STEVENSON
UNIVERSITY
BEVERLY K. FINE SCHOOL of the SCIENCES
Engineering, Math, and Physics

Getting Your Students on Track

Applying the 5 A's of Alignment in Physics Labs

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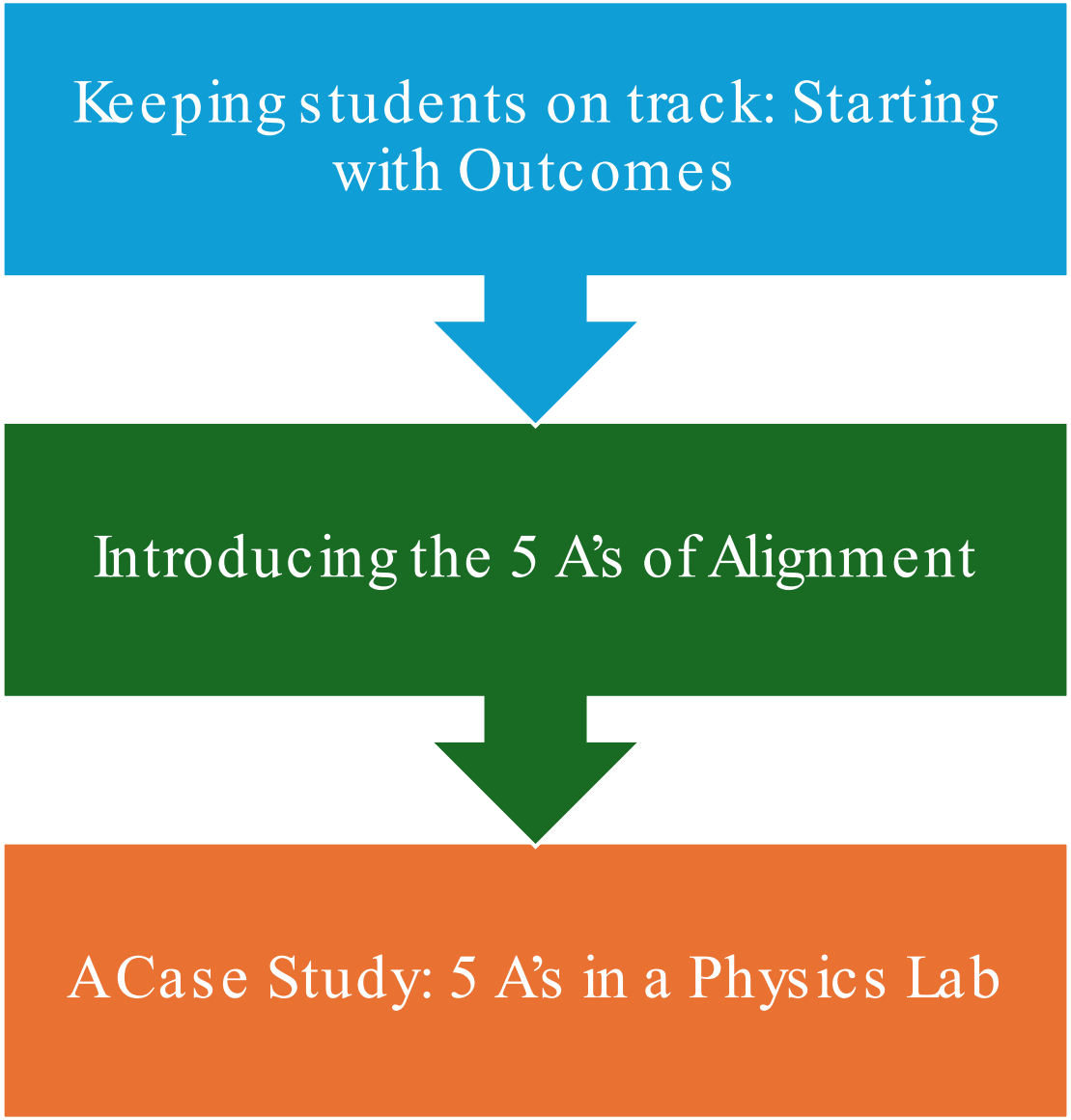
Agenda


