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Teachers' Opinions About Virtual Reality Technology in School-based Agricultural Education

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Abstract

Technology in school settings has undergone a tremendous degree of evolution in recent decades. Educational technologies can be used for a wide range of applications. In school-based agricultural education (SBAE) settings, an assortment of educational technologies is often used to achieve instructional objectives. As a computer-based technology, virtual reality (VR) technology has been applied in educational contexts for years and is anticipated to grow in use and popularity. VR technology has received little attention in SBAE-focused research. Through the lens of an adapted version of Fishbein and Ajzen's (2010) reasoned action model, we sought to describe the opinions teachers have regarding VR technology in SBAE. Following Dillman, Smyth, and Christian's (2014) recommendations, we used an Internet-based questionnaire to collect data from 90 SBAE teachers in Iowa during the 2017-2018 academic year. Our results indicated the teachers generally held favorable opinions about VR technology intertwined with a considerable degree of uncertainty about the technology and its uses. To facilitate opportunities for VR technology-related professional development, we recommend agricultural teacher education faculty develop their own knowledge and skills related to VR technology applications.

Keywords: school-based agricultural education; virtual reality; simulation; technology; educational technology

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Introduction

Technology has long been a landmark contributor to the American school experience (Saettler, 2004). From the use of books, pencils, and paper to the incorporation of advanced computer hardware, software, and films, technology has become engrained in American classrooms and is consistently re-defined and expanded (Saettler, 2004). Regarding the impacts of technology in educational environments, the United States Office of Educational Technology (n.d.) stated:

> Technology can be a powerful tool for transforming learning. It can help affirm and advance relationships between educators and students, reinvent our approaches to learning and collaboration, shrink long-standing equity and accessibility gaps, and adapt learning experiences to meet the needs of all learners. (¶ 2)

The use of technology as an assistive tool is supported by educational philosophers, psychologists, and theorists (Saettler, 2004). Education is progressive in nature and mental faculties can be developed through connections and interactions between concepts and mediums (Dewey, 1916). This could include those connections offered between technologies and their use

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in an educational environment. Vygotsky (1978) noted using tools can positively contribute to intellectual development over time.

Educational technology has continued to evolve and broaden within a multitude of common everyday settings (Saettler, 2004). Examples of technologies that have emerged more prominently over the past three decades include: (1) mobile devices (Park, 2011), (2) digital games (Amory, Naicker, Vincent, & Adams, 1999), (3) web-based resources (Gray, Thomas, Lewis, & Tice, 2010), (4) augmented reality (AR) (Lee, 2012; Yuen, Yaoyuneyong, & Johnson, 2011), (5) mixed reality (MR) (Hughes, Stapleton, Hughes, & Smith, 2005), and (6) virtual reality (VR) (Bailenson, 2018; Youngblut, 1998). In recent years, these technologies have become more readily available to classroom teachers (Gray et al., 2010). The rise of such technologies has helped to increase the dissemination of advanced modern technologies into American classrooms (Gray et al., 2010).

The impact of educational technology use on the teaching and learning processes can vary. For example, Stone, Watts, and Zhong (2011) found the use of VR technology can be positively impactful on skill development processes. However, Wenglinsky (1998) cautioned "technology could matter, but that this depended on how it was used" (p. 1). Wenglinsky (1998) further admonished that quantity of availability and use of educational technology does not necessarily equate to improved educational impact; rather, practitioners should carefully consider how a type of educational technology is employed in order to maximize the learning potential.

Phipps, Osborne, Dyer, and Ball (2008) acknowledged educational technologies can be powerful tools for teaching and learning in school-based agricultural education (SBAE) settings. Mimicking the nature of educational technology in education more broadly, educational technologies used in SBAE have evolved considerably. Educational technologies studied within SBAE-focused research include: (1) smartphones (Smith, Stair, Blackburn, & Easley, 2018), (2) interactive whiteboards (Bunch, Robinson, & Edwards, 2015), (3) serious digital games (Bunch, Robinson, Edwards, & Antonenko, 2014, 2016), (4) iPods and MP3 players (Murphrey, Miller, & Roberts, 2009), (5) physical simulation systems (Agnew & Shinn, 1990; Perritt, 1984), and (6) computers (Miller & Kotrlik, 1987; Smith et al., 2018).

