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West Virginia Agricultural Educators' Usage of Internet-Based Instructional Technology

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Abstract

Technology is vital to American education. Each year schools spend millions of dollars on various technologies intended for use in classrooms, but research shows over a third of this equipment goes unused. This study explores how West Virginia agricultural educators make decisions about adopting and integrating internet-based technology into their classrooms. Results showed educators were most likely to use learning management systems and search engines, and least likely to use websites, apps, games, and the online curriculum platform iCEV. Educators integrated technology into their classrooms primarily by using it to provide and review lesson content with classes. Less common uses included introducing, activating, and assessing learning.

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Introduction and Problem Statement

Modern agricultural practices rely on technology to assist in the production food and fiber. Technological advances allow agriculturists to improve the output, profitability, efficiency, and safety of their operations while reducing environmental impact (United States Department of Agriculture National Institute of Food and Agriculture [USDA NIFA], 2023). If agricultural education programs are to prepare students for technology-based careers and educate the populace about agriculture in the 21st Century, we must examine how agricultural educators integrate technology into their classrooms.

The most common type of technologies used in U.S. classrooms, and in agricultural education classrooms, are those available through the Internet (Tsai et al., 2011; Vega & Robb, 2019, Williams et al., 2014a). These technologies include video sharing websites, learning management systems (LMS), apps, games, and online educator resources (Vega & Robb, 2019). Use of such technology in the classroom supports student learning, creativity, and motivation while improving teachers' abilities to differentiate course concepts and provide easy, more affordable access to course materials (Bekele, 2010; Williams et al., 2014a). Factors impacting agricultural educators' technology use include cost, availability, complexity, learning time, implementation time, support, and positive modeling of the technology during the teacher education process (Al-Ruz & Khasawneh, 2011; Coley et al., 2014; Williams et al., 2014b).

Reports show many successful educational technologies go completely unused due to lack of access, support, and teacher efficacy with the product (Crossley & McNamara, 2017). In some cases, this phenomenon extends to least one third of all educational technology products purchased by schools (Binkley, 2013; Glimpse K12, 2019; Vega & Robb, 2019; Yoder, 2023). Educators may also implement ineffective technologies – or use technologies ineffectively – due to inexperience, personal preference, outside influences, and educational mandates (Glimpse K12, 2019; Vega & Robb, 2019; Yoder, 2023). The Glimpse K12 Analysis of School Spending (2019) estimates that this non-use of technology costs schools over five billion dollars each year.

Theoretical and Conceptual Framework

Rogers's Diffusion of Innovations

Rogers's theory of the Diffusion of Innovations (2003) forms the basis of this study. This theory examines how individuals within a social system evaluate an innovation's utility and make decisions regarding the adoption or rejection of that innovation through trial and communication. Factors influencing an individual's decision to adopt an innovation include the qualities of the innovation itself, communication methods, time, and social system characteristics (Rogers, 2003).

Rogers (2003) divides the diffusion process into five stages: knowledge, persuasion, decision, implementation, and confirmation. First, an individual learns about the innovation and asks questions regarding its purpose, use, and ability to address needs. Next, that individual experiments with and develops attitudes about the innovation before deciding on its suitability. If the innovation is adopted, it is then implemented into everyday life for a trial period. Following this trial period, the individual then decides if permanent adoption is warranted.

After adoption, discontinuation or alteration can occur (Rogers, 2003). These processes result from dissatisfaction with or misuse of the original innovation. Discontinued innovations will die out as they pass through a social system and never reach sustained adoption. Altered innovations will remain in the system, although in a different form than originally intended. Successful reinvention of an innovation increases the likelihood of adoption and decreases the time necessary for the diffusion process to occur. The innovations most likely to be reinvented are those offering individuals more freedom of and possibilities for use (Rogers, 2003; Sahin, 2006). Sahin (2006) notes technologies such as computers are particularly ripe for reinvention, as they allow “many possible opportunities and applications” (p. 4).

