Innovative Idea Poster

Crate it Away! Construction of a Wooden Crate in a Power Tool Skill Development Course

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Introduction/Need for Innovation or Idea

Psychomotor skill development is an important aspect in many agriculture pathways (Phipps, Osborne, Dyer, & Ball, 2008). The development of skills is often seen as a critical component of technical agriculture training as it leads to skills necessary in agriculture careers (Roberts & Ball, 2009). Psychomotor skills allow for concrete experiences (Shoulders & Myers, 2013), one of the four stages of Kolb's (1984) experiential learning model. Secondary agriculture teachers can reinforce student development in the operation and application of power tools by having students build a required project designed by the teacher (Hainline & Wells, 2019; Phipps, et al., 2008). Instructors at Colorado State University offer a course in power tool safety and management in which students learn the safe operation of tools found in a Power, Structure, and Technical Systems (PSTS) laboratory. There was a need to build a final project in this course to demonstrate cumulative learning and application of tools; the desire was also to find a final product which the students would take pride in building and want to take home following construction. The project needed to be cost effective to fit into the program budget and completed in a timely manner. With these items in mind, the instructor designed a wooden crate project in which students construct three wooden crates, one at a time, from 2"x6" stud lumber, high-density fiberboard (HDF), and 14-gauge steel.

How it Works/Methodology

Project building is taught in the power tool safety and management course for preservice agricultural education students. First, students are taught how to safely operate each tool in the PSTS laboratory. Second, they practice safe operation of the tools to develop the basic skill of operation. Third, students are given plans for the wood furniture crate final project. The set of plans includes scale drawings of the project, materials list, and an order of operations sheet.

The ends and sides of the crate are cut from one 8' 2"x6" piece of lumber and the bottom is cut from an 1/8" thick sheet of HDF. The side slats are fastened to the ends of the crate using metal brackets students design and fabricate themselves. During construction of the project, students use a total of 15 different power tools both portable and stationary. Portable tools include the use of the circular saw, jig saw, portable grinder, sander, drills (corded, cordless, and impact), router, and a pneumatic brad nailer. Stationary tools include the table saw, miter saw, metal band saw, drill press, bench grinder and iron worker. In addition, students design their own metal bracket hardware from 14-gauge steel. They use drafting software on their computers to design the bracket and transfer the files to a G coding software and cut the brackets using a CNC plasma cutting table. For this project to be utilized, three items are necessary for efficient completion: layout of the lab, efficient order of operations, and duplication of the project.

All tools, portable and stationary, have a set location in the lab (i.e. circular saws for cutting HDF are on one bench, drills for pocket screw holes on a separate bench, router on its own bench, etc.). Students move from station to station depending on the task they need to complete. This helps the instructor know what stage each student is at in the construction process, eliminates students standing in one spot "waiting" for a random tool, and helps to reinforce the application of using the correct tool to complete a specific job. The project is small enough that students can carry parts to the different locations with little trouble. Additionally, the order of operations list is first divided into three initial sections: cutting the 2x6 to length, cutting the HDF bottom, and designing and cutting the bracket hardware. The class is also divided into three different groups. Each group begins work on a different section of the project. As each of these sections requires the use of different tools, the class is spread out across the different tool stations in the lab. This strategy helps to eliminate student down time as they are not all waiting for one specific tool to start the project. Once a student completes all the tasks in their assigned section, they move to the next section assigned in rotation order until they have completed all three sections. Once all three are completed students move onto the fourth section, which is to assemble the final project. Once the first crate is completed, they start on a second crate, following the same order of operation as they did before.

Results to Date/Implications

Though the project is not large, it is challenging and allows for significant skill duplication. After construction of the first crate, students completed the other crates at a much faster rate and to a higher quality. They were able to apply what they learned during the first try to improve on their performance. Additionally, utilizing stud construction grade lumber was first purchased as a cost saving measure, the rough raw material forced students to use different problem-solving strategies during constructing to ensure the final product is still of high quality. The project also provides an opportunity for instructors to model effective laboratory teaching strategies which limit “bottlenecking” at tool stations, limiting student downtime and keeping them on task in the lab. By breaking the class into three groups and having them start the project at different points and having the laboratory set up in stations, students experience how effective planning and preparation will help enhance the learning in project construction activities. Finally, multiple former students have indicated the usefulness of the project when they leave, having sent pictures of them being used as furniture.

Future Plans/Advice to Others

Modifications to the project are ongoing. As students encounter different challenges or have different ideas, we will continue to make modifications. If looking to replicate this project, know that 15 tools and the plasma table are not essential to construct this project, it can be adapted to fit whatever tools are available in any PSTS laboratory. Laboratory layout for efficient movement of students however is essential.

Costs/Resources Needed

Costs for the project are minimal, each crate requires one piece of stud lumber, HDF cut from a 4’x8’ sheet and brackets cut from a 4’x8’ sheet of steel. Other materials include screws and brad nails needed for assembly. The completed project has a total cost of $9.00 per crate or $27.00 for all three. A few consumables such as sandpaper, grinder flap discs, saw blades, etc. are needed, however, they are used for multiple students and in multiple classes so the per project cost of them is minimal. All costs are offset through a student paid course fee upon registering for the course.

References

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