Keeping students on track: Starting with Outcomes
Introducing the 5 A's of Alignment
A Case Study: 5 A's in a Physics Lab

Keeping Students on Track in the Course

Clear instructions → reduce unproductive ambiguity

Project timelines → scaffold long, open-ended work

Early feedback → identify and address misconceptions sooner

Backward-designed curriculum → align activities with course outcomes

Lab Outcomes – The Aim

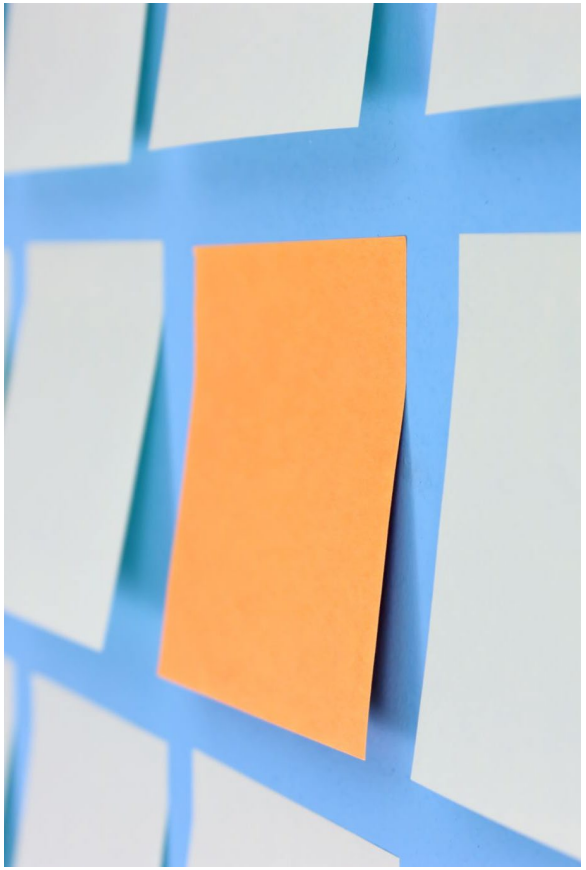
- Collaborate Effectively to
- Safely perform experiments
- Collect & Analyze Data
- Perform error calculations
- Communicate results

5 A's of Alignment ➔

5 A's Alignment

A way to ensure student actions and assessments remain aligned with course outcomes throughout the semester.

- Aim
- Action
- Assessment
- Analysis
- Adjustment



Aim

Effective Collaboration in the Physics Lab

Action - What Students Actually Do

- Weekly Labs
- 3 students per group
- 6- 7 groups per class

Assessment

Instructor Observation (Group Level)

- Monitored student participation and group interactions
- Not formally structured, but feasible with a small class (~20 students)
- Provided real-time insight into engagement

Individual Lab Test

- Students performed a lab independently
- Assessed ability to:
  - Set up experiment
  - Collect data
  - Analyze results

Analysis – What the Evidence Revealed

What Group Shows

- Group labs appear productive
- Tasks are completed and submitted
- Participation within groups varies

Hands-on setup and troubleshooting are often led by one student.