SBAE teachers recognize the value of integrating educational technologies into their curricula (Williams, Warner, Flowers, & Croom, 2014b). SBAE teachers have indicated their local school districts and administrators are supportive of infusing educational technologies into SBAE programs (Smith et al., 2018; Williams et al., 2014b). Williams, Warner, Flowers, and Croom (2014a) found North Carolina teachers often have access to or use certain types of educational technology, such as desktop computers, but not always others, such as simulation and visualization programs.

Barriers such as cost may inhibit educational technology adoption and use (Alston, Miller, & Williams, 2003; Coley, Warner, Stair, Flowers, & Croom, 2015; Williams et al., 2014b), which may result in missed opportunities for progress and change. Kotrlik, Redmann, and Douglas (2003) cautioned "that much more needs to be done to encourage and support [SBAE] teachers in the teaching/learning process" (p. 88). As such, progress is a prerequisite for useful change. Kotrlik et al. (2003) advised effective change regarding educational technology integration and education can be implemented by SBAE stakeholders. Anderson and Williams (2012) noted a considerable number of SBAE teachers have taught themselves how to use the technologies available to them. As such, teachers may be willing to learn how to use available technologies if benefits are expected.

VR technology can be described as "a three-dimensional, computer-generated environment which can be explored and interacted with by a person" (Virtual Reality Society, 2017, ¶ 5). VR technology can be used for a variety of functions, including skill-oriented training, social entertainment, and educational purposes (Bailenson, 2018). The use of VR technology in the context of educational environments dates back several decades. Helsel (1992) wrote positively of VR technology's potential for use in education, noting "[v]irtual reality holds much promise for education… [just as] education has a tremendous wealth of information and experience to bring to the VR curriculum" (p. 42). Pantelidis (1993) suggested as of the early 1990s, VR technology could have much potential to help address educational needs in the coming years. More recently, Potkonjak et al. (2016) described greater access to resources and more flexible teaching and learning opportunities offered via some forms of VR technology could help to improve the teaching and learning processes.

As a developmental tool, VR technology has found useful roles in the teaching, learning, and assessment practices in various career areas. In weld process training, VR technology has been used as a skill development method in several studies (Byrd, 2014; Byrd, Stone, Anderson, & Woltjer, 2015; Stone et al., 2011; Stone, McLaurin, Zhong, & Watts, 2013). Cope and Fenton-Lee (2008) examined the use of a VR technology as an assessment tool in surgical training, while Filigenzi, Orr, and Ruff (2000) applied VR technology to mine safety training. Within each of these contexts, VR technology found its place as a method to help provide initial exposure to subject matter and to positively reinforce skill development.

Alston et al. (2003) found SBAE teachers expressed mixed perceptions about VR technology in SBAE. Since Alston et al.'s (2003) study, VR technology has changed considerably and has become more widely accepted and used in educational settings (Bailenson, 2018; Potkonjak et al., 2016). What are SBAE teachers' opinions about using VR technology over a decade later?

Theoretical Framework

We adapted Fishbein and Ajzen's (2010) reasoned action model (see Figure 1) to serve as the theoretical framework that guided our study. We used this model to better understand how SBAE teachers' opinions about VR technology may ultimately impact their intentions and behaviors regarding VR technology.

