



Social Dynamics and Positioning around a Black Woman's Equipment Handling in a Physics Lab

Mark O. Akubo,
University of Delaware

Emily Stump, Natasha G. Holmes
Cornell Physics Education Research Lab (CPERL)

CSAAPT, DOVER

March 16, 2024

Motivation for this Research

- On average, women handle equipment less than men in physics labs (Danielsson, 2012; Holmes, Roll, & Bonn, 2019)
- But there is scant research on Black women's equipment handling
- Division of labor in an explicit way — is highly supportive of equitable participation. (Doucette, Clark, & Singh, 2020)
- Experiences of Black women in physics highlight the exclusion of women of color in physics (aip.org, Hennessey et al. 2019; Rosa & Mensah, 2016; Santana & Singh, 2022)

Framework: Positioning, & Equity of Individuality

Positioning = the ordering of social actions and participants' preferences and obligation to act and speak in certain ways

Dynamics = Enactment of interactions around equipment handling roles

(Davies & Harré, 1990; Hirvonen, 2016; Harré, 2012b ; Harré & Van Langenhove, 1991)

- **Implicit:** Participants do not verbalize their intention to handle equipment in a certain role but simply take on the role
- **Explicit:** Participants state their intention to handle equipment in a certain role, ask someone else to take on a certain role
three forms: (Self-advocacy, Other-assigned, group-talked)

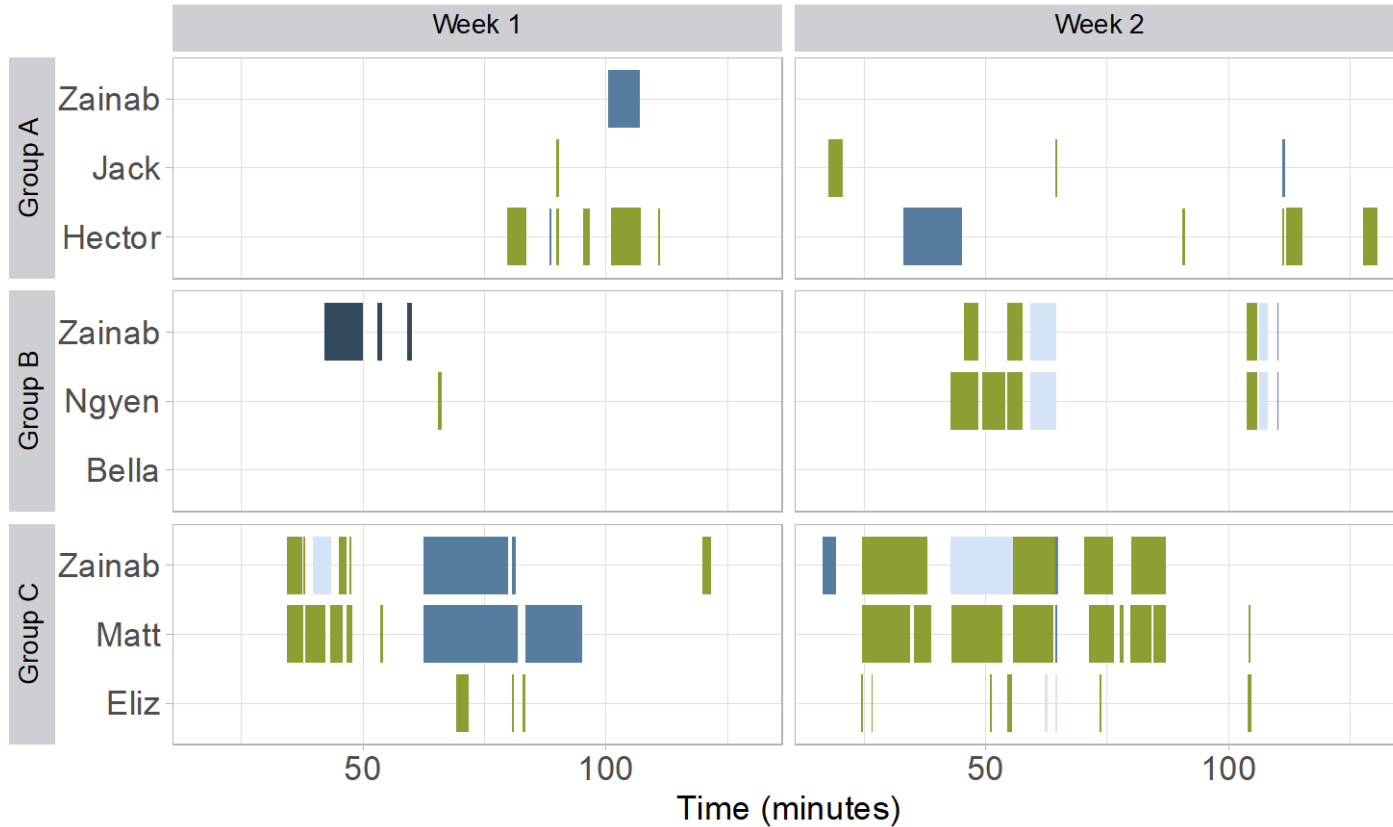
Roles — describe the major ways students participate or contribute to their group work (Akubo, Sundstrom, Holmes, 2022; Quinn et al. 2020)