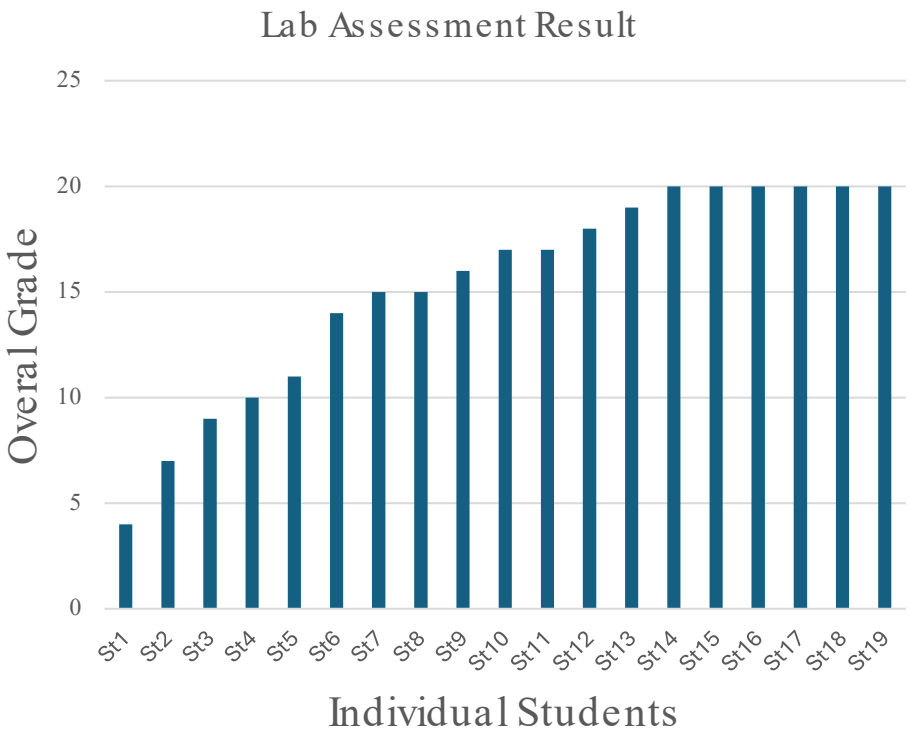
When Individual Work Made Differences Visible

- Group submissions masked individual differences.
- Individual lab assessment revealed substantial variations
- Roughly:

1/3 low performance.

1/3 mid performance.

1/3 high performance.



Adjustment – Planned Next Steps

Strengthen individual experimental reasoning

- Scenario-based worksheets: students design a method for a given lab situation
- Used throughout the semester (stand-alone or embedded in homework)

Reduce reliance on "cookbook" structure

- Introduce selected labs requiring independent planning and decision-making
- Less step-by-step guidance; greater focus on method design and troubleshooting

Assess individual lab competence explicitly

- Administer an individual lab assessment at the end of the semester

Student Feedback on Lab Test

Q: How confident did you feel while completing the lab test, and why?

Student A: "I did not feel confident completing the lab test. When we completed the lab in class that the assignment was based off of, I was doing notes and calculations and not working with the device. I was very confused and had poor results."

Student B: "Very confident. This is because I understood all of the labs we performed in class (such as how to measure voltage and current in a circuit using DMM)"

Student Feedback on Lab Test

Q: What would help you feel more prepared or comfortable for future lab tests?

Student A: "nothing, as long as the individual contributes during lab they will be fine"

Student B: "I think maybe a study guide would help but it honestly was not too bad and I think that if you participate in lab then the test is really not that hard."

Conclusion

- Our group labs weren't failing because students couldn't collaborate, but our assessments didn't make individual participation visible.

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Thank you!

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References

- Quinn, K. N., Kelley, M. M., McGill, K. L., Smith, E. M., Whipps, Z., & Holmes, N. G. (2020). Group roles in unstructured labs show inequitable gender divide. Physical Review Physics Education Research, 16(1), 010129. https://doi.org/10.1103/PhysRevPhysEducRes.16.010129
- Day, J., Stang, J. B., Holmes, N. G., Kumar, D., & Bonn, D. A. (2016). Gender gaps and gendered action in a first-year physics laboratory. Physical Review Physics Education Research, 12(2), 020104. https://doi.org/10.1103/PhysRevPhysEducRes.12.020104