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Educators' Perceptions of and Intent to Use VR to Teach International Agriculture Topics in SBAE Before and After a PD

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Abstract

This study examined school-based agricultural education (SBAE) teachers' perceptions of and intent to use virtual reality (VR) to teach international agriculture topics before and after participation in a five-day professional development workshop. Guided by the Theory of Planned Behavior, the study administered pre- and post-surveys to 27 SBAE teachers from two United States (U.S.) states to assess confidence, attitudes, subjective norms, perceived behavioral control, intention, and global competence indicators. Findings indicated participants maintained highly positive attitudes and strong intent to use VR both before and after the workshop, while perceived preparedness to integrate VR improved notably following training. However, confidence to teach international agriculture and broader global engagement remained relatively stable, suggesting that technical VR training alone may not substantially strengthen teachers' global instructional readiness. Results highlight VR's potential as an accessible tool for expanding international agricultural education while emphasizing the need for sustained professional development, stronger curricular integration, and enhanced development of global competence. Recommendations include combining immersive technology training with deeper international agriculture content and institutional support to improve long-term implementation

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Introduction and Problem Statement

Society's increasing global interconnectedness has increased demand for globally aware school-based agricultural education (SBAE) students (Pigg et al., 2022). Chieffo and Griffiths (2004) defined global awareness as "intercultural awareness, personal growth and development, awareness of global interdependence, and functional knowledge of world geography and language" (p. 167). Often referred to as global competence, this skill is considered essential for the modern workforce (Tichnor-Wagner, 2021). Despite this need, international topics remain limited in U.S. secondary agricultural education, and no national SBAE curriculum for international agriculture currently exists (Heinert et al., 2020). However, prior studies consistently support the need for internationalized agricultural curricula (Conner et al., 2017; Ibezim & McCracken, 1994).

Ibezim and McCracken (1994) found that SBAE teachers believed an internationalized curriculum better prepares students for global careers and broadens interest in agricultural education, while also calling for further curriculum development and testing. More recent studies have focused primarily on student perceptions. Heinert et al. (2020) found that students held positive attitudes toward international agricultural concepts but identified a need for stronger foundational knowledge. Similarly, Conner et al. (2017) reported that students supported international agricultural instruction that emphasized global agricultural relationships and impacts on U.S. agriculture.

Virtual Reality Technology

Given the identified need for innovative instructional materials (Conner et al., 2017; Heinert et al., 2020; Ibezim & McCracken, 1994), this study evaluated virtual reality (VR) as a tool for teaching international agriculture topics. VR immerses users in 360° images, videos, or interactive experiences through headsets and motion-tracking devices (Belisle & Roquet, 2020). Educational research has supported VR as an engaging instructional tool (Al Breiki et al., 2023; Marks & Thomas, 2021), including within agricultural education for technical and mechanical skill development (Pulley et al., 2024; Wells & Miller, 2020). Pulley et al. (2024) found VR enhanced engagement by providing otherwise inaccessible experiences, while Wells and Miller (2020) reported generally favorable but cautious teacher perceptions. VR was selected because its immersive capabilities can provide learners with experiential access to international agricultural settings, practices, and perspectives that may be difficult to encounter firsthand because of geographic, financial, or logistical barriers (Greig et al, 2024). Compared with text-based and two-dimensional media, VR can create a stronger sense of presence and allow learners to explore distant environments from multiple perspectives.

Theoretical and Conceptual Framework

Ajzen's (1991) theory of planned behavior (TPB) guided this study in examining the Agriscience Metaverse Academy (AMA) participants' intentions to use VR to teach international agricultural concepts following completion of the AMA. TPB posits that attitude, subjective norms, and

perceived behavioral control shape behavioral intent, which predicts readiness to perform a behavior. Attitude reflects favorable or unfavorable evaluations, subjective norms represent perceived social pressures, and perceived behavioral control refers to the perceived ease or difficulty of performing the behavior, based on prior experiences and anticipated barriers.

TPB is widely used to predict technology adoption and instructional decision-making in education (Al Breiki et al., 2023; Teo et al., 2016), including VR adoption. Al Breiki et al. (2023) applied TPB alongside Rogers's (2003) diffusion of innovations theory (DOI) and found that attitude, subjective norms, and perceived behavioral control significantly influenced science teachers' behavioral intentions to adopt VR.