Positioning \longleftrightarrow Roles (Depperman, 2015)

Equity of Individuality = individual students' excellence and access

(Rodriguez, Brewé, Sawtelle, & Kramer(2012).

Dynamics around Zainab's Equipment Handling



Dynamics ■ Implicit ■ Explicit (self) ■ Explicit (other) ■ Explicit (group)

Data

- **Six 2-hour lab class sessions in the F2019 semester**
(Transcripts of videos, memos, pictures, graphical illustrations)

3 Groups:

- **A— Pendulum Lab**
- **B — Objects in flight**
- **C — Hooke's Law Lab**

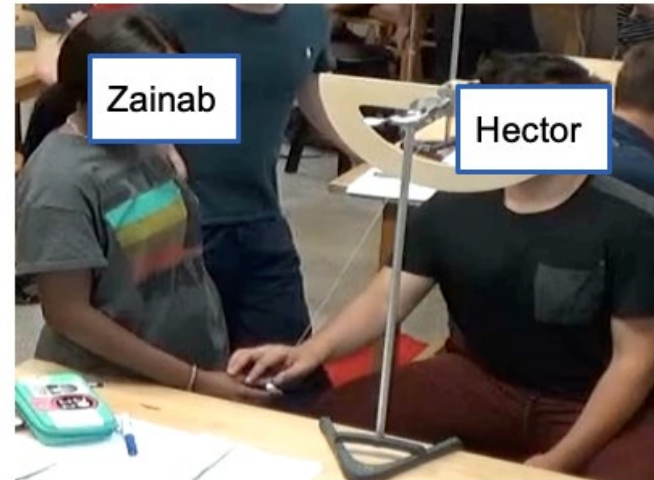
Finding: Implicit and explicit dynamics were enacted in a range of ways, with different positionings for Zainab, and implications for her equitable access to equipment handling

Group A

Explicit Dynamic:

Someone asks someone else to help them.

Supportive positioning



Finding: Implicit and explicit dynamics were enacted in a range of ways, with different positionings for Zainab, and implications for her equitable access to equipment handling

