem Foundation of Quality Matters™ Rubrics[1]

★**EQUITY** in assignment rubrics[2]

★**ACCESS** for students where they are[3], divergent learning[4], diverse needs[5]

★**INCLUSION** in student-focus[6], agency[7], identity[8]



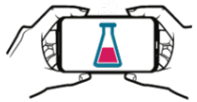
THE DIY GOAL: IMMERSIVE ONLINE CONTENT APPROACH

STEP 1

Pick space

STEP 2

Record



STEP 3

Add quizzes & hotspots

STEP 4

STEP 5

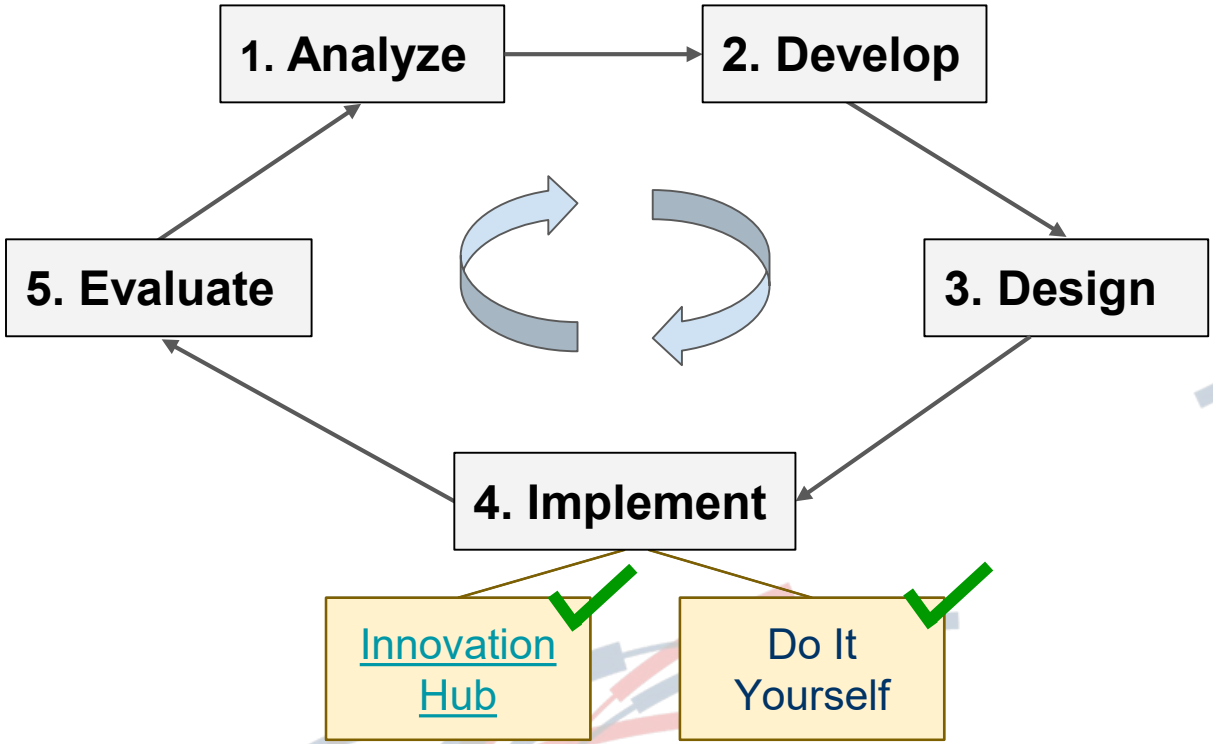
Post online

STEP 6

Student interacts