To better contextualize participants' readiness to teach international agriculture, this study also examined global awareness and global engagement using adapted measures from Chieffo and Griffiths (2004). Global awareness reflects participants' self-perceived understanding of global systems, intercultural issues, and international relationships, while global engagement captures the frequency of participants' involvement in globally oriented behaviors and information consumption. Within the Theory of Planned Behavior (TPB), these constructs were treated as background factors that may inform the beliefs underlying attitudes, perceived behavioral control, and intentions rather than as additional components of the model. Teachers with greater global awareness or engagement may, for example, perceive international agriculture as more relevant, feel more prepared to teach it, or recognize fewer barriers to its inclusion. However, the study did not test global awareness or engagement as predictors or moderators of the TPB constructs; they were included to provide descriptive context for interpreting participants' readiness and responses to the professional development experience. Global experience, including prior travel or study abroad, and current teaching of international topics were also measured to further describe participants' international exposure and instructional background.

Study Context

Agriscience Metaverse Academy (AMA)

This study involved SBAE teachers from Tennessee (*n* = 19) and Nebraska (*n* = 9) who participated in the AMA, a five-day VR integration professional development workshop held in summer 2024. Participants learned headset operation, educational VR content identification, 360° content creation, and engaged in two Immersive Metaverse Experiences (IMEs). Funded by a USDA Professional Development for Agricultural Literacy grant, the PD aimed to prepare teachers to use VR for agricultural literacy and career exploration. Participants also received classroom equipment, including headsets, headphones, and a 360° camera.

One IME featured an international agricultural lesson using three 360° videos filmed in Cambodia during a study abroad experience. Developed by agricultural education and communications faculty, with support from graduate students, the lesson exposed participants to international agricultural systems and incorporated guided reflection. Learning objectives focused on understanding international agricultural systems, comparing them to U.S. systems, and designing agritourism experiences for international audiences. Participants received

classroom-ready materials and completed pre- and post-surveys measuring confidence, perceived behavioral control, attitude, subjective norms, and intent to use VR for teaching international agriculture topics

Purpose

The purpose of this study was to describe AMA participants and their intent to use VR to integrate international agriculture topics. The following objectives guided this study:

1. Describe AMA participants' demographics and global experience, awareness, and engagement.
2. Describe AMA participants' confidence to integrate international agriculture concepts into their curriculum before and after participation in the AMA.
3. Describe AMA participants' perceived behavioral control, attitude, subjective norms, and intent toward using virtual reality to integrate international agriculture concepts into their curriculum before and after participation in the AMA.

Methods

A Qualtrics survey adapted from Harmon (2023) was distributed to AMA participants before the IME international lesson and after the PD to fulfill the purpose of this study (IRB #UTK IRB-23-07752-XP). Pre and post-surveys assessed participants' confidence, attitude, perceived behavioral control, subjective norms, and intent to use VR to teach international agriculture topics. The post-survey also included questions adapted from Chieffo and Griffiths (2004) measuring participants' global awareness, global engagement, and prior experience with international travel and teaching international topics.

The instrument included adapted items from previously validated TPB scales (Harmon, 2023). Harmon's study examined the impact of a PD on SBAE teachers' intent to use inquiry-based learning. Adaptations modified contextual wording without altering the conceptual structure. Two faculty experts in agricultural education and technology integration reviewed construct alignment with the PD context. Internal consistency was examined post hoc using Cronbach's alpha. Reliability was acceptable for confidence (pre $\alpha = 0.84$; post $\alpha = 0.92$), attitude (pre $\alpha = 0.82$; post $\alpha = 0.92$), subjective norms (pre $\alpha = 0.73$; post $\alpha = 0.80$), and behavioral intention (pre $\alpha = 0.82$; post $\alpha = 0.78$). These values were generally comparable to those reported by Harmon et al. (2023). However, perceived behavioral control demonstrated substantially lower reliability (pre $\alpha = 0.08$; post $\alpha = 0.18$) than reported by Harmon et al. Consequently, perceived behavioral control was not analyzed as a composite construct, and its items were reported individually. Factor analysis was not conducted because the small sample size ($n = 27$) was insufficient to produce a reliable assessment of the measures' factor structure. Thus, although the alpha coefficients provide evidence of internal consistency, the unidimensionality of the measures was not independently confirmed.

