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Research Article

APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN AGRICULTURAL TRAINING IN SWITZERLAND

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Abstract

Virtual reality (VR) technology has shown great potential in various sectors, including the agricultural sector which requires practical training. This study aims to evaluate the effectiveness of VR technology in improving the skills of farmers in Switzerland through agricultural training. This study uses a quasi-experimental method by comparing the group that uses VR training and the control group that uses conventional methods. The results showed that participants who took part in VR-based training had significant skill improvements and higher levels of satisfaction compared to traditional methods. Despite the challenges of early adaptation to VR technology, participants generally found the learning experience to be more interactive and effective. The conclusion of this study states that VR can be an effective tool in developing farmers' technical skills in a safer, more flexible, and interactive way. More research is needed to explore the long-term use of VR in agricultural training.

Keywords: Virtual reality, agricultural training, skills

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INTRODUCTION

Virtual reality (VR) technology has become one of the fastest-growing technological innovations in various sectors, including agriculture (Benjamin et al., 2024). The use of VR allows for the creation of simulated environments that are close to reality, so that users can experience a very realistic experience without having to be physically present at the location (Rogger et al., 2024). In the context of agriculture, VR provides opportunities for more interactive and practical training for farmers and agricultural workers (Ozal et al., 2024). Thus, VR can overcome the limitations of conventional training which may require a lot of time and resources.

Agriculture is a very important sector for the economies of many countries, including Switzerland, where this sector not only provides food sources, but also supports environmental sustainability (Guilin et al., 2024). However, the sector also faces various challenges, such as climate change, declining soil quality, and the need to improve production efficiency (Marquez et al., 2026). To overcome this challenge, agricultural workers need to receive comprehensive training and in accordance with the latest technological developments (Derk et al., 2024). VR is here as a solution to provide more effective and efficient training.

VR in agricultural training allows farmers to learn about best practices without having to face real risks in the field (Sepehrzad et al., 2026). This technology provides the opportunity to simulate various agricultural scenarios, such as the use of heavy equipment, crop management, or pest management, which typically require specialized skills and field experience (Majidi Nezhad et al., 2025). With VR, training can be tailored to specific conditions and repeated many times without significant time limitations or additional costs.

In addition to improving technical skills, VR can also be used to introduce sustainable agriculture concepts (Shamshiri et al., 2024). Farmers can learn about the importance of crop rotation, water management, and other environmentally friendly practices through interactive and easy-to-understand simulations (Ding et al., 2026). This can raise awareness about the importance of sustainability in agricultural practices, while providing tangible solutions that can be implemented in the field.

The use of VR in agricultural training in Switzerland is becoming increasingly relevant considering that the country is known for its advanced and sustainable agricultural systems (Dernat et al., 2025). Nonetheless, the adoption of VR technology in agricultural training is still relatively new and requires further research to understand its impact on training effectiveness and agricultural productivity (Sheffield et al., 2025). With adequate research, VR has the potential to revolutionize the way agricultural training is conducted in Switzerland and other countries.

A deeper understanding of how VR technology can be integrated into agricultural training is an important step to ensure the sustainability of the sector in the future (Masyhur et al., 2024). This technology not only offers innovative solutions for training, but also provides opportunities for agriculture to develop more efficiently and sustainably.

The use of virtual reality (VR) technology in agricultural training is still relatively new and has not been widely applied in this sector, especially in Switzerland (Zyoud & Zyoud, 2025). Although the potential of VR in improving training effectiveness has been widely discussed in various sectors, there is still little in-depth research on how this technology can be optimally adapted in the context of agriculture (Liu et al., 2025). This limitation creates a knowledge gap regarding the best method to integrate VR in the agricultural training curriculum.

The lack of empirical data related to the direct impact of VR on farmers' productivity after participating in VR-based training is also one of the gaps that need to be filled (Rebello et al., 2024). It is not known for sure whether the simulation experience produced by VR is able to provide training results equal or even better than conventional training methods. In addition, technological adaptation by agricultural workers, especially those who are not familiar with digital technology, is still not fully understood.