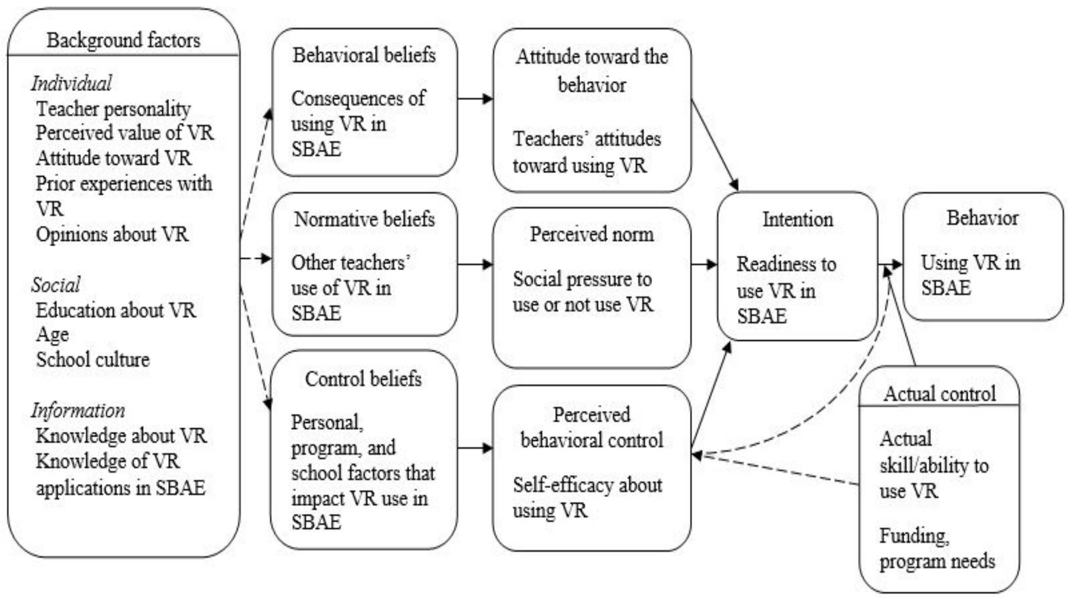

Figure 1. Reasoned action model for VR. Adapted from *Predicting and Changing Behavior: The Reasoned Action Approach* (p. 22), by M. Fishbein and I. Ajzen, 2010, New York, NY: Psychology Press. Copyright 2010 by Taylor and Francis Group, LLC. Adapted with permission.

Within this adapted model, Fishbein and Ajzen (2010) surmised a variety of factors ultimately influence human behavior, noting "[a]s a general rule, the more favorable the attitude and perceived norm, and the greater the perceived behavioral control, the stronger should be the person's intention to perform the behavior in question" (p. 21). Fishbein and Ajzen (2010) postulated individuals' backgrounds (e.g., personal and professional values, prior experiences, knowledge about a subject, etc.) are a foundational root of behavioral intention influencing behavioral, normative, and control beliefs. Behavioral beliefs influence attitudes toward a behavior, normative beliefs impact perceptions about the norm, and control beliefs affect perceived behavioral control, which influence intentions that, along with interventions via actual control emerging from one's own skills, abilities, and environmental factors, impact a behavior or set of behaviors.

In the context of our study, we operationalized behavior as the use of VR technology in SBAE settings for teaching and learning purposes. We believed personal, individualized factors such as opinions about VR technology, previous experiences with using or even observing VR technology, educational level, and professional experiences and values could ultimately guide SBAE teachers' behaviors regarding VR technology adoption and use. Perceptions and realities about other teachers' use of VR technology can impact intentions to pursue the use of VR technology in SBAE settings. Teachers' beliefs about and attitudes toward the use of VR technology in their own SBAE programs can influence intentions and behaviors. Opinions and actualities about control and perceived control regarding the learning environment are also influential variables. Teachers' own skills, abilities, and environmental factors such as available space, funding, curricula being taught, students' needs, and school administrators' support were categorized as actual controls that can impact perceived behavioral control and impact behaviors.

As documented by Anderson and Williams (2012), SBAE teachers often view the use of different types of technologies for education-related purposes favorably. Perhaps the same is true regarding VR technology in SBAE programs. Because initial opinions and beliefs can impact individuals' adoption- and use-related behaviors (Fishbein & Ajzen, 2010), understanding SBAE teachers' opinions about VR technology can help the profession to better understand the utility of this educational technology within SBAE programs.

Purpose and Objectives

The purpose of our study was to describe the opinions teachers have about VR technology in SBAE settings. To address this purpose, we established the following objectives to guide this study:

1) Describe teachers' self-reported experiences with VR technology.
2) Describe teachers' opinions regarding VR technology.
3) Describe teachers' perceived frequency of incorporating new and emerging instructional technologies.

The present study aligned with the American Association for Agricultural Education (AAAE) National Research Agenda (NRA) Research Priority Area 2: New Technologies, Practices, and Products Adoption Decisions (Lindner, Rodriguez, Strong, Jones, & Layfield, 2016). Understanding SBAE teachers' opinions about VR technology can help agricultural education stakeholders, such as teacher educators and software and hardware developers and programmers, to better understand how to identify, plan, design, and implement VR technology that may be beneficial to SBAE programs and curricula.

Methods

This descriptive study sought to examine teachers' opinions about VR technology in SBAE. To accomplish this purpose, we developed and used an electronic questionnaire. Based on the recommendations of Ary, Jacobs, and Sorensen (2010), a panel of experts was used to determine the face validity, construct validity, and content validity of the questionnaire. Three panel members were selected based upon their backgrounds as former SBAE teachers and current agricultural teacher educators. Their past professional experiences included working with simulator technologies. Two panel members taught at land-grant, research-focused universities while the third taught at a regional, teaching-focused university.