Group B

Implicit dynamic

Two people “just fall into the same positioning” around different roles

Collaborative positioning



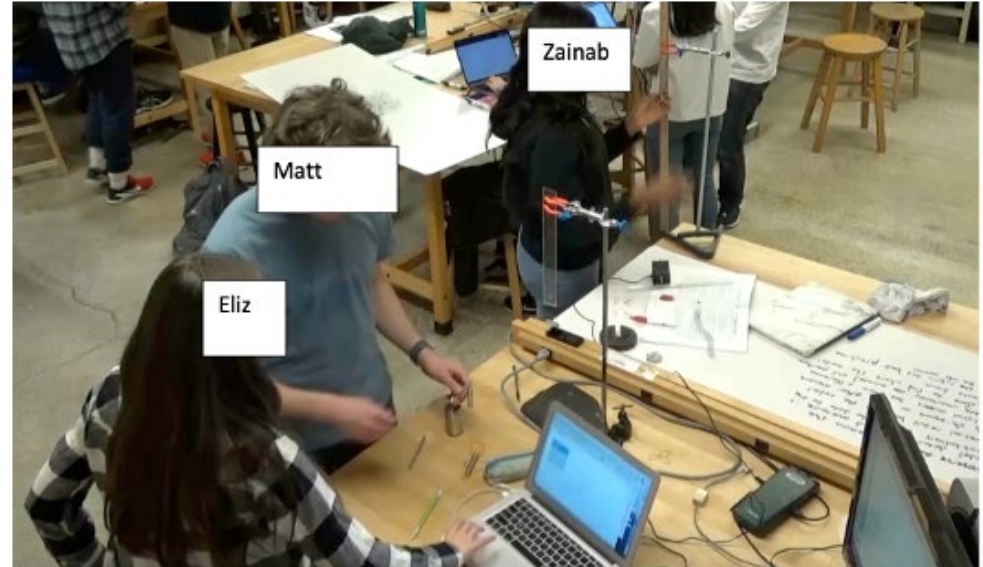
Finding: Implicit and explicit dynamics were enacted in a range of ways, with different positionings for Zainab, and implications for her equitable access to equipment handling

Group C

Explicit dynamic: Someone tells someone else what to do

Eliz: Okay, so, one person will check if the diameter of the spring changes the point at which it breaks down. And another person checks if the magnitude of the spring constant changes where it breaks down. Okay, and I can do excel and if you guys check, I can just record the data.

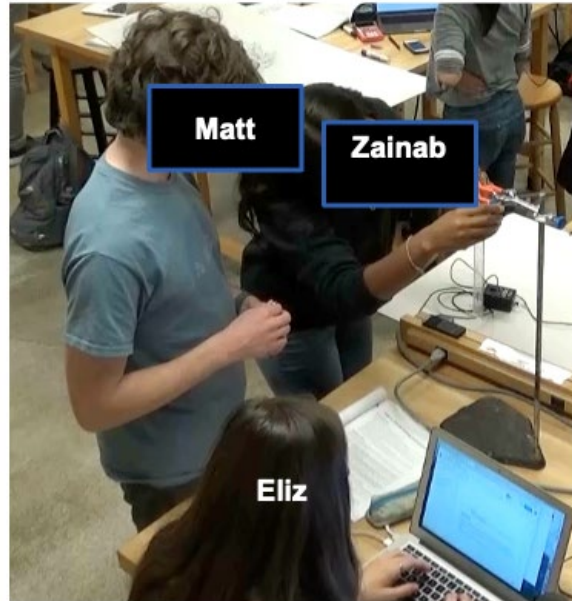
Eliz positioned Zainab in-charge



Finding: Implicit and explicit dynamics were enacted in a range of ways, with different positionings for Zainab, and implications for her equitable access to equipment handling

Implicit dynamic:

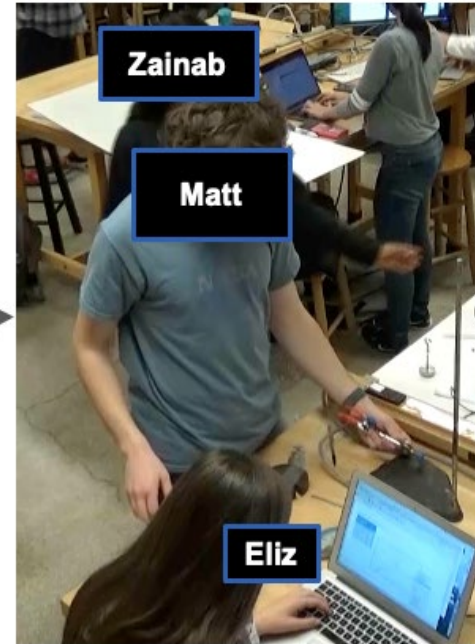
Positioned between different equipment handling roles