Response scales were retained from the original instrument to preserve consistency with the previously validated measures and facilitate comparison with earlier findings. The even-numbered format required participants to indicate whether their perceptions leaned in a positive or negative direction and reduced the possibility of selecting the midpoint as a default response. However, removing a neutral response option may have required participants with genuinely neutral or uncertain perceptions to select a response that did not fully represent their views. This forced-choice format may therefore have introduced measurement error or slightly overstated the direction of participants' perceptions.

Confidence was measured using a 4-item, 6-point Likert-type scale ranging from 1 = strongly disagree to 6 = strongly agree. Participants responded to statements regarding their confidence in teaching international agriculture concepts and global awareness skills before and after the PD. Mean scores were used to create pre-confidence (Cronbach's $\alpha = 0.84$) and post-confidence (Cronbach's $\alpha = 0.92$) constructs. Real limits following Sheskin (2004) were applied for interpretation: 1.00–1.49 = strongly disagree, 1.50–2.49 = disagree, 2.50–3.49 = slightly disagree, 3.50–4.49 = slightly agree, 4.50–5.49 = agree, and 5.50–6.00 = strongly agree.

Perceived behavioral control was measured using a 4-item, 6-point Likert-type scale with identical labels. Participants reported their perceived control over the use of VR to teach international agriculture concepts and global awareness skills before and after the PD. Reliability for the pre-survey (Cronbach's $\alpha = 0.08$) and post-survey (Cronbach's $\alpha = 0.18$) was unacceptably low, possibly because the items captured distinct dimensions of perceived control, including personal capability and external constraints. Although adapted from an existing instrument, the scale's construct and content validity were not independently assessed in this context. Therefore, averaged constructs were excluded from further analysis, and individual item responses were reported instead to ensure transparency. Future research should refine this scale to improve internal consistency.

Attitude was measured using an 8-item, 6-point bipolar semantic differential scale assessing perceptions of using VR to integrate international agriculture topics. Participants completed the prompt, "I believe using VR to integrate international agriculture topics into my classroom is..." using adjective pairs such as bad/good, negative/positive, and trivial/crucial. Items were coded so that negative responses equaled 1 and positive responses equaled 6. Mean scores created the pre-attitude (Cronbach's $\alpha = 0.82$) and post-attitude (Cronbach's $\alpha = 0.92$) constructs. Although the larger number of items may have contributed to these coefficients, an alpha-if-item-deleted analysis was not conducted. Real limits ranged from 1.00–1.49 = strongly negative to 5.50–6.00 = strongly positive.

Subjective norms were measured using a 6-item, 6-point Likert-type scale. Participants indicated agreement with statements regarding social and institutional influences on VR integration, such as administrative encouragement and state learning standards. Mean scores created pre-subjective norms (Cronbach's $\alpha = 0.73$) and post-subjective norms (Cronbach's $\alpha = 0.80$) constructs. Real limits matched those used for confidence.

Intent to use VR to teach international agriculture topics was measured using a 3-item, 6-point Likert-type scale ranging from 1 = extremely unlikely to 6 = extremely likely. Participants responded to prompts regarding their likelihood of using VR in instruction. The construct was created using averaged item scores (pre-intent: Cronbach's $\alpha = 0.82$; post-intent: Cronbach's $\alpha = 0.78$). Real limits ranged from 1.00–1.49 = extremely unlikely to 5.50–6.00 = extremely likely.

The post-survey also measured participants' global experience, global awareness, and global engagement, as well as whether they currently taught international topics. Adapted items from Chieffo and Griffiths (2004) were used to assess global awareness and engagement, with minor revisions to reflect technological advancements. Global experience and prior travel or study abroad experience were measured using singular items.

Global awareness was measured using a 7-item, 6-point Likert-type scale (Cronbach's $\alpha = 0.85$), with real limits matching those of confidence. Global engagement was measured using a 10-item, 5-point Likert-type scale assessing weekly participation in globally oriented activities, ranging from 1 = never to 5 = 5 or more times a week (Cronbach's $\alpha = 0.89$). Real limits ranged from 1.00–1.49 = never to 4.50–5.00 = 5 or more times a week. Current teaching of international topics was assessed with a singular yes/no item.

