Open-inquiry experiments using sensors controlled by Arduinos in a pandemic-resilient lab course

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Open-inquiry experiments using sensors controlled by Arduinos in a pandemic-resilient lab course

Picture of students or project

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AUC (NL)
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UA (NL)

Qr to go to materials

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Outline

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps

- Motivations for open-inquiry
- Choices for:
  - Flipped Lab methods
  - Arduinos & Maker tools
- Course structure & pandemic resiliency
- Results and advantages
- Pandemic resiliency,
- Conclusions
- Next steps

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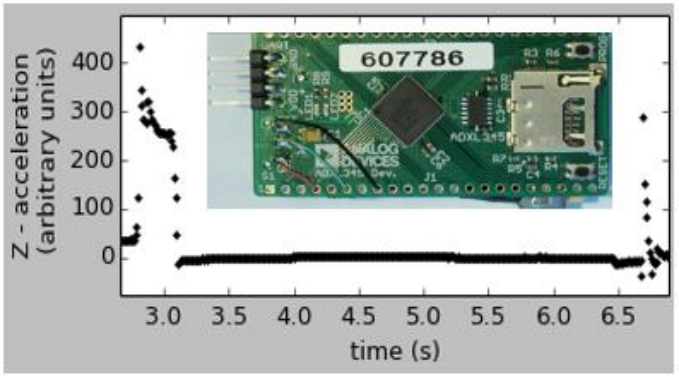
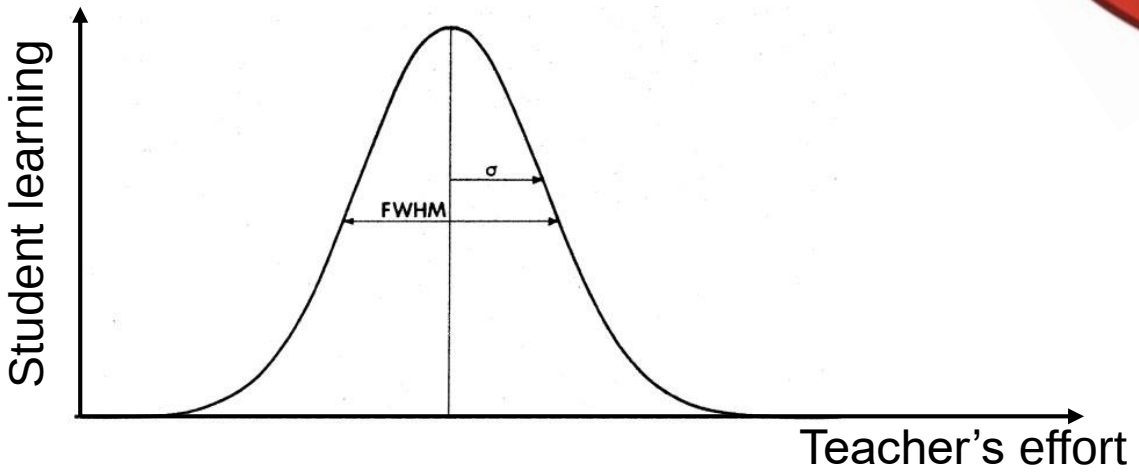
Rocket project

- Comparing numerical models to onboard accelerometer data.
- First year was thrilling!



Rocket project

- Further development work led to ~~diminishing~~ negative results.



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AUC – Open lab course

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps

- AUC's natural science students pick 1 lab course.
- Experience research cycle.
- No labs available.

Picture of typical AUC

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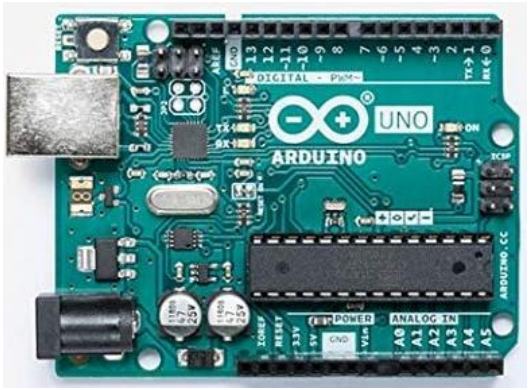
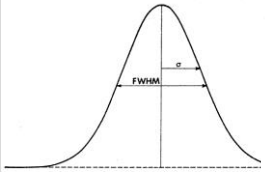
Requirements

- Open
- Freedom of choice (sensors)
- Cheap
- Safe



Timeline

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps



skills training
structured inquiries

1st open inquiry
@home

picture

go/no go

midway

final presentation

2nd open inquiry
@home

picture

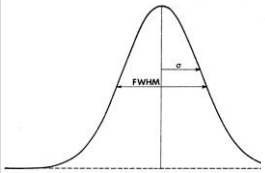
go/no go

midway

final presentation

Timeline

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps



skills training
structured inquiries

1st open inquiry
@home

2nd open inquiry
@home

go/no go *building closes* *midway* *final presentation* *go/no go* *midway* *final presentation*

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Project examples

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps

- Comparing water retention of alternative potting soils against those with unsustainably harvested peat-moss.
- Optically measuring heart rate and characterizing its post-exercise recovery to equilibrium.
- Measuring color fidelity of a Macbook's screen with an RGB sensor.
- Pushing the Arduino's sampling rate for precision sound frequency determination.
- Measuring local wind-speeds to determine suitable bee-habitat.
- Comparing signatures of bicep muscle fatigue between dominant and non-dominant arms with median frequency evolution of the EMG power spectrum.

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Student ownership

- *Their* areas of interest,
- *Their* research question and experimental design,
- *Their* residences as lab room, available at *their* convenience,
- and instructors prevented from taking the reigns!

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Advantages of flipped labs

- More time for personalized attention and feedback (focuses on difficult bits of research cycle).
- Instructor as research supervisor (transforms the student-instructor dynamic).
- Students continually practice communication skills in authentic context.

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Pandemic Resilient

- Flipped teaching methods
- Maker tools (sensors controlled by Arduinos)
- Fully open-inquiry projects

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Conclusions

- Maker Lab pilot demonstrates these methods achieve intended learning outcomes.
- Maker Lab pilot coincidentally proved to be pandemic resilient.

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What's next?

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps

- Open-source course materials available: insert surfdrive link here
- Faculty Online Learning Community for practitioners - please be in touch: f.r.bradbury@auc.nl
- Continuing work:
  - How best to adapt first third for fully online course?
  - How to include TA's in teaching team?
  - Minimizing risks in at-home experiments by teaching and promoting a safety culture
  - Doing science versus Demonstration of (advanced) physical phenomena
  - Develop shorter variant (~60 student hours instead of 168) with one open-inquiry project

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What's next?

- Motivations
- Choices
- Structure
- Results
- Pandemic
- Conclusions
- Next steps

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