Zainab Sets up the apparatus

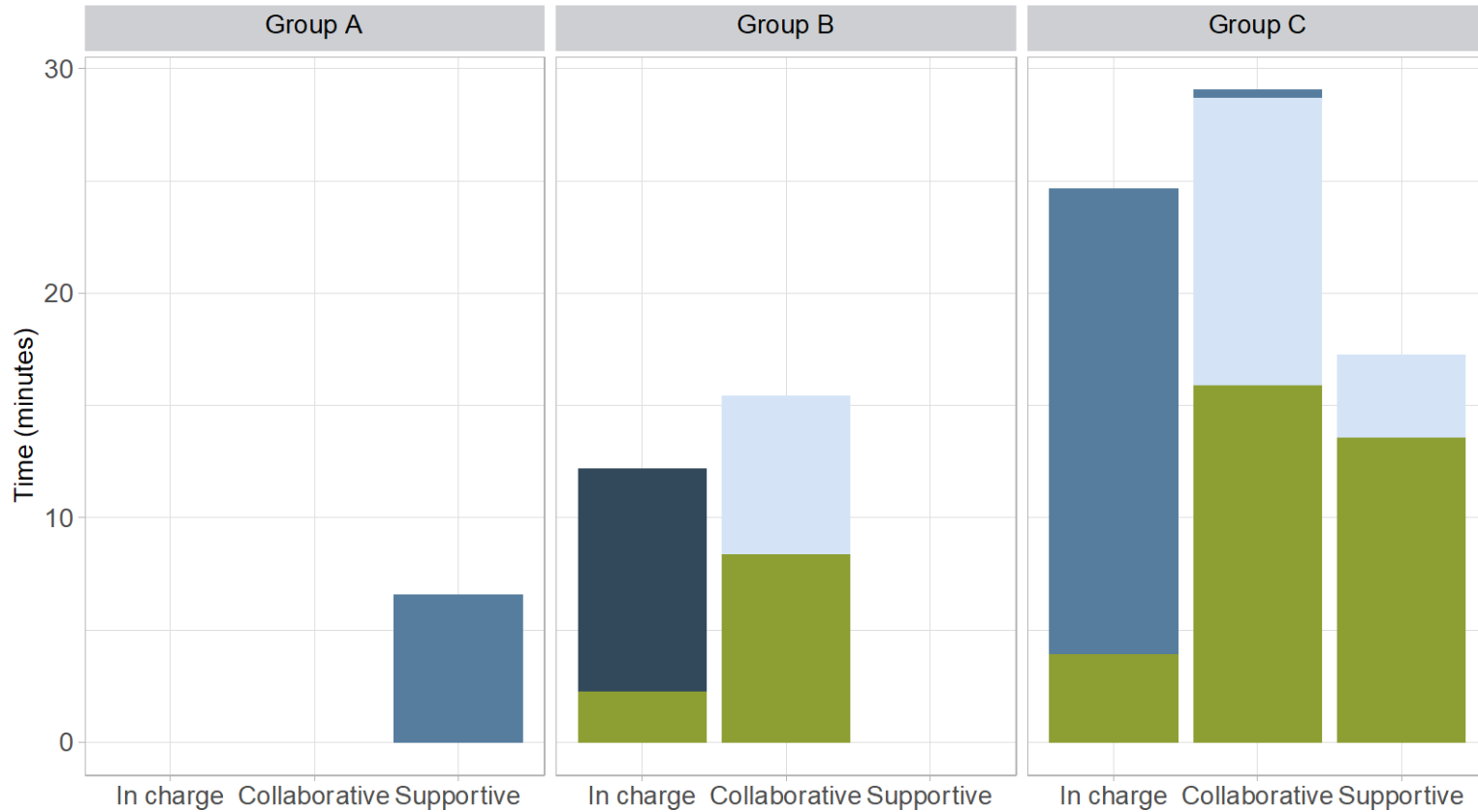
Group C

Positioned out from in-charge to supportive



Zainab Hands on masses to Matt

Summary of Zainab's Positionings During Diverse Dynamics



Dynamics ■ Implicit ■ Explicit (self) ■ Explicit (other) ■ Explicit (group)



Discussion

Previous evidence has argued that implicit dynamics lead to inequities in group work. We see that it is not always the case.