We sent detailed instructions to the panel members. We sent each panel member a copy of the questionnaire as well as guidelines for the review process. We asked the panel members to evaluate only the items addressing teachers' opinions about VR technology. The items not evaluated by the panel members included nine items regarding teachers' use of VR technology, six items addressing teacher demographics, and five items concerning SBAE program and school demographics. We did not ask the panel members to evaluate these specific items because they were designed only to provide greater details about the teachers' backgrounds with VR technology. We addressed the recommendations provided by the panel members. The panel members determined the items they were asked to evaluate were face valid, construct valid, and content valid.

We used a pilot study to establish the reliability of the questionnaire. Prior to the launch of the pilot study, we obtained permission from the Iowa State University (ISU) Institutional Review Board (IRB). The questionnaire was constructed in Qualtrics and followed the Tailored Design Method for Internet Surveys (Dillman, Smyth, & Christian, 2014). We sent the questionnaire to 10 teachers selected from the 2017-2018 Iowa SBAE teacher directory.

Prior to the pilot study distribution of the questionnaire, we sent the 10 teachers a pre-notice message informing them about the pilot study and inviting them to be a part of it. A few days later, we sent the teachers a link to the questionnaire. Within one week, we received five completed questionnaires, yielding a response rate of 50%. One week after the teachers were sent the questionnaire link, we sent a reminder message to the five non-respondents. Within two weeks after the reminder message was sent, none of the remaining five teachers responded. We subsequently implemented the second round of the pilot study and randomly selected 10 additional teachers. Within one week, five more teachers completed the questionnaire, yielding a response rate of 50%. We used IBM Statistical Package for Social Sciences (SPSS©) Version 24.0 software to calculate a Cronbach's alpha reliability coefficient for the 29 items that addressed teachers' opinions about VR technology.

We used a standardized Cronbach's alpha as the reliability coefficient ($\alpha = .940$). As noted by Cohen, Manion, and Morrison (2011), standardization can be used for comparing items composed of different scales. In our case, the teacher opinions about VR technology portion of the questionnaire consisted of a total of 29 items and includes: 25 items using the same five-point Likert scale, one item using a four-point scale Likert-type scale, two items using two different five-point Likert-type scales, and one item using a three-point Likert-type scale. Based on the interpretations given by George and Mallery (2003), the reliability coefficient was regarded as *Excellent*. After the conclusion of the pilot study, the panel members were asked to re-evaluate the items addressing teachers' opinions about VR technology to determine if each item was still face validity, construct validity, and content validity. All three panel members determined the items they previously evaluated were still face valid, construct valid, and content valid.

Our design was a census study. We sent the questionnaire out to the entire population of SBAE teachers in Iowa ($N = 265$). Because we did not alter the questionnaire between the pilot study and the formal study, we decided to include the 10 pilot study participants in the data set reported in this manuscript. However, we did not re-send the questionnaire to the pilot study participants, thus reducing the number of teachers to whom we sent the formal study questionnaire to 255. To maximize the response rate, we followed the recommendations of Dillman et al. (2014) and incorporated five points of contact. Using Qualtrics, we sent a pre-notice e-mail to all the teachers within the population of interest ($n = 255$). A few days later, we sent them an e-mail containing the link to access the questionnaire. Over the next few weeks we sent two additional reminder e-mails to non-responders. These e-mails were spaced at least one week apart and were sent out early in the morning to allow teachers time to respond before the school day started. We deliberately elected to avoid sending out the reminder e-mails on either Monday morning or weekends. Our final reminder was a postcard sent by U.S. mail. The postcard contained a reminder message, a web link to the questionnaire, and our contact information.

Ninety teachers provided usable data in the pilot and formal studies, yielding a response rate of 33.9%. As nonresponse error is considered an external validity threat in survey research (Ary et al., 2010; Lindner, Murphy, & Briers, 2001), we controlled this threat by comparing early and late responders. Because we could not identify a wave of late responders, we categorized the latter 50% of respondents as late responders in accordance with the recommendations of Lindner et al. (2001). Our use of an independent samples t-test on the 29 items related to teachers' opinions about VR technology revealed no statistically significant ($p > .05$) differences between early and late responders. Thus, in accordance with Ary et al. (2010), "[we] can assume the respondents are an unbiased sample… [and] can thus generalize to the total group" (p. 409).