Rogers (2003) described five characteristics which impact an individual’s decision to either adopt or reject an innovation: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to an innovation’s superiority over existing ideas, systems, or options. Compatibility describes an innovation’s fit within the needs, beliefs, and situations inherent to a social system. Complexity refers to the perceived level of difficulty associated with using an innovation as intended. Trialability is the degree to which an innovation may be experimented with or tested by potential adopters. Observability is concerned with the visibility and impact of outcomes which arise from an innovation. Innovations in possession of high levels of relative advantage, compatibility, trialability, and positive observability, alongside low levels of complexity, are more likely to be adopted.

Gagné’s Events of Instruction

The in-class usage methods for technology included in this study were derived from the work of Gagné et al. (1992), which described the purposeful development of quality educational lessons through a systematic process. This process was derived from a model of events that occur when adults are presented with learning outcomes and related stimuli and was designed to structure the learning process in the most effective manner based off that model (Gagné et al., 1992). Gagné et al. (1992) originally proposed nine distinct steps in their lesson design procedure, but some steps were combined for clarity and to reduce survey length. The sequence of these steps was kept intact to maintain fidelity to Gagné et al.’s (1992) original model. These changes were made with the guidance and approval of Agricultural and Extension Education faculty at West Virginia University.

Purpose

The purpose of this study was to explore West Virginia agricultural educators’ use of internet-based technology in their classrooms and identify connections between technology use patterns and respective adoption characteristics. In doing so, agricultural educators and teacher educators can gain a more thorough understanding of how internet-based technology is currently used in the classroom, and how the differing attributes of such technology can create more impactful learning opportunities for students when used in appropriate contexts. Specific objectives guiding this study included:

1. Identify how many West Virginia agricultural educators have access to reliable internet service and technology in their classrooms.
2. Identify the frequency with which West Virginia agricultural educators used specific internet-based technologies in the classroom in their lessons.
3. Examine when and how agricultural educators in West Virginia integrate internet-based technologies into their lessons.

Methods

This descriptive study explored West Virginia agricultural educators' internet-based technology habits and preferences. The population for this study included all agricultural educators employed in West Virginia (*N* = 103). The Tailored Design Method (Dillman et al., 2014) was used to guide instrument design and participant contact procedures. Participants were contacted by email and asked to complete an online survey instrument on technology usage in their classroom. Participants that did not respond after two weeks received a reminder email and a telephone call asking them to complete the survey or provide information orally. Those who did not respond after four weeks received a second similar reminder. At the close of the survey period, 32 agricultural educators provided usable data, offering a 31% response rate. Differences in early respondents and late respondents were not significant.

The instrument was composed of four sections. The first section asked respondents if they used internet-based technologies in their classrooms, and if they had reliable access to internet and technology sources provided by their school. The second section queried if participants used selected internet-based technologies, and if so, how frequently this use occurred. Frequency responses were recorded on a four-point Likert-type scale ranging from "always = 4" to "rarely = 1." The third section asked respondents to indicate when and how each technology was integrated into regular learning activities. The fourth section collected respondents' demographic information. Researchers used Cronbach's alpha to measure the reliability of the statements included on the instrument. All statements demonstrated a Cronbach's alpha of .70 or above, which is acceptable in social science research (Nunnally, 1994).

The types of internet-based technology included in the study were derived from Vega and Robb (2019), which included search engines, learning management systems (LMS), virtual field trips, video sharing platforms, and supplemental materials such as apps and games. The researchers chose to add the iCEV website to the survey because it is commonly used in West Virginia as a technological teaching aid. iCEV provides subscribing teachers with Career and Technical Education-specific resources including lesson plans, videos, activities, study materials, and assessments (iCEV, 2024). iCEV was founded in 1987 and is now used in over 2,000 classrooms worldwide (iCEV, 2022).

To ensure validity, the survey was first examined by a panel of agricultural education teacher educators at West Virginia University, and pilot tested on Mississippi secondary agricultural educators. Mississippi was chosen because it possessed levels of in-school technology and internet access similar to those in West Virginia. Data were analyzed for frequencies, means, and standard deviations using IBM® SPSS® 27.0 for Windows (2021).