PURSUING QUALITY ASSURANCE: OUR ROADMAP TO QUALITY IOC COURSE DESIGN

ITERATIVE R&D PROCESS

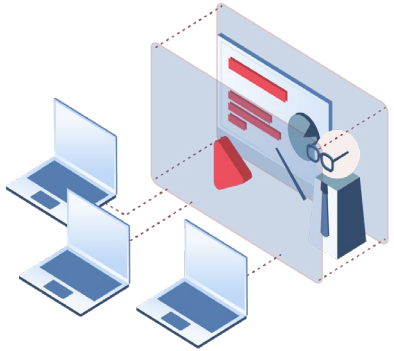


IMPACT

1. ↓ $ STEM lab experience
2. Equitable consistent student learning experiences across lab sections
3. ↑ education access all together
4. ↑ instructor presence
5. ↓ in-person bench space
6. GTA training tool

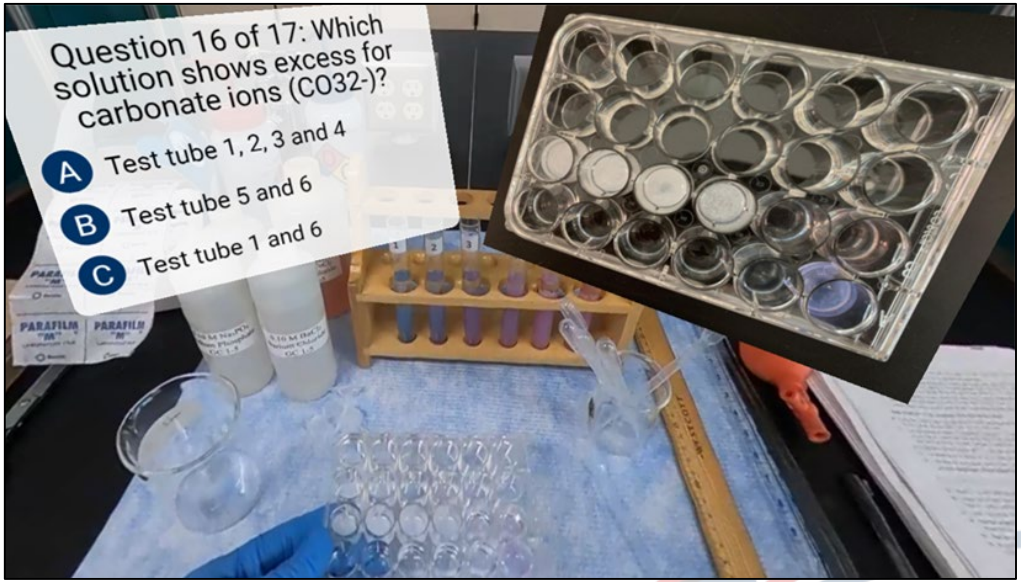
BEFORE 360
Redundant lecturing

AFTER 360 Ecosystem enhanced by promotion of teacher presence & student self-regulation



