Incorporating Geospatial Technologies in Agricultural Education

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Introduction

Technology has been at the center of educational reform for decades (Culp, Honey, & Mandinach, 2005). The role of technology in the classroom continues to expand in many school systems as access and money to support the use of technology becomes more readily available (Cuban, Kirkpatrick, & Peck, 2001; USDE, 2010). Agricultural education instructors should be leaders of technology integration and mimic technological use in current and emerging agricultural practices (Smith, Rayfield, & McKim, 2015). Geospatial technology is used extensively in agriculture and natural resources. For instance, Global Position Systems (GPS) and Geographic Information Systems (GIS) are widely used in precision farming practices to increase production efficiency. GIS software allows users to obtain, manage, analyze, and view all forms of geographical data. Digital maps can be created that include multiple map layers that provide spatial information to solve complex problems. Users can create map layers of features through uploaded GPS coordinates. Map layers can be added to existing base-maps and can be "stacked" on top of each other to investigate spatial relevance of the layer's features (Heraud & Lange, 2009). School-Based Agricultural Education (SBAE) programs can incorporate GIS and GPS technologies in the classroom to solve issues of relevance in the community.

How it Works

Two examples of project-based learning are discussed that illustrate how the instructor utilized geospatial technologies in an agricultural education course in a rural SBAE program. Each project was designed and selected based on the following criteria: 1) ability to involve students in the identification of the problem; 2) ability to solve an immediate problem of local context; 3) ability to solve the problem through geospatial technologies; and 4) ability to identify and involve stakeholders of the problem.

Two projects that met the above criteria were selected by the instructor and students of the SBAE program. The first project involved creating a digital map of town fire hydrants and water meters for the village municipal system. The second project involved creating a digital map of tree species for the school district's grounds.

For the first project, students in the course worked with city government officials to identify local problems that could potentially be solved using geospatial technologies. Students and government officials decided that the town's paper maps of fire hydrants and water meters should be updated into digital maps. Having such features mapped through GIS could be used to increase the efficiency of village work operations and future city development. It was decided that one map layer would be created for fire hydrants and another layer would be created for water meters.

The first step students took in creating a GIS map layer was to collect GPS coordinates of the fire hydrants and water meters. Students used Garmin® eTrex™H hand-held GPS units to collect coordinates. Each hydrant and meter was physically identified and its coordinates captured in the GPS unit. Data was collected systematically by breaking the town into small sections and assigning a group of students to collect data from each section. After all coordinates were collected, students uploaded their data points to ArcMap10.2®. Students then used the software and data points to create the map layers for water meters and fire hydrants. These map layers were shared with government officials.

For the second project, students in the course created a digital map of trees on school district grounds. Students used hand-held GPS units to collect the coordinates of each tree on the school grounds. Trees were also identified by species. Data points were uploaded to ArcMap10.2® were a map layer was created. This map layer can be used by the school district for future projects involving landscaping and tree identification along the school grounds.

Implications

Incorporating geospatial technology curriculum in the SBAE program provides many positive outcomes. Using industry-supported technology in the classroom to solve localized issues establishes relevance to student's lives, the community, and to the agricultural industry. Furthermore, problem-based group learning projects encourages creative thinking and collaborative work skills as also reported by Smith, Rayfield, and McKim (2015). As a result of these projects, digital maps were created that serve a purpose to the school and community. In the case of the first project, the town now has access to digital maps of fire hydrants and water meters found within the village. The second project produced a digital map of trees on the school grounds that can be used for a variety of purposes. For example, students studying for a Forestry Career Development Event (CDE) may find the map helpful in locating certain tree species. Unlike paper maps, digital maps can easily be updated when the location of these features change and as new features are built. Each map layer can be saved in a geodatabase that will allow the user to have access to the layer.

Future Plans

It is likely that the incorporation of technology in the classroom will continue to be a topic of discussion. Agricultural education is well positioned to provide technical hands-on and minds-on experience that addresses or mimics real-world problems. It is recommended that SBAE programs include GIS and GPS in their curriculum. Furthermore, using these tools to solve localized issues and to provide the community with a product, captures the attention and support of the community for the SBAE program. It is suggested that the projects discussed be expanded to identifying and creating additional map layers (e.g. city waterlines) that can be included in the geodatabase. It is suggested that additional projects are created in this community based upon evolving localized problems or areas of needed investigation.

Resources Needed

Resources must be considered with the implementation of any new instructional project. This is especially true regarding projects that involve technological equipment which can be costly. Geospatial projects such as these, require GPS devices, GIS software, and computers. Although a hand-held GPS device may be more accurate, a standard smart phone can be used to collect GPS coordinates. Esri®, an international supplier of GIS software, proudly promotes the use of GIS in education and often offers free GIS software to school districts.

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