Pre and post-survey responses were exported from Qualtrics to SPSS version 29 for analysis. Descriptive statistics were used for all study objectives. Frequencies were reported for individual items, except attitude items, for which means and standard deviations were used. Means and standard deviations were also reported for each valid construct.

Limitations

This study is limited by its focus on a specific population of SBAE teachers who participated in the AMA in 2024. Because the PD was designed for a defined group of educators in two states, the sample was not intended to be representative of all SBAE teachers, and the findings should not be generalized beyond this context. The study relied on self-reported data, which may be influenced by social desirability bias or participants' interpretations of survey items. Additionally, the small, purposively defined sample limited statistical power and broader population-level inference; therefore, analyses remained descriptive and aligned with the study's exploratory objectives. The low reliability of the perceived behavioral control scale limits the interpretability of its items. Despite these constraints, the study provides valuable insights into teachers' perceptions and intentions regarding the use of VR to teach international agriculture topics and offers a foundation for future research and PD design in similar educational settings.

Findings

Objective 1: Describe AMA participants' demographics and global experience, awareness, and engagement.

A total of 28 SBAE teachers from Tennessee (*n* = 19) and Nebraska (*n* = 9) voluntarily participated in the AMA; however, one participant did not complete the post-survey and was removed from data analysis. Therefore, 27 participants were included in the study (96.4% participation rate). Among these participants, nine self-identified as male and 18 as female. All participants self-identified as white, and none identified as Hispanic or of Spanish-speaking descent. Participants had a mean age of 33.3 (*SD* = 9.7), ranging from 21 to 51 years old. Teaching experience ranged from 1 to 27 years. As shown in Table 1, participants' teaching experience was categorized by career stage (Huberman, 1989): novice (0 to 5 years), mid-stage (6 to 15 years), and late stage (16 or more years). Most participants (77.7%) were in the novice or mid-career stages.

Table 1

Participant Career Stages (n = 27)

Career Stages	*%*
Novice	44.4
Mid	33.3
Late	22.2

To better understand participants' backgrounds, the post-survey assessed global experience, awareness, and engagement. Prior global experience was measured by the number of times participants had traveled or studied abroad since age 18. Prior international exposure was measured broadly by the number of times participants had traveled or studied abroad since age 18. The broad wording was intended to capture the prevalence of any international travel among participants rather than the purpose, duration, or cultural depth of those experiences. Consequently, these responses should be interpreted only as frequency of international exposure and not as a measure of intercultural engagement or competence. Participants reported: never (37.0%), 1–2 times (37.0%), 3–5 times (14.8%), 6–8 times (3.7%), and more than 8 times (7.4%). Thus, most participants (74.0%) had either never traveled abroad or had done so only once or twice, while only 11.1% had traveled or studied abroad six or more times. Participants were also asked whether they currently taught international agriculture concepts; 70.4% reported that they did, while 29.6% did not.

Regarding global awareness, most participants agreed or strongly agreed that they wanted to learn more about world geography (70.4%) and that they were patient with individuals in the United States who do not speak English well (77.8%). However, only 7.4% reported being comfortable with their understanding of U.S. trade relations with at least one other country. The global awareness construct mean was 4.16 (*SD* = 0.98), indicating participants slightly agreed they were globally aware.

Global engagement levels were lower. Only one-fourth (29.6%) of participants reported consciously withholding judgment on controversial international events until learning more facts. Most participants (77.7%) reported watching or reading non-American media sources less than once a week or never. The global engagement construct mean was 2.61 (*SD* = 0.69), indicating participants engaged in global activities only once or twice per week on average.

Objective 2: Describe AMA participants' confidence to integrate international agriculture concepts into their curriculum before and after participation in a VR professional development workshop.

Almost half (44.4%) of the participants agreed or strongly agreed in the pre-survey that they felt comfortable in their own global awareness. However, only one-fourth (25.9%) of the participants agreed, and none (0%) strongly agreed that they felt comfortable with their knowledge of international agriculture. The construct mean for confidence in the pre-survey was 4.16 (*SD* = 0.69), indicating that participants slightly agreed they were confident in their ability to integrate international agricultural concepts into their curriculum.