STANDARD 5: LEARNING ACTIVITIES & LEARNER INTERACTION

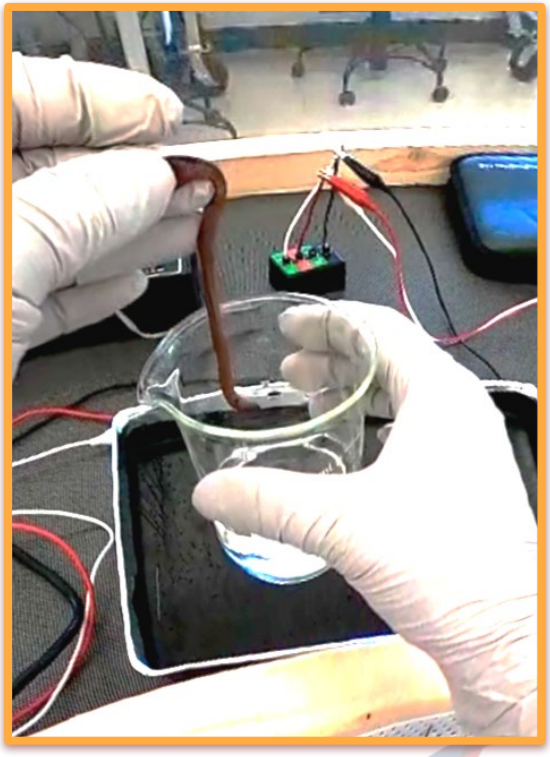
Lab Activity → Data Collection

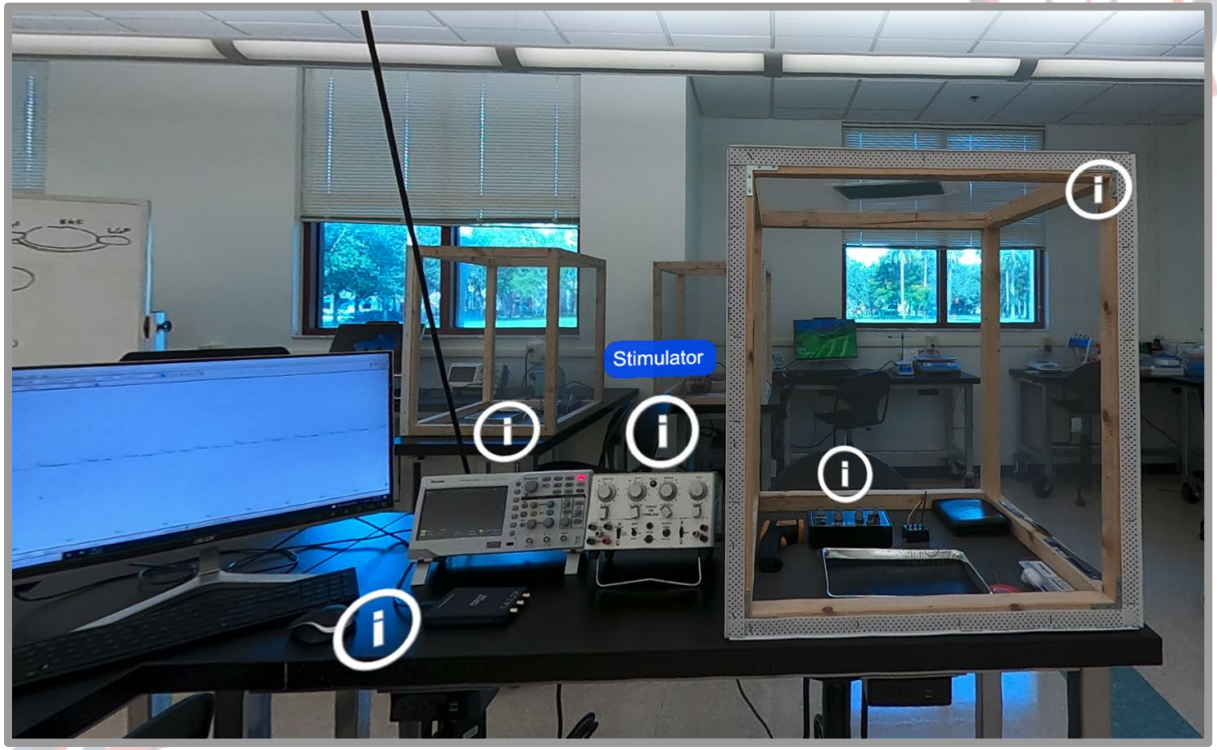


Precipitate formation observations	Test tube #1	Test tube #2	Test tube #3	Test tube #4	Test tube #5	Test tube #6
Reaction of supernatant liquid w/ NA_3PO_4						
Reaction of supernatant liquid w/ $BaCl_2$						

CHEMISTRY 360° VR LAB DEMO

BIOLOGY 360°
VR LAB DEMO





TREASURE MAP QUEST: 360° VR LABS

- Explore however you are comfortable
  - Small groups
  - Individually
  - Observe
- QR code for phone
- URL for laptop
- Accessibility

