Safety, Safety, Safety! Using the Lathe Safety Simulator to Introduce Proper Machinery Operation Principles and Work Habits

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Introduction

Safety remains an important topic in the discipline of agricultural education (Saucier, Vincent, & Anderson, 2014; Schafbuch, Vincent, Mazur, Watson, & Westneat, 2016). As accidents are a frequent possibility within agricultural education settings, particularly agricultural mechanics laboratories, proper training and operational practices on the parts of students and teachers are a must (McKim & Saucier, 2011; Saucier et al., 2014). Moreover, as agricultural mechanics curricula and laboratories remain as staples within many programs (Burris, Robinson, & Terry, 2005), teachers must be prepared to effectively and safely deliver instruction in content areas that include woodworking, metalworking, and so forth (Shultz, Anderson, Shultz, & Paulsen, 2014). Teachers must also have access to adequate tools and equipment (i.e., power tools, training software and hardware, etc.) necessary to prepare the next generation for entry into the workforce (McCubbins, Anderson, Paulsen, & Wells, 2016).

Regarding the educational process, simulation has been cited as a useful method of instruction in agricultural education (Agnew & Shinn, 1990). As such, virtual reality (VR) simulators have been deemed suitable for training purposes beyond the scope of agricultural education as well, including medical practice (Gallagher et al., 2003), welder training (Byrd, 2014; Stone, Watts, & Zhong, 2013), and more. VR simulators used for training purposes can allow users to gain a deeper understanding of psychomotor skill abilities, as well as shortcomings, within a safe and controlled environment (Byrd, 2014; Gallagher et al., 2003; Stone et al., 2013), allowing for minimal risk as users work to improve and hone their abilities within a given context (e.g., tool and equipment operation, process completion, etc.). At the moment there exist few VR simulators designed to train individuals to properly use and work around woodworking and metalworking equipment such as lathes. Perhaps such a simulator could be beneficial in allowing individuals the opportunity to receive useful equipment operation training in a safe atmosphere prior to using a physical machine.

How it Works

Prior to using the Lathe Safety Simulator (LSS), several pieces of hardware were needed, including a VR headset, ear phones, a base station, hand controllers, and a link box. Each hardware piece provided the user with the ability to interact within the full scope of the VR experience. Through full-immersion VR, users can interact with the equipment to complete various tasks. Earphones allow a user to experience realistic sounds, the base station permits a user to move within a given space, the hand controllers allow a user to manipulate objects (i.e., levers, knobs, work pieces, etc.), and the headset provides a 360° panoramic view of the work area. The link box serves to connect each piece of hardware together.

The LSS is a VR simulator designed to introduce the concepts of proper machine operations and safety practices within a game-based setting (Valve Corporation, 2017). Users are also given a summary of any deficiencies in their safety habits (Valve Corporation, 2017). Once

an individual begins using the LSS, he/she will be greeted by a virtual robot. This robot will explain the features of the LSS and allow the user to select an option for interaction, which includes *Game Overview*, *Lathe Overview*, *Lathe Safety*, *Turn a Workpiece*, or *Missions*. The *Game Overview* provides a description of the purpose of the game. The *Lathe Overview* walks users through the components of the lathe (e.g., chuck guard, etc.), while *Lathe Safety* will outline the steps for safe operation of the lathe. This includes a discussion of proper personal protective equipment, and the steps for loading a workpiece for performing various functions. *Turn a Workpiece* is a free environment where a user can operate the lathe without guided instructions from the robot. The *Missions* portal has various tasks that users can complete. The lounge area has a board that tracks error types (e.g., oversized workpiece, etc.), and the number of occurrences.

Results to Date

The LSS was initially piloted at Tennessee Tech University (TTU) in an undergraduate work study program for agricultural education students. After we tested the LSS and created a suitable set-up for its use, the LSS was then introduced in a methods of teaching course within a unit of instruction on educational technology. All students enrolled in the course were given the opportunity to practice using the LSS. Anecdotally, those who used the LSS expressed an enthusiastic response toward using this type of VR technology to introduce safety and operational procedures for a new piece of equipment. Some concerns, however, were noted regarding the transferability of skills learned through the LSS to the use of an actual lathe.

Future Plans & Advice to Others

We plan to continue using this and other VR technologies related to agricultural education. Plans also exist to create, film, and explore additional agriculturally-based settings and concepts. We also wish to develop and implement VR technology application training for preservice and inservice teachers. A collaborative examination of the effectiveness of the LSS with a college of engineering at TTU is currently in development. Regarding hardware, we currently use an Alienware PC with HTC VIVE VR technology, but additional ambitions include purchasing a selection of different technology delivery packages, such as the Oculus Rift VR system. The prices for differing VR technologies should be considered depending on circumstances, as lower-cost alternatives are available based upon differing needs. VR technologies may become more cost-effective and attainable as adoption increases.

Costs

The HTC Vive we used retailed for $800.00 and included a headset, two wireless controllers, two base stations, and one link box for connection to the computer. In order to operate the system, a VR-ready computer was also needed. We utilized an Alienware model with a base price of approximately $2,700.00. As technology advances and becomes more widespread, prices for VR-ready systems may continue to drop. Prices for VR-ready computers have a wide price range. As such, a computer costing approximately $500.00 may be a more viable option for an agricultural education program. Internet access is required.

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