Even though explicit assignment of roles by a peer leads to Zainab's taking charge of her own experiment and equipment handling, this effectively makes her overworked.



Conclusion

Implicit and explicit dynamics can happen in different ways, with different positionings, and implications for equity.

Implications

For Research: Need for more research to understand differences in the minoritized students' experiences from group to group

For Practice:

- Toward more instructor facilitation of equitable handling of equipment in lab, need for training on what kinds of explicit assignment are equitable.

Future Work

Intersectionality lens to understand nuances in positioning and dynamics around equipment handling by the minoritized participant

The role of **explicit negotiation** in (in)equity around equipment handling



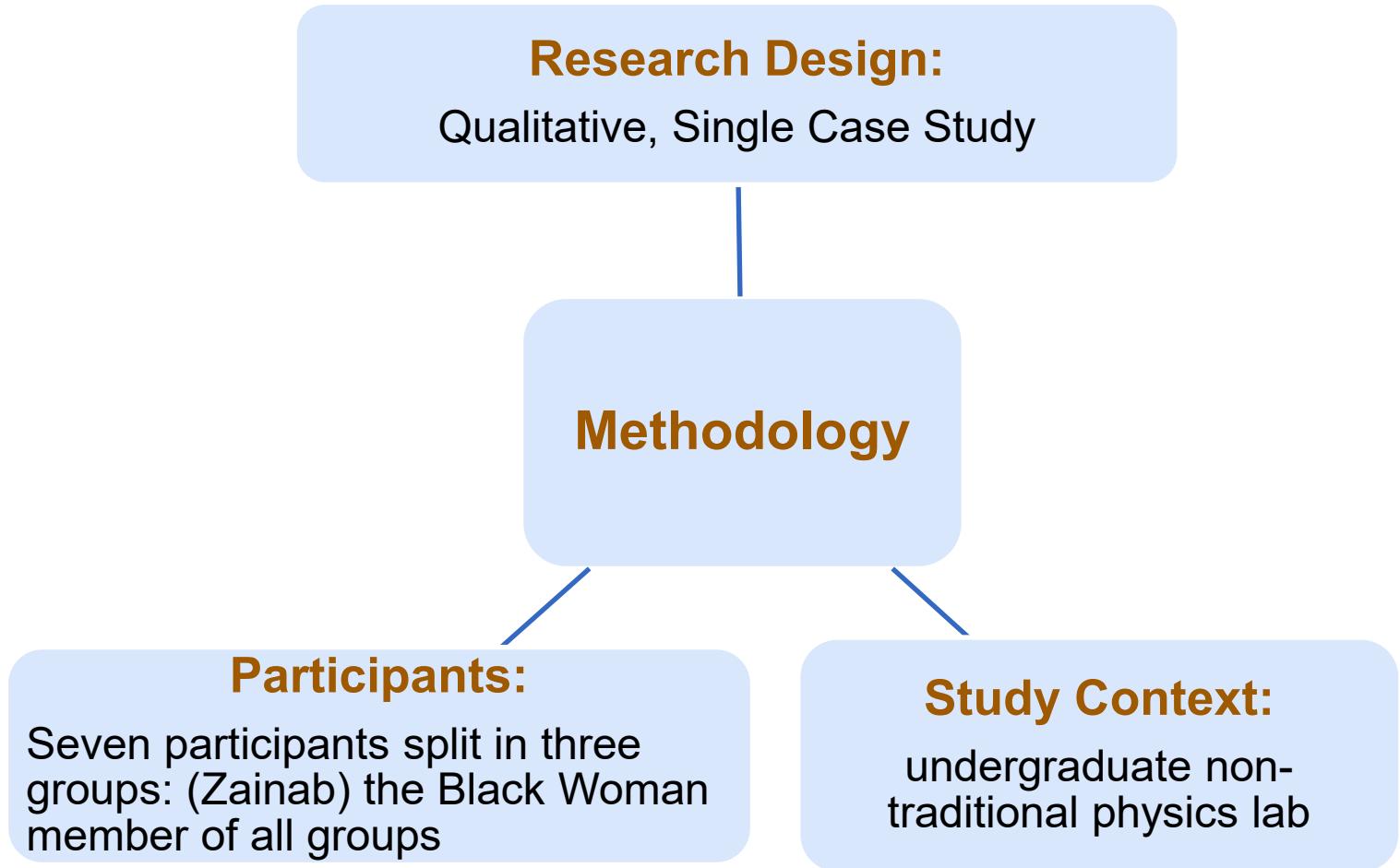
GRFP Grant No. DGE-2139899 & NSF Grant No. DUE-2000739



