

Design, Build and Test Arduino Modules Using NI software and Discovery Based Learning for MEMS

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Lets dissect the title “Design, Build and Test Arduino Modules Using NI software and Discovery Based Learning for MEMS” to better understand the presentation

Design, Build and Test – a cyclic process that can be used to develop a new product, commonly used in industry for product development

Arduino Modules – family of inexpensive programmable microcontrollers with open source operating system.

NI software – LabView is a graphical programming language that allows the user to develop custom code with an appealing GUI

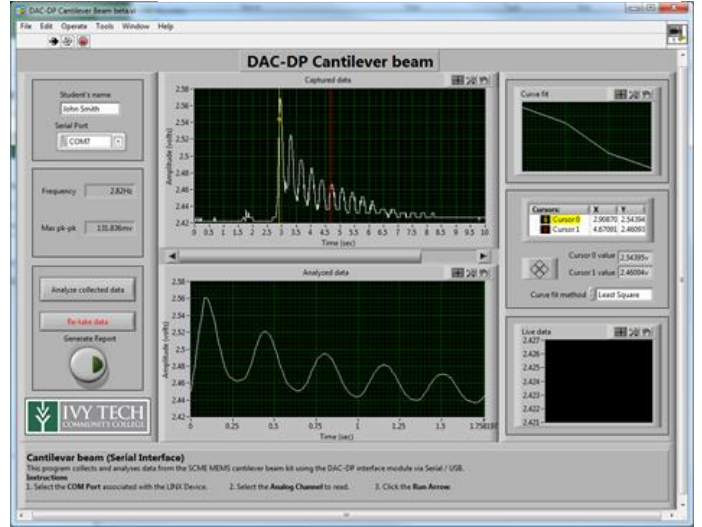
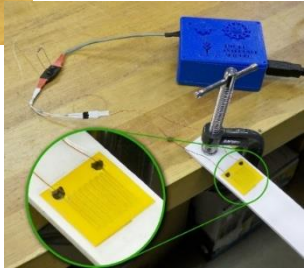
Discovery Based Learning – “I hear and I forget. I see and I remember. I do and I understand” – Confucius

MEMS – Microelectromechanical systems – small size sensors, actuators and transducers.

Testing the success of Discovery Based Learning in MEMS education with Student Workers

Task - development of Arduino and LabView MEMS kits based on the SCME MEMS kits.

Demographics	
Category	Student Worker
age - 19 to 29	8
Veteran	1
Male	5
Female	3
Gender Unknown	0
USA	5
White, non-Hispanic	3
Multiracial	2
International	3
African	2
Asian	1
Homeschooled	3
Attended Pressure Sensor Workshop	4
Attended NSF ATE Conference	5



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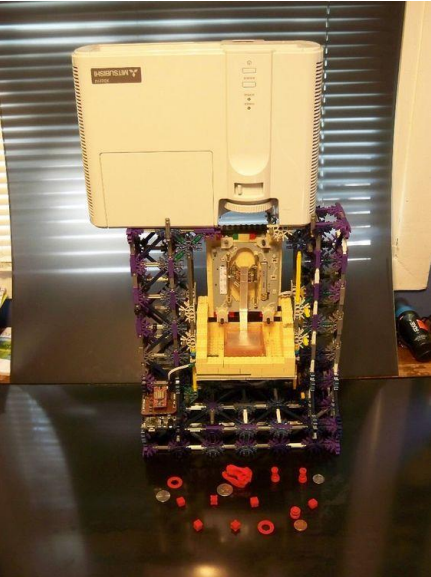
Student Worker needed for Engineering Technology. Approx. 15 hours per week, \$10 per hour. (most students only worked 10 hrs. per week). Perform engineering and clerical tasks such as, moving, organizing and sorting engineering parts and equipment, assembly of lab experiments and test kits and typing and other routine duties. Current student in good standing at Ivy Tech Community College. Must have successfully completed a minimum of 12 credit hours at Ivy Tech. Prefer some experience with Microsoft Office (Word, Power Point and Excel).