The primary limitation for this study involved the fact that participants were contacted only via email and not through other means. This contact method made it more likely that respondents would be more familiar with, and thus more likely to use, technology. Even though all agricultural educators in West Virginia are given email addresses by the West Virginia Department of Education, it is possible that some educators did not see the email, did not know how to complete an online survey, or did not feel comfortable doing so.

A second limitation for this study involves technology access for teachers. Not all respondents said their schools offered reliable internet access. As participants were contacted over the Internet through official school email addresses, some agricultural educators in West Virginia may have been unable to access their email or the survey. Access to equipment is a reported issue regarding technology adoption in schools and is most likely to occur in Title I schools (Vega & Robb, 2019). These findings cannot be generalized to other agricultural education programs in other states and territories.

Findings

Thirty-two educators completed the study for a response rate of 31.06% (*n* = 32). Eighteen respondents identified themselves as male (56.30%) 13 as female (41.60%), and two did not provide their gender (3.10%). The average length of respondents' teaching careers was 14.63 years (*SD* = 10.20).

Research Objective One

Of the 32 respondents, 31 (96.88%) reported having reliable internet and technology access in their school building on a regular basis. All 32 respondents (100%) stated their students had access to such resources, either through personal or school-owned devices. This access made it possible for every responding educator to utilize at least one form of internet-based technology in their classrooms. Such findings agree with the idea that technology is important in agricultural education classrooms, and with Vega and Robb's (2019) estimate of 95% of teachers using technology in some form. They also agree with Tsai et al.'s (2011) finding that internet searches are one of the most common forms of technology use in classrooms. Smith et al. (2018) noted use of student-owned devices such as smartphones is becoming more common in schools which do not have the resources to provide reliable technology access for all.

Research Objective Two

This study explored how frequently respondents used each piece of internet-based technology in their everyday classroom instruction. Respondents indicated if they "always," "often," "occasionally," or "rarely" used the technology. "Always" was defined as use of the technology every day, "often" described use a few times a week, "occasionally" referred to use a few times a month, and "rarely" referred to use only a few times a semester.

Results showed a clear hierarchy of internet-based technology use in West Virginia agricultural education classrooms. Technologies which displayed a variety of uses and allowed input from the teacher proved to be much more popular and frequently used than those which were not. Table 1 illustrates West Virginia agricultural educators' technology preferences and use frequencies.

Table 1

Frequency of use of Internet-based technology

	Always		Often		Occasionally		Rarely	
Technology	*f*	%	*f*	%	*f*	%	*f*	%
LMS	17	53.13	11	34.38	3	9.38	1	3.13
Search Engines	10	31.25	18	56.25	3	9.38	1	3.13
Virtual Field Trips	0	0.00	1	3.45	15	51.72	13	44.83
Video Sharing Platforms	1	3.5	14	50.00	6	21.43	7	25.00
Apps/Games	1	3.57	4	14.29	10	35.71	13	46.42
iCEV	4	18.18	7	31.82	4	18.18	7	31.82

Learning management systems demonstrated the greatest frequency of use and widest levels of adoption of all technologies. All 32 respondents (100%) used LMS as part of their classes, and over half (*f* = 17, 53.13%) used it every day. Eleven employed it "often" (34.38%), while three used it "occasionally" (9.38%), and one respondent "rarely" used it (3.13%).

All respondents (n = 32, 100%) used search engines, although less frequently than they did LMS. Ten respondents "always" used search engines (31.25%), while 18 used them "often" (56.25). Three used them "occasionally," (9.38%), and one used them "rarely" (3.13%). In a 10-year review of literature regarding educational technology integration, Tsai et al. (2011) found search engines to be the most commonly integrated piece of internet-based technology on a global scale. While this may be still the case, in many countries use of Learning Management Systems surged during the height of the COVID-19 pandemic, as there were few other safe options for educating students (Lee et al., 2022; Prat et al., 2021). If this study had been performed prior to the pandemic, it is likely that LMS use would be lower.