Contact: marka@udel.edu

References

- Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *u. Chi. Legal f.*, 139.
- Doucette, D. Clark, R. & Singh, C. Hermione and the secretary: how gendered task division in introductory physics labs can disrupt equitable learning, *European Journal of Physics* 41,035702 (2020).
- Danielsson, A. T. (2012). Exploring woman university physics students ‘doing gender’ and ‘doing physics’. *Gender and Education*, 24(1), 25-39.
- Freeman, S., Haak, D., & Wenderoth, M. P. (2011). Increased course structure improves performance in introductory biology. *CBE—Life Sciences Education*, 10(2), 175-186.
- Harre, R. & Van Langenhove, L. (1991). Varieties of positioning, *Journal for the theory of social behavior* 10.1111/j.1468-5914.1991.tb00203.x.
- Holmes, N. G., Roll, I., & Bonn, D. A. (2019). Participating in the physics lab: does gender matter? *arXiv preprint arXiv:1905.03331*.
- MacIsaac, D. (Ed.). (2019). US government releases Charting a Course for Success: America’s Strategy for STEM Education, report guiding federal agencies that offer STEM funding opportunities. *TPT*, 57(2), 126-126.
- Rosa, K., & Mensah, F. M. (2016). Educational pathways of Black women physicists: Stories of experiencing and overcoming obstacles in life. *Physical Review Physics Education Research*, 12(2), 020113.
- National Science Teachers Association. (2007). NSTA position statement: The integral role of laboratory investigations in science instruction. *NSTA Handbook: 2010*, 11, 201-204.
- Partnership for 21st Century Skills (P21). Framework for 21st Century Learning. December 2009. Science Maps: <http://science.nsta.org/ps/Final21stCSkillsMapScience.pdf>
- Rodriguez, I., Brewé, E., Sawtelle, V., & Kramer, L. H. (2012). Impact of equity models and statistical measures on interpretations of educational reform. *Physical Review Special Topics-Physics Education Research*, 8(2), 020103.
- Santana, L., & Singh, C. (2022, July 13-14). Investigating experiences of a Black woman in physics and astronomy. Paper presented at Physics Education Research Conference 2022, Grand Rapids, MI. Retrieved March 29, 2023,
- Walsh, C., Lewandowski, H. J., & Holmes, N. G. (2022). Skills-focused lab instruction improves critical thinking skills and experimentation views for all students. *Physical Review Physics Education Research*, 18(1), 010128.



Research Design:

Qualitative, Single Case Study

Methodology

Participants:

Seven participants split in three groups: (Zainab) the Black Woman member of all groups

Study Context:

undergraduate non-traditional physics lab

Data/Analysis

- Purposefully selected the lab groups/sessions involving Zainab.

Why?

- Her indication of interest to handle equipment
- So, we wanted to characterize her equipment handling in the lab

Analysis

Developed **positioning coding scheme**

In-charge (I): Participant independently handles equipment or leads equipment

Collaborative (C): Two or more participants work together handling equipment during their lab activity

Supportive (S): Participant takes on an equipment handling role which is

- (a) auxiliary to another role,
- (b) enacted with evidence of receiving constraining direction