We used IBM SPSS© Version 24.0 software to analyze our data. Frequencies, percentages, means, medians, modes, and standard deviations were used to summarize the data. As noted by Boone and Boone (2012), Likert scale and Likert-type scale data can be appropriately analyzed using these descriptive statistics.

Results

The typical respondent was male (*f* = 52; 57.8%), was 39.79 years of age (*SD* = 13.37), had taught for an average of 15.58 (*SD* = 12.51) academic years, primarily taught coursework at the high school level (*f* = 89; 98.9%), and held a bachelor's degree as his highest degree earned (*f* = 52; 57.8%). (Table 1).

Table 1

SBAE Teacher Demographics

Item	*f*	%
Gender		
Male	52	57.8
Female	36	40.0
Did Not Indicate	2	2.2
Age		
22-26	19	21.1
27-31	18	20.0
32-36	6	6.7
37-41	8	8.9
42-46	8	8.9
47-51	6	6.7
52-56	11	12.2
57-61	8	8.9
62+	5	5.5
Did Not Indicate	1	1.1
Years of Teaching Experience		
1-5	25	27.8
6-10	16	17.8
11-15	6	6.7
16-20	11	12.2
21-25	7	7.8
26-30	3	3.3
31-35	11	12.2
36-40	7	7.8
Did Not Indicate	4	4.4
Grade Level(s) Taught		
Elementary School	0	0.0
Middle School	43	47.8
High School	89	98.9
Community College	12	13.3
Four-year College / University	1	1.1
Highest Degree Earned		
Bachelor's Degree	52	57.8
Master's Degree	36	40.0
Education Specialist Degree	1	1.1
Doctorate Degree	1	1.1

The typical respondent's SBAE program was located in a population area of at least 2,500 but less than 50,000 (*f* = 60; 66.7%), was a single-teacher program (*f* = 71; 78.9%) with an average enrollment size of 123 students (*SD* = 123.80), and most commonly included a classroom area (*f* = 89; 98.9%), an agricultural mechanics laboratory (*f* = 65; 72.2%), and / or a greenhouse / horticulture laboratory (*f* = 56; 62.2%). (Table 2).

Table 2

SBAE Program Demographics

Item	*f*	%
Local Population Density		
Less than 2,500	28	31.1
More Than 2,500 But Less Than 50,000	60	66.7
At Least 50,000	2	2.2
Number of Teachers in Program		
One	71	78.9
Two	14	15.6
Three	0	0.0
Four	4	4.4
Did Not Indicate	1	1.1
Approximate Program Enrollment		
0-50	21	23.3
51-100	33	36.7
101-150	18	20.0
151-200	4	4.4
200+	12	13.3
Did Not Indicate	2	2.2
Facilities Available for Use		
Classroom Area	89	98.9
Agricultural Mechanics Laboratory	65	72.2
Greenhouse / Horticulture Laboratory	56	62.2
Land Laboratory	46	51.1
Computer Laboratory	28	31.1
Aquaculture / Aquaponics Laboratory	16	17.8
Livestock Laboratory	10	11.1
Food Science Laboratory	3	3.3
Other	2	2.2
Meats Laboratory	0	0.0

Data regarding teachers' prior experiences with VR technology are reported in Table 3. The greatest frequency of responses was *have seen in person* (*f* = 34; 37.8%).

Table 3

SBAE Teachers' Prior Experiences with VR Technology

	NPE	HSI	HSP	HSAPUI	HSAPUP	HUM
Item	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)
Which of the following describes your prior experiences with virtual reality technology?	21(23.3)	13(14.4)	**34(37.8)**	8(8.9)	18(20.0)	28(31.1)

Note. Each respondent could have selected more than one response to this item. *NPE* = No Prior Experiences; *HSI* = Have Seen on the Internet; *HSP* = Have Seen in Person; *HSAPUI* = Have Seen Another Person Use on the Internet; *HSAPUP* = Have Seen Another Person Use in Person; *HUM* = Have Used Myself.

Data regarding teachers' perceived experiences they have had with using VR technology are reported in Table 4. The greatest frequency of teachers ($f = 49$; 55.1%) reported they have had *fairly positive* experiences with using VR technology.