Virtual field trips were seen as more of a niche product useful in certain educational situations. Twenty-nine respondents (90.63%) said they used virtual field trips at least once a semester, while three (9.37%) did not use virtual field trips at all. No respondent used them every day, although one (3.45%) did employ them "often." Most respondents accessed virtual field trips on an occasional (*n* = 15, 51.72%) or rare (*n* = 13, 44.83%) basis, likely during specific lessons for which they either had a virtual field trip opportunity available or felt one to be advantageous to the learning process.

Twenty-eight respondents (87.50%) used video sharing platforms in their classes. Over 70% of those who did used them either "often" (*n* = 14, 50.00%) or "occasionally" (*n* = 6, 21.43%), indicating that they, like virtual field trips, were helpful in specific circumstances only. One respondent (3.50%) used them every day, and a quarter of users (*n* = 7, 25.00%) called upon them "rarely."

Apps and games were not frequently included as part of normal learning activities. Only 28 respondents said they used them (87.50%) at all, and most of those did so rarely (*n* = 13, 46.42%), or occasionally (*n* = 10, 35.71%). A few included them in lessons on a frequent basis (*n* = 4, 14.29%), and one "always" did so (*n* = 1, 3.57%).

The final technology included in this study was iCEV. iCEV was polarizing to respondents, demonstrating the lowest number of total users (*n* = 22, 68.75%) and an interesting pattern of use. Half of those who implemented iCEV in their classrooms did so all (*n* = 4, 18.18%) or most (*n* = 7, 31.82%) of the time. The other half of iCEV users chose to include it in their lessons occasionally (*n* = 4, 18.18%) or rarely (*n* = 31.82%). Considering iCEV is a paid subscription service for pre-made lesson plans, activities, videos, and assessments, it is interesting to note that half of respondents did not use it much, despite making an investment to purchase it. This indicates iCEV may not be meeting teachers' needs, or may be purchased at a district level, similar to LMS.

Research Objective Three

Research Objective Three examined when and how agricultural educators integrated internet-based technologies into their lessons. Lesson segments were derived from the work of Gagné et al. (1992) and included lesson introductions, activating strategies, content provision, reviews, and assessments. Table 2 shows West Virginia agricultural educators' usage of internet-based technology divided by lesson segment in further detail.

Table 2

Use of Internet-based technology in West Virginia agricultural education classrooms

		Internet-Based Technology						
		LMS	Search Engine	Video Sharing Website	iCEV	Apps and Games	Virtual Field Trips	Total
Lesson Component	Introduction	14	17	24	10	3	12	80
	Activating Strategy	17	18	8	9	10	6	68
	Lesson Content	25	25	21	18	5	12	106
	Review	22	16	20	12	15	7	92
	Assessment	23	6	6	9	8	2	54
Total		101	82	79	58	41	39	761

Results indicated that teachers were most likely to use technology during the content provision portion of their lessons (*f* = 106), followed by review (*f* = 92), and introduction (*f* = 80) portions.

Teachers were least likely to use technology during the activating strategy (*f* = 68) and assessment (*f* = 54) segments of lessons.

Learning management systems were the most frequently used technology during classroom lessons (*f* = 101), with most usage occurring during the content provision, assessment, and review segments. Search engines (*f* = 82), video websites (*f* = 79) also had high frequencies of use, especially during content provision, introductions, and reviews. iCEV (*f* = 58), apps and games (*f* = 41), and virtual field trips (*f* = 39) were the least commonly used of all technologies.

These findings demonstrate agricultural educators in West Virginia have specific uses and preferences for technology in their classrooms. However, there are some instances where educators may not be using technology to its fullest potential. Apps and games were not often used in respondents' classes, and when they were, it was often for review purposes. However, Ting (2010) found games could serve as a useful method for activating student interest in a topic before beginning actual instruction. Only ten respondents used apps or games in such a manner. Similarly, results showed respondents did not use technology as much for assessments, preferring more traditional formats instead. These results indicate a need for greater technological creativity to be modeled during the teacher education process.

Conclusions, Discussion, and Recommendations

Results of this study confirm the importance of internet-based technology in the agricultural education classroom. Most classrooms in West Virginia had reliable internet access and school-owned technology, but in some cases students' personal devices were required. The authors recommend identifying methods of technology implementation for agricultural education programs in such situations. They recommend performing such an analysis through survey methods that do not use the internet in order to catch programs which may have been left out of this study due to poor internet or technology availability.