Analysis

- Developed two **coding schemes: (a) positioning (b) dynamics**
- Selected transcripts of equipment handling episodes,
- Research group deliberated on selection for equipment-handling-definition fit
- First and second authors independently coded video/transcripts for the dynamics, compared coding in research group meetings, reaching approximately 90% agreement, discussed disagreement, where still unreconciled, 3rd researcher's decision was accepted
- Similar iteration for Zainab's positioning around equipment handling agreed almost in all cases
- Plotted graphs/charts to visualize the dynamics & positioning, computed the duration of each positioning

Analysis

Developed **dynamics coding scheme**

Implicit

= Participants do not verbalize their intention to handle equipment in a certain role but simply take on the role

Explicit

= Participants state their intention to handle equipment in a certain role, ask someone else to take on a certain role

Negotiation

= Participants democratically discuss the available role options, and each chooses what equipment handling role they wanted to take on

Our Definition of Equipment Handling

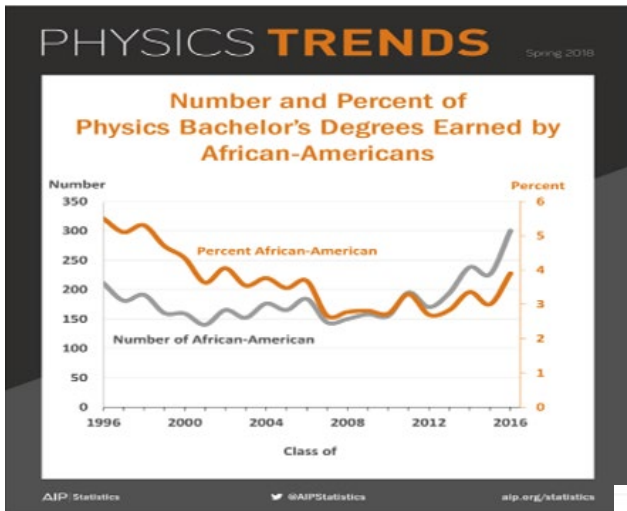
When participants collect/put away equipment for their investigation,

use the equipment

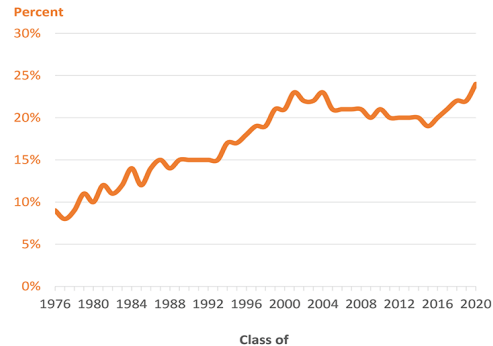
- to conduct investigation, and so generate data,
- during a discussion to illustrate a point while sharing ideas,
- take/read measurements,

In general, the activity will be fundamentally changed if they were not handling the equipment.