Table 4

SBAE Teachers' Perceived Experiences Using VR Technology

	No Prior Experie nces	Very Negative	Somewhat Negative	Fairly Positive	Very Positive	Did Not Indicate
Item	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f* (%)	*f*(%)
Which of the following best describes any experiences that you have had with using virtual reality technology?	23(25.8)	2(2.2)	8(9.0)	**49(55.1)**	7(7.9)	1(1.1)

Responses to the 25 five-point Likert scale items pertaining to teachers' opinions about VR technology are detailed in Table 5. The responses with the highest modes for each item are bolded. The item with the highest percentage of *agree* or *strongly agree* responses was "Virtual reality technology would increase my students' interest in content at least some of the time." (81.1%). The item with the greatest percentage of *unsure* responses was "Virtual reality technology is only useful for psychomotor skill development." (53.3%). The item with the highest percentage of *disagree* or *strongly disagree* responses was "Virtual reality technology is more of a gimmick or a game than an actual teaching tool." (54.4%).

Table 5

SBAE Teachers' Opinions About VR Technology

Item	D %	U %	A %	*Mdn*	*Md*	*M*	*SD*
My students are / would be comfortable trying to learn a new skill using virtual reality technology.	0.0	21.1	**78.9**	4	4	3.93	.596
My students enjoy / would enjoy using virtual reality technology in the classroom.	0.0	22.2	**77.8**	4	4	3.93	.614
My students are / would be comfortable trying to learn a new concept using virtual reality technology.	0.0	23.3	**76.7**	4	4	3.92	.622
Virtual reality technology would increase my students' interest in content at least some of the time.	0.0	18.9	**81.1**	4	4	3.90	.520
I am familiar with the concept of virtual reality technology.	10.0	10.0	**80.0**	4	4	3.87	.851
There is great value in trying to learn a new skill using virtual reality technology.	3.3	25.6	**71.1**	4	4	3.81	.701
There is great value in trying to learn a new concept using virtual reality technology.	5.6	27.8	**66.7**	4	4	3.76	.769
Virtual reality technology can be used effectively in agricultural education classroom settings.	3.3	31.1	**65.5**	4	4	3.74	.712
My administration would have a positive opinion toward the use of virtual reality technology in my program.	4.4	30.0	**65.6**	4	4	3.70	.694
Virtual reality technology adds / could add value to my instructional approach.	10.0	21.1	**68.9**	4	4	3.67	.764
Virtual reality technology can be used effectively in agricultural education laboratory settings.	4.4	35.6	**60.0**	4	4	3.67	.734
I am comfortable trying to learn a new skill using virtual reality technology.	10.0	24.4	**65.6**	4	4	3.64	.783
I enjoy / would enjoy using virtual reality technology in my classroom.	8.9	33.3	**57.8**	4	4	3.62	.829
I am comfortable trying to learn a new concept using virtual reality technology.	10.0	25.6	**64.4**	4	4	3.62	.815
Virtual reality technology is a useful method for psychomotor skill development.	5.6	37.8	**56.7**	4	4	3.61	.745
Virtual reality technology is too costly to use in my classroom.	6.7	40.0	**53.3**	4	3	3.60	.845
I have a positive opinion about virtual reality technology.	10.0	31.1	**58.9**	4	4	3.59	.847

Table 5

SBAE Teachers' Opinions About VR Technology Continued…

Item	D %	U %	A %	*Mdn*	*Md*	*M*	*SD*
Virtual reality technology would add more of a STEM focus to my program.	12.2	27.8	**60.0**	4	4	3.57	.822
Virtual reality technology use will increase as a method of psychomotor skill development.	5.6	**50.0**	44.4	3	3	3.43	.671
The potential benefits to incorporating virtual reality technology into my classroom outweigh the potential costs of the technology.	20.0	**52.2**	27.8	3	3	3.08	.782
My student treat / would treat virtual reality training as a game or gimmick rather than as an actual teaching tool.	28.9	**42.2**	28.8	3	3	3.01	.906
My administration would support me in funding virtual reality technology for my program.	22.2	**52.2**	25.6	3	3	2.98	.807
Virtual reality technology is more of a gimmick or a game than an actual teaching tool.	**54.4**	32.2	14.4	2	2	2.58	.887
Virtual reality technology is only useful for psychomotor skill development.	43.3	**53.3**	3.3	3	3	2.57	.619
My teaching methods / strategies would not benefit from the use of virtual reality technology.	**53.3**	32.3	15.1	2	2	2.57	.875

Note. Scale: 1 = *strongly disagree* (SD); 2 = *disagree* (D); 3 = *unsure* (U); 4 = *agree* (A); 5 = *strongly agree*; *Mdn* = Median; *Md* = Mode; *M* = Mean; *SD* = Standard deviation. Following the statistical analysis, strongly disagree and disagree were collapsed into the disagree column and strongly agree and agree were collapsed into the agree column.