In the post-survey, almost half (44.4%) of the participants agreed or strongly agreed that they were able to teach global awareness concepts. Additionally, 44.4% of participants agreed or strongly agreed that they feel confident that they could teach global awareness through international agriculture topics in their classrooms. The construct mean for confidence in the post-survey was 4.21 (*SD* = 0.96), indicating that participants slightly agreed they were confident in their ability to integrate international agricultural concepts into their curriculum.

Objective 3: Describe AMA participants' perceived behavioral control, attitude, subjective norms, and intent toward using virtual reality to integrate international agriculture concepts into their curriculum before and after a VR professional development workshop.

In the pre-survey, 63.0% of participants agreed or strongly agreed that they would have enough time during the semester to use VR to teach international agriculture topics. Additionally, 63.0% disagreed or strongly disagreed that integrating VR for international agriculture would inhibit teaching state standards. No participants strongly agreed that they felt equipped to integrate VR for this purpose.

In the post-survey, 66.6% of participants agreed or strongly agreed that they felt equipped with the knowledge and skills necessary to successfully integrate VR to teach international agriculture topics, and the same percentage agreed they would have sufficient time during the semester. Nearly half (48.1%) disagreed or strongly disagreed that VR integration would inhibit teaching state standards. Compared to the pre-survey, a substantially greater percentage of participants agreed or strongly agreed that they felt equipped to integrate VR (post-survey = 81.4%; pre-survey = 11.1%). Slight increases were also observed in perceptions of available time (post-survey = 66.7%; pre-survey = 63.0%), while fewer participants in the post-survey disagreed that VR would inhibit state standards (post-survey = 48.1%; pre-survey = 62.9%).

Participants' attitudes were assessed using the prompt, "I believe using VR to integrate international agriculture topics into my classroom is..." Overall, participants held highly favorable attitudes before and after the PD. For example, participants rated VR integration as more good than bad in both the pre-survey (*M* = 5.67; *SD* = 0.48) and post-survey (*M* = 5.78; *SD* = 0.51), with similarly positive responses for the positive/negative scale. The not beneficial/beneficial item showed the least change between pre-survey (*M* = 5.48; *SD* = 1.01) and post-survey (*M* = 5.59; *SD* = 0.75). The overall attitude construct mean increased from 5.14 (*SD* = 0.62), indicating positive attitudes, to 5.51 (*SD* = 0.57), indicating strongly positive attitudes toward using VR to integrate international agriculture topics.

Subjective norms remained moderate across both surveys. In the pre-survey, 40.7% of participants agreed or strongly agreed that important individuals in their lives wanted them to use VR to integrate international agriculture topics, while 29.6% agreed or strongly agreed that their school administration encouraged them to increase their knowledge of VR integration. In the post-survey, these percentages increased slightly to 37.0% for administrative encouragement and 37.0% for perceived social support. Additionally, 40.7% of participants agreed that educational legislation influenced their motivation to use VR in the post-survey, compared to 14.8% in the pre-survey. The subjective norms construct mean increased slightly from 3.82 (*SD* = 0.67) to 3.97 (*SD* = 0.83), indicating participants slightly agreed that subjective norms influenced their VR integration decisions.

Participants reported consistently strong intent to use VR for teaching international agriculture topics. In the pre-survey, 81.4% indicated they were likely or extremely likely to use VR 360° videos and VR content related to international topics, while 88.9% reported likely or extremely likely intent to use the IME lesson's 360° videos. Additionally, 81.5% indicated intent to integrate international agriculture concepts into their curriculum. In the post-survey, all participants (100.0%) indicated they were at least somewhat likely to integrate international agricultural concepts, use 360° VR videos, and implement IME lesson materials. Despite this, overall intent remained stable, with a pre-survey construct mean of 5.17 (*SD* = 0.62) and a post-survey mean of 5.11 (*SD* = 0.62), indicating participants were likely to use VR to incorporate international agriculture concepts both before and after the PD.

Conclusions, Discussion, and Recommendations

This study examined how SBAE teachers perceived their ability and willingness to use virtual reality (VR) to teach international agriculture topics following participation in the AMA. For agricultural development stakeholders, these findings provide insight into how immersive technologies may support broader efforts to strengthen global agricultural literacy, workforce preparedness, and educational innovation.

