**Benefits of Virtual Reality to Agricultural Education and Research Communities**
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‘Millennials’ (born after the late 1980’s) have learning styles that matured in technologically oriented environment (Junco and Mastrodicasa, 2007; Ryan, 2007; Strauss and Howe, 2009). Technology in classroom has slowly evolved towards digital media, providing student’s information through sound, photos, videos, and using interactive 360° virtual media (Rose and Meyer, 2002). For successful instructor conveyance of message in virtual media to students, the correct tools and visual language must be selected (Carruth, 2017; Deb et al., 2017). The secondary entertainment factor helps capture the student's attention, and connects them playfully with topics and content (Velev and Zlateva, 2017). Engagement is especially important when introducing trainees to high-risk environments that are unattainable in real-world environments (Deb et al, 2017). O’Connor et al. (2018) found students, in multiple VR user environments who manipulated complex theoretical molecular models, learned tasks more quickly than if through conventional educational means. Even users with little or no VR experience were able to accomplish modeling tasks at accelerated rates. The study benefits appear to transfer to multiple users who were engaged and co-located. Virtual reality training provides a framework that is complementary to research activities aimed at enticing users to discover, design, and create.

Laurel (2016) proposed technologies are augmentations of human intention and that these technologies can be committed for purposes of good, especially if the technology allows meaningful insight into a practice that cannot otherwise be simulated or experienced. Virtual training experiences generate measurable gains in performance and experience especially when tools are accessible by users with appropriate but not necessarily costly technology (Carruth, 2017). While inside a VR training experience, the trainee’s accuracy of performance, response to actions required, and task completion time are recorded metrics, which subsequently permit post-training analysis of training content and its validity in an instructional system. Although agriculture education attempts to synthesize and summarize experience through traditional curriculum, the classroom effect may forestall true learning due to the lack of hands-on exposure to farming elements (Roberts, 2006).

Needed in agriculture education is an approach that moves beyond theoretical-experiential models and onto models that integrate real-world experiences with traditional learning approaches. A pedagogic cycle of a) initial training focus, b) interaction with a virtual phenomenon, c) creating generalizations about an experience, and then d) testing those generalizations is attainable in a Conventional-plus-AR/VR coursework and research environment. Although an educational pedagogy ranks higher in impact than single technology interaction in post-secondary education, benefits are gained through VR approaches when cognitive support tools simulate high-risk training experiences (Schmid et al., 2014). Virtual-reality instructional support tools can be programmed to increase exposure to unscripted conditional training, and thereby yield superior training outcomes.

Benefits of stand-alone VR training tools include reduced need for faculty support, decreased costs of training implementation, decreased risk, and increased opportunities to experience scenarios during off-season months (Lueke, 2012; Gonzales, et al., 2017). However, this project does not propose virtual reality educational experiences that acts as stand-alone video gaming systems ferrying a trainee from the beginning to the end of a production cycle. Extensive overuse of interactive electronic devices and applications is shown to have deleterious effects on social behavior, learning, and cognitive capacity (Billieux et al., 2014; Van Rooij and Kardeflt-Winther, 2017; Ward et al., 2018). Rather, the VR training tools we propose are suitable for students who cannot learn discrete activities in the classroom. Future Grower Technologies are proposed for visualizing, monitoring, and management of crops in a virtual environment as extemporized by previously learned concepts and principles, which may lead to effective applications in real- or condensed-time scenarios. Using 3D technology to demonstrate stress effects of plants and animals creates synergies in agricultural when researchers, students, and producers are able to visualize potential realities, and define probable mitigation techniques. Likewise, engaging students in innovative technology development will enhance research activities and outcomes.

For this project, we propose a cross-disciplinary approach that develops and employs both traditional agriculture lecture and virtual media as teaching/learning/assessment tools. Moreover, once developed, these same outcomes will be integrated into a software training tool available to broad-reaching education markets though application programming interfacing (API data format for web-based services).

To summarize the intent of the Future Grower Technologies project: we propose that students receive traditional agriculture lectures on related subject matter before engaging in intermittent farm-production VR experiences. Furthermore, we propose agriculture educational scenarios, or guided narratives, be incorporated into the VR system that relate directly to course content taught in a traditional method. Conventional assessments of a post VR-training experience should include synthetic, reflective writing exercises after a VR experience in order to improve learning in the cognitive, affective, and psychomotor domains (Boyd et al., 2006). Ultimately, the goal of FGT VR training tools is for students to experience increases in fluid memory through episodic emersion in goal-directed selection, analysis, manipulation and storage of information that respects a trainee’s working memory limitations (or 3-5 chunks of information per VR visit) (Halford et al., 2007).

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