Data regarding the teachers' opinions about the importance to consider adding VR technology in SBAE programs are reported in Table 6. The greatest frequency of teachers (*f* = 43; 47.8%) reported it was *slightly important* teachers consider adding VR technology as an instructional component in their programs.

Table 6

SBAE Teachers' Opinions About the Importance to Consider Adding VR Technology in SBAE Programs

Item	Not Important *f* (%)	Slightly Important *f* (%)	Moderately Important *f* (%)	Very Important *f* (%)
How important is it for teachers to consider adding virtual reality technology as an instructional component within their agricultural education programs?	8(8.9)	**43(47.8)**	32(35.6)	7(7.8)

Data regarding teachers' opinions about the quality of VR technology over time are reported in Table 7. The greatest frequency of teachers (*f* = 78; 86.7%) reported the quality of VR technology has *improved* over the last five years.

Table 7

SBAE Teachers' Opinions About the Quality of VR Technology Over Time

Item	Declined *f* (%)	Neither Declined nor Improved *f* (%)	Improved *f* (%)
The quality of virtual reality technology has _________ over the last five years.	0(0.0)	12(13.3)	**78(86.7)**

Data regarding teachers' opinions about their future plans to implement VR technology are reported in Table 8. The greatest frequency of teachers (*f* = 51; 56.7%) reported they *possibly* plan to implement VR technology within their classrooms in the near future.

Table 8

SBAE Teachers' Opinions About Future Plans to Implement VR Technology

Item	Definitely Not *f* (%)	Probably Not *f* (%)	Possibly *f* (%)	Probably *f* (%)	Definitely *f* (%)
I plan to implement virtual reality technologies within my classroom in the near future.	3(3.3)	21(23.3)	**51(56.7)**	9(10.0)	6(6.7)

Data regarding teachers' perceived frequency of incorporating new and emerging instructional technologies in their classrooms are reported in Table 9. The greatest frequency of teachers (*f* = 52; 57.8%) reported they *occasionally* incorporated new and emerging technologies in their classrooms.

Table 9

SBAE Teachers' Perceived Frequency of Incorporating New and Emerging Instructional Technologies

Item	Never *f* (%)	Rarely *f* (%)	Occasionally *f* (%)	Frequently *f* (%)	Very Frequently *f* (%)
How frequently do you incorporate new and emerging instructional technologies in your classroom?	1(1.1)	2(2.2)	**52(57.8)**	29(32.2)	6(6.7)

Conclusions, Discussion, Recommendations, & Implications

The findings of our study indicated Iowa SBAE teachers did, for the most part, view VR technology in a favorable light. Echoing Alston et al.'s (2003) findings, there was a considerable degree of uncertainty about the topic. Many teachers believed they were familiar with VR technology, held positive opinions about the topic, and were receptive to possibly implementing VR technology into their SBAE programs. Most teachers opined VR technology quality had improved over recent years and they perceived they regularly incorporated new and emerging instructional technologies within their SBAE programs. Many teachers indicated they believed their students could be effectively engaged in the learning process by using VR technology as an instructional medium and VR technology could positively impact their SBAE programs. Many teachers indicated they believed VR technology was a valuable and useful instructional approach that could be used for a wide range of purposes and settings in SBAE.

While most teachers indicated VR technology is useful for psychomotor skill development, many teachers were also uncertain about whether VR technology could be useful beyond just teaching psychomotor skill-oriented content and whether the technology's usage for psychomotor skill development will increase. Though many teachers did express they had positive prior experiences with VR technology, they also believed VR technology was too costly for them to acquire and implement into their respective SBAE programs, thus indicating the financial burden of acquiring VR technology is a primary barrier. The cost of technology applications has been identified as a barrier to adoption by other researchers (Alston et al., 2003; Coley et al., 2015; Williams et al., 2014b).

Williams et al. (2014b) noted SBAE teachers are generally supportive of incorporating educational technologies into their programs, which echoed the sentiments we found about VR technology. Anderson and Williams (2012) noted teachers often have favorable attitudes toward using different types of technologies for educational purposes. Considering these ideas along with the results of the present study, we anticipate VR technology adoption may begin to increase as VR technology application diversity increases, becomes more affordable, and increases in relevance. Bailenson (2018) predicted these factors will soon begin to happen more rapidly.