DO IT YOURSELF TOOLBOX: CAMERAS & PRODUCTION SOFTWARE

360° Cameras

- Newer smartphones
- 5K, 6K GoPro Max
  - $399.98
  - Includes audio and camera stabilization
- Insta360
  - Insta360 Mini
    - $299.99
  - 8K Insta360 Pro 2
    - $4,599 - $5,449
    - Packages vary with audio and production software
    - Full Adobe Premiere Pro integration

Production Software

- CenarioVR™
  - $1,599/yr
- Articulate 360 suite
  - Storyline 360 app, Rise 360 app, plus add-ons
  - $499/yr
- Adobe 180 & 360/VR
  - Adobe Premiere Pro, After Effects, Photoshop bundle
  - $40 - $55/mo
- VR for Education Resources

DO IT YOURSELF TOOLBOX: SOFTWARE SELECTION

CenarioVR

- Using CenarioVR to Create VR eLearning video
- Getting Started in CenarioVR video
- How to Create a Scenario in CenarioVR video
- CenarioVR - Experience Virtual Reality video
- Getting Started Guide for CenarioVR document

Articulate

- How to Pick Articulate Storyline vs. Rise for Your eLearning Projects video
- A Quick Overview of Storyline 360 video
    - 360 VR begins at time [13:12 / 29:39]
- Embed Storyline 360 project in Canvas using iframe community forum

DO IT YOURSELF TOOLBOX: AUDIO & LIGHTING

Audio

- Manfrotto VR medium carbon fiber extension boom
  - $216.99 - $518.99
- Rode Wireless Go microphone
  - $199.99
- Zoom H30-VR audio recorder
  - $249.99
- Zoom H4N wireless lavaliers audio recorder
  - Zoom F1 Field Recorder + Lavalier Mic
  - $169.99

Lighting

- Manfrotto VR small leveling base tripod
  - $ 293.99 - $303.99
- Aputure 120D II (light)
  - $545.00
- Dracast DRSP-500B (light)
  - $184.60
- Spiffy Gear Spekular Interview Kit
  - $595.00

CONCLUSION & THANK YOU!

Anonymous Feedback Survey QR Code

http://tiny.cc/5190vz

Immersive Online Content CoP QR Code

http://tiny.cc/r1ntuz

QUESTIONS & ANSWERS

SUPPLEMENTAL SLIDES

Stay up to date with us at our homepage

[Florida Atlantic STEM Research Group for Digital Laboratory Learning]

FAU
CENTER FOR ONLINE AND CONTINUING EDUCATION
Florida Atlantic University

REFERENCES

[1] Board of Governors (2015, November 5). *Online education 2025 strategic plan*. State University System of Florida. https://www.flbog.edu/wp-content/uploads/2015_11_05-FINAL_StratPlan_RevPerfIndicators_-2020_05_05.pdf

[2] Rosenberg, J., & Smith, W. (2021, October 26). *Implementing active learning in undergraduate STEM courses* [webinar]. National Science Foundation, Improving Undergraduate STEM Education Initiative. https://youtu.be/slRrGT_6I7o

[3] Manier, L., Veague, T., York, T. T., Wagstaff, I., & Carinci, J. (2022). Lessons Learned During COVID-19: Strategies Transforming the Future of STEM Education. American Association for the Advancement of Science - Improving Undergraduate STEM Education Initiative. https://aaas-iuse.org/lessons-learned-report

[4] Mohiuddin, S., Roshan, D., & Knorpp, H. (2016). Utilization of immersive 360 degree spherical videos and google cardboard in medical training and simulation: a novel and multi-dimensional way of learning. *Anesth. Anal*, *122*.

[5] Kandalaft, M. R., Didehbani, N., Krawczyk, D. C., Allen, T. T., & Chapman, S. B. (2013). Virtual reality social cognition training for young adults with high-functioning autism. *Journal of autism and developmental disorders*, *43*(1), 34-44.

