Innovative

Utilizing vehicle mounted Global Positioning Systems (GPS) to increase Science, Technology, Engineering, and Mathematical comprehension: From concepts to real-world applications

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Utilizing vehicle mounted Global Positioning Systems (GPS) to increase Science, Technology, Engineering, and Mathematical comprehension for precision agriculture: From theoretical concepts to real-world applications

Introduction

Based upon suggestions by the National Research Agenda for Agricultural Education (Roberts, Harder, & Brashears, 2016), as a country, the U.S. lacks a sufficient scientific and professional workforce that can address the Science, Technology, Engineering, and Mathematics (STEM) challenges of the 21st century workforce. According to Sargent (2017) “the U.S. Bureau of Labor Statistics (BLS) projects that the number of science and engineering (S&E) jobs will grow by 853,600 between 2016 and 2026, a growth rate (1.1% Compound Annual Growth Rate - CAGR) that is somewhat faster than that of the overall workforce (0.7%).” Furthermore, he noted that the “BLS projects that 5.179 million scientists and engineers will be needed due to labor force exits and occupational transfers (referred to collectively as occupational separations). BLS projects the total number of openings in S&E due to growth, labor force exits, and occupational transfers between 2016 and 2026 to be 6.033 million, including 3.477 million in the computer occupations and 1.265 million in the engineering occupations” (Sargent, 2017). For modern agricultural applications, Global Positioning Systems (GPS) have revolutionized how agricultural operations collect data, plot soil conditions and locations, apply fertilizer and herbicides, plant seeds, and harvest crops (John Deere, 2017). These STEM operations are collectively known as *precision agriculture*. Researchers have noted that many farmers and industry professionals are in need of professional development regarding precision agriculture (Crumpler, 2004; Erickson, Fausti, Clay, & Clay, 2018; Fausti, Erickson, Clay, Schumacher, Clay, & Skouby, 2018; Kitchen, Snyder, Franzen, & Wiebold, 2002; Shannon, Davis, Sudduth, & Wiebold, 2002). To better prepare a 21st century workforce for the growing technology demands found within agriculture, faculty at Sam Houston State University have incorporated a GPS/precision guidance laboratory activity into a predominately lecture-based course utilizing modern guidance technology and vehicles found in agriculture and construction.

Program Phases

Students in a GPS/GIS Applications in Agriculture and Construction laboratory were asked to review the owner’s manual on Trimble EZ Guide 250 precision guidance systems. Afterwards they were instructed to work in groups of three to install the units into either a Caterpillar UTV, Kubota UTV, or Kubota utility tractor. The final objective of the laboratory was for them to operate the equipment simulating three different field operation patterns: a typical A-B (back and forth) pattern, a circuitous pattern, and a circular pattern simulating working around a center pivot irrigation system. For laboratory purposes, all swath widths were established at 20’. Concluding the laboratory, students were asked to respond to three summative questions: 1) What was your level of experience with GPS/Precision Guidance before today’s lab? 2) What are three key points you learned from today’s lab concerning GPS/Precision Guidance? 3) How do you envision using this technology in your future career?

Results to Date

Concluding the laboratory activity, students responded to the following questions:

Question 1: What was your level of experience with GPS/Precision Guidance before today's lab?

- Two of eighteen students reported some experience with GPS guidance systems previously (namely utilization of GreenStar equipment), others reported no experience other than typical navigation in automobiles. "My experience with GPS before lab today was a navigation system in a car."

Question 2: What are three key points you learned from today's lab concerning GPS/Precision Guidance?

- Students realized the class goals of learning to navigate through owner's manuals, install the systems into tractors and/or ATV's, and inputting proper commands into the system to achieve operations in three different field patterns. "Hooked up our system which was really easy and asked to do a square pattern, a circle pattern, and an AB pattern with our system to show us how it works in real life."

Question 3: How do you envision using this technology in your future career?

- The students obviously recognized the benefits of utilization of precision guidance when operating field machinery or construction machinery. "This tool could be used in many ways such as highway construction, farming, grading land and many more." "I can envision myself using the system we used today in my future on small tractors, using it to spray pastures, hay fields, or even small sections of crop land."

Cost/ Resources Needed

For this laboratory activity, a program owned Caterpillar UTV ($16,500.00), and a borrowed Kubota UTV and compact Kubota tractor (25 hp) was utilized for instruction. For guidance, three donated Trimble EZ Guide 250 precision guidance systems were utilized ($1,279.99 each). Additionally, classroom desktop computers ($1,500.00) were utilized for instructional purposes.

Future Plans

To assist with an ever growing and changing technology-rich subject such as precision agriculture, corporate educational contacts and/or their technology will be maintained and utilized to deliver premier instruction to students. Based upon student feedback, this activity will be continued and integrated with a boom-type sprayer. Additionally, guest speakers and field trips to actual application sites will be integrated.

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