When viewed through the lens our adapted version of Fishbein and Ajzen's (2010) reasoned action model, we focused specifically on how intentions and behaviors can be shaped and informed by a variety of factors, such as prior experiences, personal beliefs, and so forth. Through examining SBAE teachers' opinions about VR technology, we believed opinions could very well influence intentions and use of VR technology. As noted by Fishbein and Ajzen (2010), human behaviors are complex processes developed through numerous contexts and lenses. Based on the findings of our study, we believe while teachers held mostly positive opinions about the topic, the considerable degree of uncertainty they exhibited may yield a mixture of resulting behaviors regarding VR technology adoption and use. Individual opinions about a topic are a background factor impacting a behavior (Fishbein & Ajzen, 2010). Understanding what those opinions are can be useful to identifying courses of action agricultural teacher educators, SBAE teachers, and hardware and software developers should take when working to develop and implement VR technology.

We recommend SBAE teachers engage in professional development opportunities in which VR technology is being used to help increase exposure and generate ideas for applying the technology in their programs. Teachers who are interested in using VR technology in their own programs should consider pursuing grants funds from educational foundations and community organizations. SBAE teachers who wish to use VR technology in their programs should also consider using funding from the Carl D. Perkins Career and Technical Education Act to facilitate VR technology purchases.

We also recommend teacher educators with interests in educational technology work to develop their own knowledge and skills related to VR technology applications in SBAE settings. Doing so will help to facilitate the further inclusion of opportunities for education about the subject for preservice teachers via coursework and for inservice teachers via professional development opportunities. In terms of using VR technology in teacher education coursework, teacher educators could consider developing learning experiences employing the technology in various ways. For example, an agricultural teacher educator who teaches an undergraduate-level agricultural mechanics course including weld process training could employ a VR welding system to help preservice teachers develop their welding-related psychomotor skills and expose them to a VR technology application that could be very practical for SBAE programs. The same agricultural teacher educator may continue this approach in a weld process training professional development session for inservice teachers. Funding to support such opportunities could come from a variety of sources, including university technology acquisition funds, private donors, and industry-based support.

We recommend additional exploration of this topic be conducted with other groups of SBAE teachers from across the United States. Doing so will help the profession to develop a deeper understanding of SBAE teachers' opinions about VR technology. While we imagine much of this research would be of a quantitative nature, the value of qualitative research should not be understated either. Qualitative inquiry studying SBAE teachers who currently implement VR technology in their programs could help to provide a more in-depth examination of the specific VR technology applications teachers are using as well as exactly how they are being used for educational purposes. As noted by Bailenson (2018), the possibilities for VR technology application development and implementation are practically endless and new opportunities for expansion are regularly being identified. Qualitative and quantitative inquiry could also be used to examine the impacts using VR technology as an instructional tool has on students.

Regarding our study's implementation, our response rate of 33.9% left us with some questions. As we followed Dillman et al.'s (2014) methods for implementing Internet-based survey research, we wondered what factors may have contributed to the lack of response from the broader population of 265 SBAE teachers throughout Iowa. Perhaps SBAE teachers' lack of interest in the topic, teachers' workloads with FFA activities, or other obligations may have negatively impacted our response rate. It is also conceivable that non-responding teachers may have been unfamiliar with the topic and thus felt their contributions to the study's data set would have been minimal. We found non-response error was not an issue and we can generalize our results to all Iowa SBAE teachers in accordance with Ary et al. (2010). However, we acknowledge that we cannot generalize our results beyond Iowa SBAE teachers.

As the SBAE teachers in our study opined the cost of VR technology is too great, this may be a barrier currently limiting the adoption of VR technology. Future studies to identify additional barriers and decision-making factors regarding VR technology adoption and use should be conducted. While barriers to educational technology usage by SBAE teachers do exist (Coley et al., 2015), technology adoption and use must be emphasized to help maintain effective instruction within SBAE programs (Kotrlki et al., 2003). Failure to effectively implement educational technologies could compromise opportunities to provide adequate educational experiences within technical agriculture content (Kotrlik et al., 2003).

We recommend future studies expand and include educational technologies beyond VR, such as augmented reality (AR) and mixed reality (MR), to build upon the educational technology literature. As the rate of technological change continues to increase each year (Bailenson, 2018), it is vital the agricultural education profession remains able to keep pace with new developments. Educational technologies can serve to assist with better educating the public at large as well as students in all types of agricultural education settings and should be better understood to maximize their utility (Lindner et al., 2016).

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