[6] Nesenbergs, K., Abolins, V., Ormanis, J., & Mednis, A. (2021). Use of augmented and Virtual Reality in remote higher education: A systematic umbrella review. *Education Sciences*, *11*(1).

[7] Freude, H., Reßing, C., Müller, M., Niehaves, B., & Knop, M. (2020, January). Agency and body ownership in immersive virtual reality environments: A laboratory study. In *Proceedings of the 53rd Hawaii International Conference on System Sciences*.

[8] Goldman, S. R., Petrosino, A. J., & Cognition and Technology Group at Vanderbilt. (1999). Design principles for instruction in content domains: Lessons from research on expertise and learning. In F. T. Durso, R. S. Nickerson, R. W. Schvaneveldt, S. T. Dumais, D. S. Lindsay, & M. T. H. Chi (Eds.). *Handbook of applied cognition* (pp. 595-627). Wiley.

[9] Quality Matters (2020). *Specific review standards from the QM higher education rubric* (6th ed.). https://www.qualitymatters.org/sites/default/files/PDFs/StandardsfromtheQMHigherEducationRubric.pdf

SUPPLEMENTAL REFERENCES

CAST (2018). Universal Design for Learning Guidelines version 2.2. Retrieved from http://udlguidelines.cast.org

Coy, K. (2020. April 30). *UDL is essential for post-secondary pandemic learning.* eCampusNews, Today's Innovations in Education. https://www.ecampusnews.com/2020/04/30/udl-is-essential-in-post-secondary-pandemic-learning/

Dick, W., Carey, L., & Carey, O. J. (2001). The systematic design of instruction (5th edition). Longman.

Maidenbaum, S., & Amedi, A. (2015, March). Non-visual virtual interaction: Can Sensory Substitution generically increase the accessibility of Graphical virtual reality to the blind?. In *2015 3rd IEEE VR International Workshop on Virtual and Augmented Assistive Technology (VAAT)* (pp. 15-17). Institute of Electrical and Electronics Engineers. doi: 10.1109/VAAT.2015.7155404

Mancilla, R., & Frey, B. (2021). *Course design for digital accessibility: Best practices and tools* [White paper]. Quality Matters. https://www.qualitymatters.org/sites/default/files/research-docs-pdfs/QM-Digital-Accessibility-Best-Practices-Tools-WP.pdf

Martin, F., Budhrani, K., Kumar, S., & Ritzhaupt, A. (2019). Award-winning faculty online teaching practices: Roles and competencies. Online Learning, 23(1), 184-205. doi: 10.24059/olj.v23i1.1329 https://files.eric.ed.gov/fulltext/EJ1211042.pdf

Santiago, R., & Fernandez, A. (2022, February 1). *FAU Davie's Faculty Innovation Hub: Helping professors innovate their courses with technology.* FAU Broward Campuses News. https://www.fau.edu/broward/news/innovation-hub-a-hit-with-faculty/

Scavarelli, A., Arya, A., & Teather, R. J. (2019, March). Towards a framework on accessible and social VR in education. In *2019 IEEE conference on virtual reality and 3D user interfaces (VR)* (pp. 1148-1149). Institute of Electrical and Electronics Engineers. doi: 10.1109/VR.2019.8798100

Siu, A. F., Sinclair, M., Kovacs, R., Ofek, E., Holz, C., & Cutrell, E. (2020, April). Virtual reality without vision: A haptic and auditory white cane to navigate complex virtual worlds. In Proceedings of the 2020 CHI conference on human factors in computing systems (pp. 1-13). doi: 10.1145/3313831.3376353

CHEMISTRY OER LAB MANUALS

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 1: Measurement and graphs for health science (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 2: Density (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-SA.

Yavuz-Petrowski, O. (2022). General Chemistry for Health Sciences lab manual 3: Periodic table and atomic structure (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 4: Mixtures & compounds (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 5: Gas laws (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 6: Concentration and solution preparation (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-SA.