Historical Exclusion

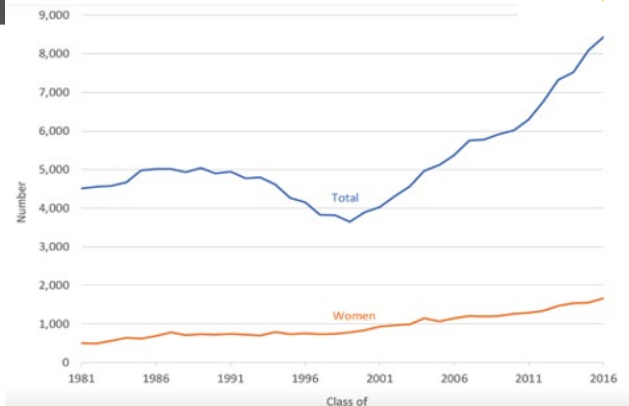


Percent of Physics Bachelor's Earned by Women, Classes of 1976 to 2020



AIP American Institute of Physics

aip.org/statistics



Black women and Latinas ~ only 2% of the total

Group B

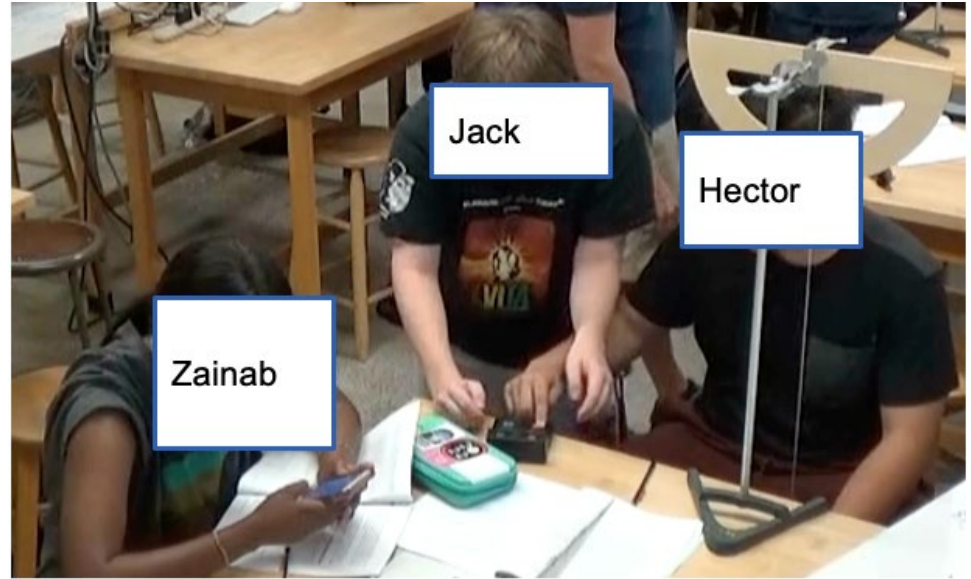
In-charge positioning

Explicit (Negotiation) Dynamic

1. **Ngyen:** So, one person can take down notes.
2. **Bella:** ...I think I can take down the notes.
3. **Ngyen:** Okay
4. **Ngyen:** What do you want?...
5. **Zainab:** I could do the experiment.



**Implicit
Dynamics:
Two people
just “fall into
the role”**



Zainab did not handle equipment

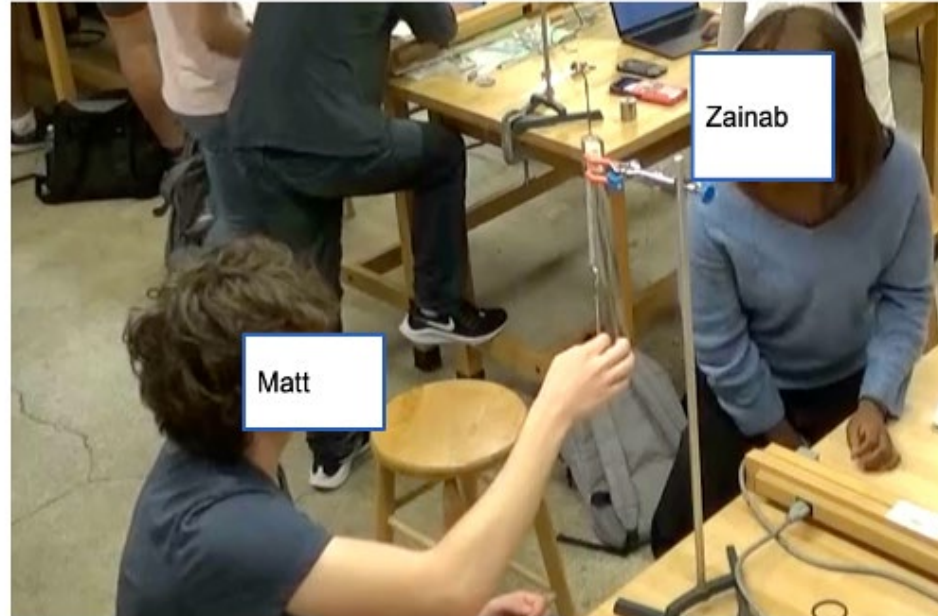
Implicit and explicit dynamics were enacted in a range of ways, with different positionings. Replace with Ngyen and Zainab

Group C

Collaborative positioning

Implicit dynamic

Two people “just fall into the same positioning” around different roles



Matt and Zainab collaborate: Matt hangs the load & Zainab reads measurement