Most of the internet-based technologies included in the study showed sustained and wide adoption. These technologies are essential to online learning, open to reinvention, and in possession of key attributes that Rogers (2003) linked with successful adoption. This finding is supported by observing the ways in which participants used each technology in their classrooms, as the most frequently used were also those implemented during a variety of lesson plan components. Learning Management Systems and search engines demonstrated high levels of relative advantage, compatibility, trialability, and observability and low complexity. They require little effort or knowledge to use, are accessible on small screens and slower connections, are useful to teachers and students, and versatile in function. Their use is also widely supported throughout K-12 education (Tsai et al.; Vega & Robb, 2019), increasing the likelihood that teachers will receive positive affirmation from others about their use (Rogers, 2003). In some cases, use of these technologies may be mandated by district or state educational leaders, which Rogers (2003) terms an "authority innovation decision" (p. 348). This may have led to the high number of Learning Management System users involved in the study. Either way, it is essential for educators to use these technologies fluently. The researchers recommend teacher educators teach and model essential LMS and search skills during the teacher education process, so teachers (and students in turn) can implement them to greater potential in the classroom. Research has shown that an educational technology course is not enough for students to master the material; teacher modelling and integration of technology into all courses is key (Zipke, 2018). They also recommend helping in-service agricultural educators master these technologies through demonstrations at professional development events and activities.

Less frequently used technologies like virtual field trips, video websites, apps and games, and iCEV demonstrate less of Rogers's (2003) characteristics and may be viewed as less useful than other options, incompatible with teachers' expectations, inaccessible on student devices, too expensive, or too likely to produce ineffective learning outcomes. While results indicate they are useful in certain situations, their specificity and lack of user control may make them difficult to implement as widely throughout a lesson. The researchers recommend deeper examination into the use of these less-frequently employed technologies. Understanding what virtual field trips or videos are used and how games or apps are implemented into class could assist teachers with developing more successful, creative, and engaging technology-integrated lessons while preparing students for agricultural careers and educating them on modern agricultural practices.

Current app-based agricultural technologies allow users to conduct business, keep records, monitor weather and climate information, operate irrigation systems, map fields, manage livestock, connect with experts, monitor soil health and fertility, access important information, and more (Farm Bureau, 2024; Hopkins, 2024). However, respondents in the study were either unaware of or unable to use these capabilities and heavily preferred to use apps for review instead of class content provision. Virtual field trips were more likely to be used for content, but still underutilized overall. Virtual field trips can allow students to gain insider views of agricultural operations that could not physically be visited due to logistic, funding, educational, or health and safety issues (Tuthill & Klemm, 2002). Updates with virtual reality programs could provide an in-depth, 3D experience integrating not just images, but sounds and narrations as well (Wells & Miller, 2020). With so few Americans involved in agriculture directly, viewing agricultural practices even remotely could provide valuable insight towards potential careers and general knowledge of food and fiber production. Teacher educators should introduce educators to these technologies early and require teacher candidates to practice using them creatively during lessons, and not just as tools for review.

The researchers also recommend an investigation into teachers' use of iCEV due to its interesting use patterns. Respondents were polarized regarding its implementation, and 31.82% admitted to rarely using it, despite either their programs or districts paying for the service. Knowing who uses iCEV, how it is implemented, the suitability of iCEV lessons for curricular needs, and why it is purchased if not frequently used should be explored. iCEV offers both agricultural instruction through technology, and instruction in agricultural technologies, allowing it to serve as an effective option for educating about agricultural careers, at least for some.

The researchers noted that assessment was the lesson component least tied to technology use. Some respondents did use their LMS program or iCEV for assessment, but most seemed to prefer more traditional assessment means. The researchers recommend identifying teachers' preferred assessment methods and reasonings behind those preferences. While technology may not be appropriate for all assessments in agricultural education, its use could help teachers manage submissions, provide more targeted feedback, and evaluate learning in multiple ways.

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