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Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 7: Solutions as transporters in diffusion and osmosis (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 8: Spectrophotometry (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 9: Acids and bases (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 10: Titration (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 11: Introduction to organic chemistry (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

Yavuz-Petrowski, O. (2021). General Chemistry for Health Sciences lab manual 12: Introduction to biological macromolecules (A. Perkins, Center for Online and Continuing Education, Ed.). Florida Atlantic University. CC BY-NC-SA.

IMMERSIVE ONLINE CONTENT: APPLICATIONS SPANNING DOMAINS

- Google Arts & Culture
- Center for Online and Continuing Education Professional Development sessions
  - Simulations for Educational Purposes
  - Experience and Create Virtual Field Trips in Your Course: An Exploration of Google Arts & Culture
  - Surrounded by 360 VR Videos
  - Conducting STEM Labs Online

OUR ROADMAP TO QUALITY IOC COURSE DESIGN

Salient* IOC Specific Review Standards

- **Assessment & Measurement.** 3.4 (sequenced/varied), 3.5 (multiple opportunities to track progress w/ feedback)
- **Instructional Materials.** 4.5 (variety)
- **Learning Activities & Learner Interaction.** 5.2 (active learning)
- **Course Technology.** 6.2 (engagement/active learning)
- **Accessibility & Usability.** 8.3 (text/images), 8.4 (multimedia access), 8.5 (multimedia ease of use)

* The whole QM book did not fit on slide (we tried)

ACCOUNTABILITY STRATEGY: SUSTAINING EDUCATIONAL ECOSYSTEM EFFECTIVENESS

Universal Design for Learning (CAST, 2018) to Futureproof (Coy, 2020)

- Engagement
  - Self-regulation/assessment, reflection
  - Instructor reflection (Martin et al., 2019)
- Representation
  - Audio/visual information alternatives
  - Illustration through multiple media
- Action & Expression
  - Optimize access to tools/assistive technologies

Research in Practice

- Offline & online access
  - PhET simulations
  - OER Lab Manuals
- Streamlining immersion
  - Cognitive load reduction
  - Backup guideposts
- Quality control
  - TA training
  - IOC Community of Practice
  - Continual improvement of multimedia accessibility (Mancilla & Frey, 2021)

THE TRANSFORMATIONAL GOAL: IMMERSIVE ONLINE CONTENT APPROACH

Bridging research and practice with data-driven decision making

RESEARCH QUESTIONS

1) Will implementing a high-level IOC approach in online biology and chemistry laboratory course sections result in no difference of student learning of technical scientific skills and discipline-specific concepts versus student learning in 100% in-person laboratory course sections?
2) Can the high-level IOC approach be utilized to implement high-quality standardized TA training for futureproofing digital instructional delivery?
3) Will implementation of faculty workshops support more faculty to be trained and pursue the development and implementation of high-level IOC approach in technical STEM laboratory courses?

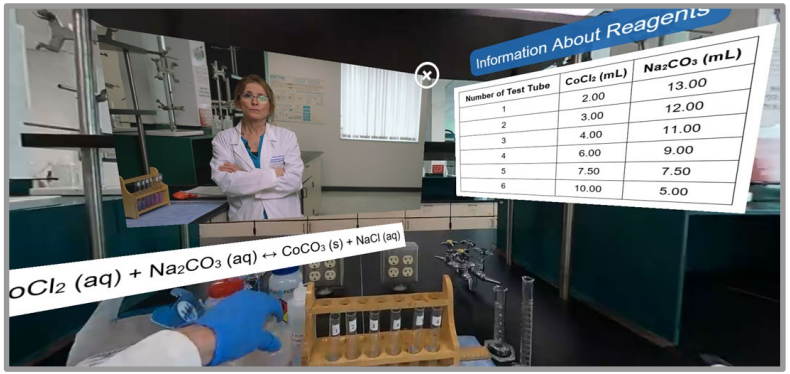
IMMERSIVE ONLINE CONTENT: R&D INSTRUMENTS