Skill levels

Hi Ajeet, I guess there were problems last night with replacing the cords on the lamps and the class blew 3 breakers. (This should have raised a red flag for you ... Also, Md showed me his lamp and you guys cut the wrong end of the extension cords off and effectively ruined all the lamps that you worked on. Cutting off the plug and the attaching a new plug would NEVER be done. This would make the lamp a fire hazard...

Hi Andy, Yes, there was problem working with the lamps last night. Among the three, first, Jorge was cutting the wire with it being attached to the power source. Second, Marco didn't correctly attach the cord. On top, he soldered the connection and didn't tape it... Yeah, I probably should have done more research about it but the instructions look pretty straight forward and we started following it without doing any research.

CHIMERA: \$60 DLP HIGH-RES 3D PRINTER



Task - Design, build and test an Arduino Uno based data acquisition system that uses NI LabView software for data capture and display. The hardware must interface to the SCME MEMS kits: Dynamic Cantilever and Pressure Sensor Model Kit. A final product will be developed and made available for MEMS education.

Work began Fall 2014 to Spring 2018

Student had to learn using discovery based learning how to do the job

- How to write LabView code
- How to program Arduino Uno microcontrollers
- How to keep good lab notes
- How to communicate and work with others
- How to solder and use some test equipment
- How to create executable code
- How to make a strain gauge
- How the SCME kits work

Discovery based learning for our grant involved:

- 1.) Assigning a specific task with general expectations and requirements
- 2.) Provide all the tools and material needed to do the task (may require student to figure out what they need)
- 3.) Make the student responsible for the task and stress “it is ok to struggle and fail”
- 4.) Allow them to research and discovery the best solution
- 5.) Provide timely feedback as needed “resist the temptation to tell them how to do it”

Obstacles

- 1.) Lack of admin rights on PCs to develop and test new code.
- 2.) Forced to work within the overall school environment for part procurement, access to the labs and classrooms, and IT support.
- 3.) Finding students willing to work that saw the value in working on a grant.
- 4.) Procurement time for parts and material.

Assessing the success of the process:

Assumption – it is ok if you fail because this is one of the ways we learn

Results – students failed at almost every task but learned from their mistakes and it was wonderful because they learned from the failures.

Examples -



"I have not failed. I've just found 10,000 ways that won't work." - Thomas A. Edison

Assessing the success of the process:

Assumption – student understand simple directions

Results – Students don't always understand but need to feel comfortable to ask questions

Examples - Round 3

Went inside and asked for a double cheeseburger with everything on it with the patties on the side. Server wrote on the ticket double cheeseburger and "ask me". I asked to talk to a manager and they said to order a double deluxe with patties on the side. When the cheeseburger arrived it was missing the top bun. So this is how my order was given to me. (Some assembly required)

My research has suggested that I should have said - *Burn two and put them in the alley, take it through the garden and pin a rose on it, with Wax, Hemorrhage and Mississippi Mud ...*