Although most constructs showed only modest pre- to post-survey movement, this pattern aligns with prior research on short-duration professional development and technology adoption (Amemasor et al., 2025). Introductory, skill-focused PD often produces limited immediate

changes because educators require sustained opportunities for practice, reflection, and classroom implementation before deeper shifts in beliefs or instructional behaviors emerge (Desimone & Garet, 2015). In this study, the post-survey was administered immediately following the PD, before participants had an opportunity to implement VR-supported international agriculture lessons. Therefore, the findings reflect participants' self-reported perceptions and intentions immediately after the experience rather than changes in instructional practice. The observed differences cannot be attributed solely to the PD, nor do they demonstrate sustained instructional change. Future research should incorporate follow-up data to examine classroom implementation and the potential value of continued support.

Participants demonstrated modest global awareness and relatively low weekly global engagement despite many reporting some prior international travel. These findings reinforce longstanding concerns that agricultural educators may possess limited functional global knowledge even when they recognize the importance of preparing students for an interconnected agricultural economy (Ibezim & McCracken, 1994). For agricultural development systems increasingly dependent on globally competent producers, communicators, and educators, this gap is particularly relevant. Teachers may be willing to introduce international topics, but limited global engagement may constrain the depth and breadth of instruction. This highlights the importance of strengthening educators' global competence alongside technological innovation if agricultural education is to effectively prepare future agricultural professionals for international markets, trade systems, and development challenges.

Participants' confidence in teaching international agriculture concepts remained relatively stable, likely because the PD focused primarily on VR integration rather than on intensive development of global agriculture content. However, the immersive international lesson provided through the Cambodia-based IME offered a practical example of how VR can expose teachers and students to otherwise inaccessible agricultural systems. This supports prior work suggesting that immersive experiences may help address barriers to global agricultural education by expanding access to international perspectives without requiring costly travel (Conner et al., 2017). For agricultural development audiences, this finding is particularly significant, as VR may serve as a scalable mechanism for exposing learners to agricultural systems, development challenges, and production practices across diverse global contexts.

Regarding the TPB constructs, participants reported consistently positive attitudes toward VR, indicating receptiveness to its potential as an instructional tool. Perceived behavioral control could not be evaluated as a composite construct because of the scale's low reliability and unconfirmed factor structure. Although responses to individual control-related items were generally more favorable following the PD, these patterns should not be interpreted as evidence of improvement in the broader perceived behavioral control construct or attributed solely to the PD. Subjective norms remained relatively weak, likely reflecting the absence of strong institutional or curricular expectations surrounding either VR implementation or international agricultural education. This lack of systemic support may help explain why teachers' intentions to use VR remained largely stable despite increased preparedness. For

agricultural development practitioners and policymakers, this finding underscores that technology adoption is not solely a matter of educator willingness or technical skill. Broader institutional structures, curriculum standards, and policy incentives are likely necessary to fully integrate global agricultural learning into formal educational systems.

Collectively, these findings indicate that participating teachers viewed VR positively and expressed interest in using it to teach international agriculture topics. Although the study did not measure student learning or classroom implementation, these perceptions support further investigation of VR as a potential tool for international agriculture instruction. However, successful implementation likely requires a more comprehensive agricultural development strategy that includes: (a) sustained teacher professional development, (b) stronger curricular integration of international agricultural concepts, (c) administrative and policy support, and (d) continued efforts to build educators' own global competence.

For practice, the participating teachers' positive attitudes and reported intentions support continued, small-scale exploration of VR in SBAE international agriculture instruction. Any implementation should include evaluation of classroom use and student learning because this study did not assess those outcomes. Future PD may also integrate technical training with curriculum planning and provide follow-up support, while research examines whether these approaches influence educators' instructional readiness and practice.

For research, additional studies should examine how global awareness, global engagement, and institutional support interact to influence long-term VR adoption in agricultural education. Longitudinal studies tracking classroom implementation are especially needed to determine whether increased technical readiness translates into sustained instructional practice. Further investigation across more diverse populations and educational systems will also help determine whether these findings extend beyond this specific PD cohort. Research exploring VR applications for broader agricultural development topics, including food security, sustainability, climate adaptation, and cross-cultural agricultural systems, may further strengthen understanding of how immersive technologies can help prepare globally competent agricultural professionals.

Overall, this study suggests that VR-supported professional development may serve as a valuable entry point for expanding international agricultural education, but its broader impact on agricultural development will depend on sustained systemic support, stronger global competency development, and strategic curricular integration.

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