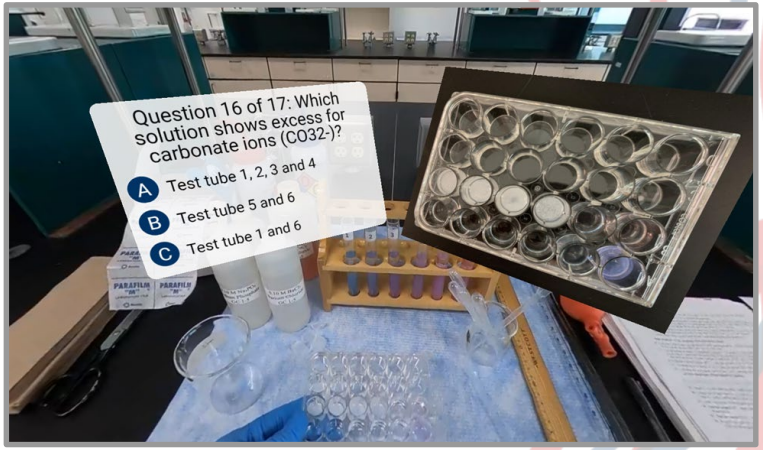
- Course-Based Undergraduate Research Experiences (CUREs) rubrics
- Virtual Engagement Questionnaire (VEQ)
- **Student Assessment of Their Learning Gains (SALG) survey**

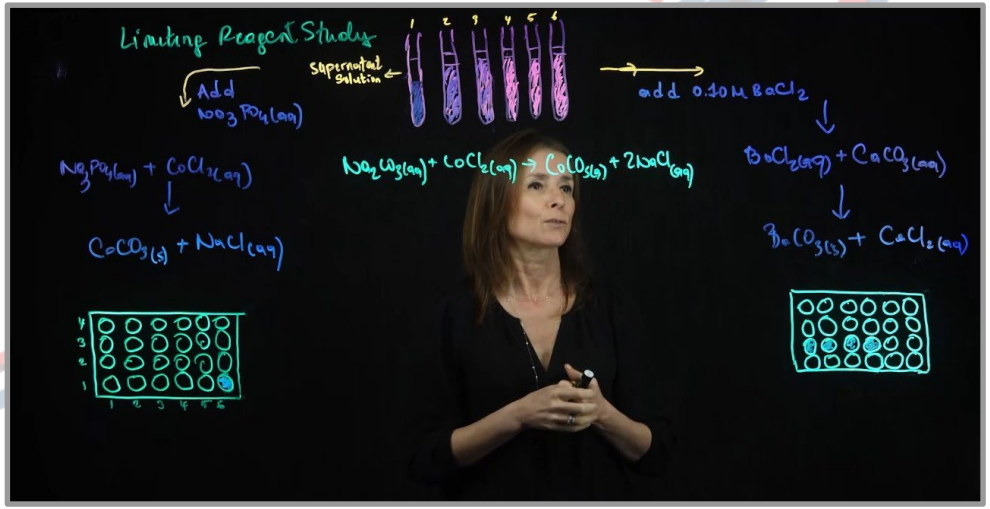
STUDENT IMPACT

- **“I have a better understanding of threshold and more confidence on the topic,”**
- **“As a result of the separating a mixture experiment, I will carry my knowledge of how to use certain lab tools that might be used for future experiments,”**
- **“The 360 video helped me as an individual learner by giving me personal questions that I have to answer to understand what was being done in the lab.”**
- **“...the 360 degree video helped me because I like having visuals, it helps me learn so the video really helped me understand.”**