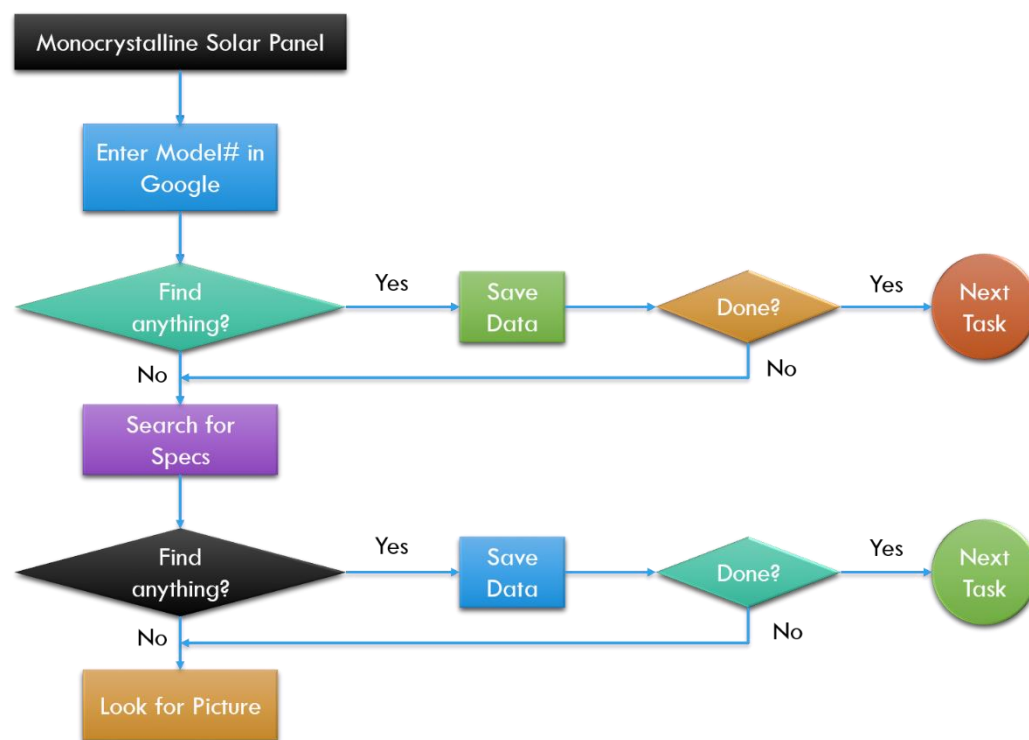
Assessing the success of the process:

Assumption - Research is inherently built in to our DNA and we know how to find things.

Results – many students didn't know how to research a concept, product, etc. It is not common knowledge. Older students, some homeschooled students and USA students appear to have more advanced skills.

Examples -

Students today don't know how to research. With all the technology today they still don't know how. One theory is it may be a generational issue, younger students have not explored "how things work" but they know how to take tests – Show me how to do it.



Assessing the success of the process:

Assumption – students know how to work.

Results – all the international students had little to no job training so this was a issue of lack of training. Some of the US students also to treat it as just a job, not an adventure.

Examples -

Observation	Expected	Why is it Important?	My Response	The Change
Showed up 10 minutes late	Show up on time	Shows respect of time of the employer and respect for the job	Late of because of traffic	Leave at 8:20 instead of 8:30
Brought the laptop unsafely	Make sure you put the laptop in the bag and then bring it.	Otherwise it shows carelessness of using the equipment.	I just glanced under the center table.	Make sure to look for things thoroughly and provide enough protection for the equipments that I am using
Did not provide enough information on the solar panel	To find information of each item individually	To match charecteristics of the parts/equipments before we put it in an assembly	I did not know how to do research properly	Learn how to

Are we training a workforce?

What real world job skills are we provided in higher ed?

Discovery based learning for our grant *update*:

- 1.) Assigning a specific task with general expectations and requirements – [no change]
- 2.) Provide all the tools and material needed to do the task (may require student to figure out what they need) – [some additional training is needed to ensure students are not spinning their wheels and getting frustrated, training is dependent on the knowledge of the student]
- 3.) Make the student responsible for the task and stress “it is ok to struggle and fail” - [yes but when student fail they sometimes get discouraged, should provide more help if a student is failing. All students come with a different skill set.]
- 4.) Allow them to research and discovery the best solution - [some students will need more guidance, examples and help which will take more of your time.]
- 5.) Provide timely feedback as needed “resist the temptation to tell them how to do it” – [This is critical because the quicker the confusion can be eliminated the better the experience will be.]

Did it work?

Yes it was very successful but improvements can be made to ensure all students get the most out of the experience. We have gaps in our educational system.

- How to research
- Job skills

Did it take up a lot of my time?

Not really, maybe on average it took no more than 2 hours per week to oversee the work. Some students needed more guidance some less.

How did demographic affect student success?

- International students had the most difficulty with the concept of “discovery based learning” and had lower work skills (most this was their first job).
- Female students also struggled and required more help but quickly caught on.
- The older veteran (who had some experience) and homeschooled students were able to excel in this learning environment.
- Students who had worked before had overall the best experience with discovery based learning ...

Questions?

<http://scme-support.org/>

<http://www.ivytech-mems.org/>

<http://faculty.ivytech.edu/~abell118/>

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