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; Phipps, Osborne, Dyer, & Ball, 2008; 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, Wells, Anderson & Paulsen, 2016).

Regarding the educational process, simulation has been cited as a useful method of instruction in agricultural education for quite some time (Agnew & Shinn, 1990; Phipps et al., 2008). 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 will be needed, including a VR headset, ear phones, a base station, hand controllers, and a link box. Each hardware piece provides the user with the ability to interact within the full scope of the VR experience.Through the use of full-immersion VR, users are able to interact with the equipment to complete various tasks.For example, the earphones allow a user to experience realistic sounds, the base station permits a user to move within a predetermined area of space, the hand controllers allow a user to manipulate objects (i.e., levers, knobs, work pieces, etc.), and the headset provides a 360^{o} 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, chuck, spindle, tailstock, 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 mission portal has various tasks that users can complete. The lounge area has a board that tracks error types (e.g., oversized workpiece, contact with the spindle, drill bit unlocked, etc.), and the number of occurrences.

Results to Date

The LSS was initially piloted at [UNIVERSITY] in an undergraduate work study program for agricultural education students. After the authors 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

The authors of this abstract plan to continue using this technology within the methods of teaching course as well as exploring other VR technologies related to agricultural education. Plans also exist to create, film, and explore additional agriculturally-based settings and concepts. The authors also wish to develop and implement VR technology application training for preservice and inservice agricultural education teachers in the near future. A collaborative examination of the effectiveness of the LSS with a college of engineering at [UNIVERSITY] is currently in development. Regarding hardware, the authors 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

Prices for VR technologies vary based upon the type and kind selected for use. The HTC Vive used by the authors retails for $800.00, which includes 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 is also needed. The authors utilized an Alienware model with a base price of approximately $2,700.00. As technology advances and becomes more widespread, the price 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. The LSS requires wireless Internet access to operate the system. Fees for Internet access vary depending on the service provider.

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