DEMONSTRATION: CHEMISTRY 360° VR LABS







OER: CHEMISTRY 360° VR LABS

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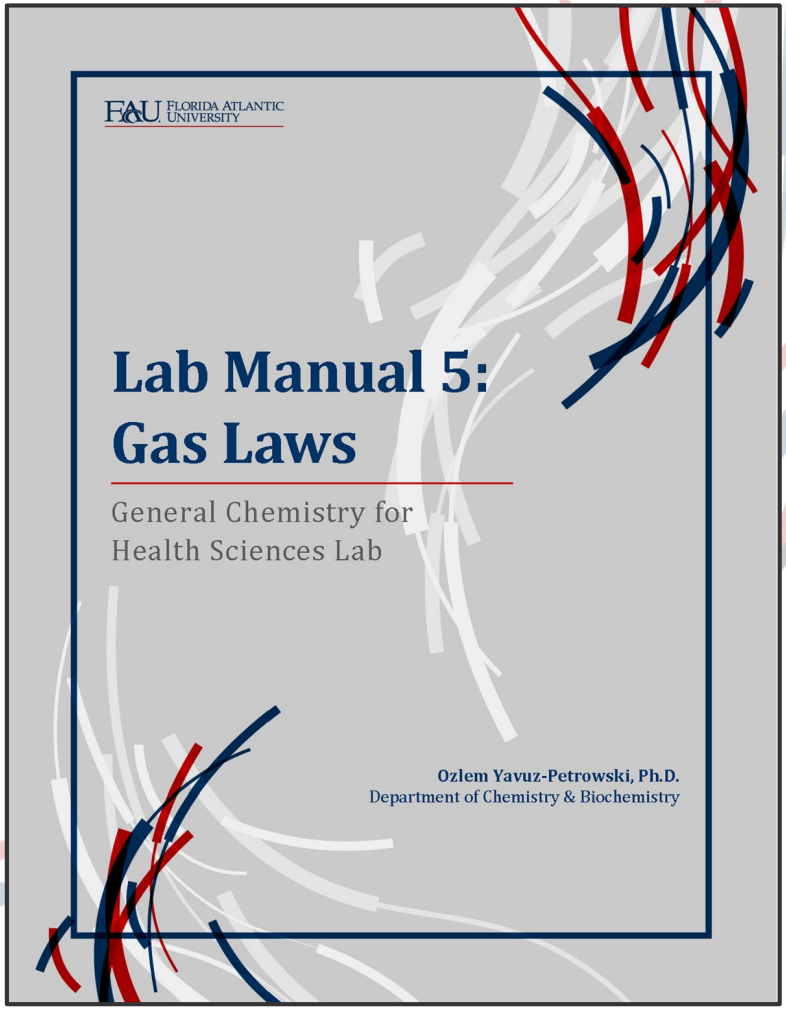

DO IT YOURSELF TOOLBOX: ACCESSIBILITY

Existing with Varying Degrees of Access and Resources

- Traditional person interpreter
- Two VR versions, one with all hotspots as audio
- Visual-to-Audio Sensory Substitution Devices (SSDs)
- Headset/smartphone triggers hotspots by
  - Tracking eye direction
  - Additional controller
- Lock rotations/zoom to 2D plane options
- WebVR with A-Frame to build multi-device interaction
- Haptic auditory white cane
- Haptic feedback gloves and shoes
- How Do People with Low Vision…Complete Science Labs?
- VR/AR in Canvas LMS with EON Reality

RESOURCES FOR FACULTY FUNDING

- DOE Grants
  - https://www2.ed.gov/fund/grant/apply/grantapps/index.html?src=ft
- Municipal Prizes
  - https://www.cfbroward.org/articles/the-be-bold-prize-rfp-now-open
- Industry Grants or Sponsorships
  - Course Hero Teaching Grant
- Organization Awards
  - The POGIL Project
- Foundation Awards
  - https://www.openphilanthropy.org/
- University-level Grants and Funding
  - https://www.fau.edu/ouri/curriculum_grants.php
  - https://www.fau.edu/techfee/