Understanding the New Hands-on Learner

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Abstract: Having students create and build an artifact during their educational journey is a powerful instructional method with many positive outcomes. This active engagement session aims to reintroduce participants to this experience and compare their reflections to those of students who participated in a similar experience.

During their first week in EENG 383 - Microcontrollers, students are required to solder together a complex development board. After completing the assignment, students reflect on the experience in an essay that includes listing their initial concerns, problems or insights while soldering, and things they would have told themselves before starting.

This active engagement session will require participants to solder some components onto a printed circuit board. Afterwards participants will reflect on their experience using the same reflection instrument used in the Microcontrollers class. The session will close by comparing and contrasting the participant's reflections of this experience to our undergraduate students. The two set of reflections – student and conference attendee – will be compare for similarities and differences.

FOCUS

Hands-on activities help develop confidence in learners by providing them with concrete evidence of their achievement and with a new tool [1]. A new tool enables one to solve existing problems, but more importantly changes the way one views the world, allowing one to create new types of problems to solve. For many students this can be a transformative experience [1].

Associated with any hands-on activity is the need to acquire the physical skills to effectively manipulate the tools. New learners are inhibited by many factors among these are concerns regarding their competence with the tools [2]. In order to best instruct students in these skills, an understand of these apprehensions is needed so that instructions can better be structured.

Today's active engagement session will require you to participate in a lab experience required in an undergraduate lab at the Colorado School of Mines, soldering components to a PCB. The primary goal is to have the participants work through this active engagement session as new learners, reflect on their experience using a standard instrument, and compare/contrast their reflections to undergraduate students who have completed a similar exercise in our labs. The two set of reflections – student and conference attendee – will be compare for similarities and differences.

LEARNING OBJECTIVES

Two main learning objectives are associated with this active engagement session, one tangible and one cognitive.

The tangible objective is teaching the participants how to solder. One of the rewarding things about soldering is that it is either "right" or "wrong" - producing a complete or incomplete connection. However, between these two, lies the degree of quality separating a novice from an expert. While a novice can assess the "correctness" of the soldering task by looking if the circuit performs as expected, an expert can comment on the quality of the work. This mastery process is applicable to a broad range of other hands-on activities that require students to build and design.

The cognitive objective is more subtle, requiring participants engage an activity there they are a new learner and have them experience the affective world of the student. After completing the soldering exercise, attendees in this session will record their reflections of the following points.

- Your concerns prior to doing the work
- Problems or insights while performing the SMT soldering
- Problems or insights while performing the thru-hole soldering
- Problems or insights with your soldering technique
- Problems or insights into instructions
- Major problem solved or still existing with board
- Tips/tricks that you would have told yourself before you started.

The same reflection points from students over the past several years are available for comparison. The most common themes for each point have been distilled. These will then be the starting point for a discussion of similarities and differences.

INSTRUCTIONAL STRATIGIES

The instructional strategies used during this session will vary depending on the objective. Lecture format will be used to welcome the class, provide an overview the objectives of the class, and to explain how to solder. Attendees employ hands-on learning to solder the parts on the PCB. After completing the soldering exercise, attendees will reflect on their experience by composing a reflection piece using a standardized template. Finally, attendees discuss their reflections in with the class.

OUTLINE

Instructions 10 minutes:

Introduction:	Who I am, where I come from.
Objective:	Experience mindset of a new learner.
Tao:	Soldering parts to a PCB.
Technical:	Completed PCB behavior.
	PCB and electrical parts.
	Location and orientation of parts on PCB.
	Tools and soldering process.

Assembly 30 minutes:

Attendees solder parts to PCB.

Reflection 20 minutes:

Attendees perform self-reflection.

Attendees compare and contrast reflections to those of students in discussion format.

RMS ASEE TARGET AUDIENCE

The audience consists of two cohorts according to the learning objectives. The first cohort is someone who has little or no prior experience with the soldering process and associated tools. This experience would provide them with the opportunity to bring a new type of hands-on learning activities into the classroom and STEM outreach activities. This cohort should be able to provide a solid set of reflections to share.

The second cohort would be veteran faculty who may have forgotten what it is like to be a new learner. While this group may not take much away from the soldering experience, they should be able to appreciate the perspective of the new learners in their classroom as reinforced by the reflections of their peers.

PRESENTER CREDENTIALS

I have taught hundreds of students the soldering process for surface mount and through hole soldering in my 15 years teaching Embedded Systems. I have designed several soldering outreach activities for STEM programs that have been used for a decade at Penn State Behrend, Erie, Pa.

REQUIREMENTS

I will provide PCBs, electronic parts, safety glasses, soldering irons, solder, miscellaneous tools, extension cords, power strips, and a cardboard surface for each attendee to work on. Attendees would be expected to work together in pairs. Each pair of attendees will need, 36" of table space and share a single soldering iron between them. I could deliver this session to between12 and 24 attendees.

Attendees are not expected to bring anything with them except a willingness to engage the activity. They get to keep the soldered PCB and parts.

REFERENCES

[1] Beard, Colin. “The Experiential Learning Toolkit: Blending Practice with Concepts.”, Kogan Page, London. 2010.

[2] Bledsoe. T.S., & Baskin, J.J. Recognizing student fear: The elephant in the classroom. College Teaching, 62(1). 32-41, 2014.