The lack of specific guidance on how VR technology can be implemented in various agricultural sub-sectors is also a challenge (Thom et al., 2025). Agricultural training involves aspects such as agronomy, machine use, resource management, and sustainability, all of which may require different VR approaches (Abbas et al., 2025). Until now, research related to VR adaptation to meet the specific needs of each of these sub-sectors is still very limited.

Research on the long-term impact of VR use in agricultural training has also not been widely conducted (Cruz-Miranda et al., 2026). How the use of VR can affect daily farming practices, environmental awareness, and the effectiveness of training in the long term is still a big question mark. Filling this gap is necessary to understand the full potential of VR technology in transforming training in the agricultural sector.

Filling this knowledge gap is crucial given the great potential of VR technology to improve more efficient and effective agricultural training (Aliyev et al., 2025). By utilizing VR, training can be carried out more flexibly, both in terms of time and location, so that it can reach more farmers who may have previously had difficulty accessing in-person training in the field (Carvalho & Freunek, 2025). The study aims to identify how VR can be better adapted in the Swiss agricultural environment, as well as the resulting impact of VR-based training.

Understanding more about the short-term and long-term effects of VR training in the agricultural sector will help policymakers and training institutions in designing more effective programs (Bongomin et al., 2025). In addition, this research is also important to explore the extent to which VR can be used to introduce sustainable agricultural practices to farmers, which are currently urgently needed in facing global environmental challenges (Kaur & Bhatia, 2025). Filling this gap could open up new opportunities for innovation in agricultural training in Switzerland.

The results of this research are expected not only to contribute to the development of VR technology in agricultural training, but also to the agricultural education sector globally. Improving farmers' skills through VR has the potential to increase agricultural productivity and farmers' welfare, as well as contribute to the sustainability of the agricultural sector.

RESEARCH METHOD

Research Design

The research design used in this study is a quasi-experimental approach that compares a group receiving training through virtual reality (VR) technology with another group that participates in traditional agricultural training. This design was selected to enable a clear comparison of training outcomes between the experimental and control groups, allowing the study to evaluate the impact of VR on improving participants' skills and understanding of technical agricultural practices.

Research Target/Subject

The target subjects of this study consist of farmers in Switzerland who are involved in various agricultural sub-sectors, including agronomy, livestock, and horticulture (Lohan et al., 2025). The sample is selected purposively from this population by considering factors such as

access to VR technology and active participation in agricultural training programs. The final sample is divided into two groups: an experimental group that receives VR-based training and a control group that undergoes conventional training methods.

Research Procedure

The procedure begins with the recruitment of farmers who meet the sampling criteria and the assignment of these participants into experimental and control groups. The experimental group receives training that utilizes VR technology, while the control group participates in traditional training sessions (Alvi et al., 2025). After both forms of training are completed, all participants take an agricultural skills test and complete a questionnaire designed to measure their perceptions and experiences of the training. The resulting data from both groups are then collected and prepared for comparison.

Instruments, and Data Collection Techniques

The instruments used in this study include a questionnaire aimed at measuring participants' perceptions of the training, a specially designed agricultural skills test, and an assessment tool to evaluate the effectiveness of VR-based training (Si-Mohammed et al., 2024). The questionnaire gathers information about users' experiences with VR and their level of satisfaction with the training method, while the skills test assesses how well participants can apply the knowledge gained in agricultural practice. Data are collected through questionnaire completion and post-training skills testing.

Data Analysis Technique

The data obtained from the questionnaires and skills tests are analyzed to determine differences in training outcomes between the experimental group using VR and the control group using conventional methods. The analysis focuses on identifying whether the use of VR leads to improved skills and understanding among participants when compared to traditional training approaches.

RESULTS AND DISCUSSION

The data obtained from this study includes the training results of two groups, namely the experimental group using virtual reality (VR) technology and the control group using conventional training methods. Measurements were made based on agricultural skills tests and questionnaires filled out by the participants. The results of the two groups were then processed using descriptive statistics, which included mean, median, standard deviation, and frequency distribution of each variable measured. The table below shows a summary of the results of each group.

Table 1. A summary of the results of each group

Group	Average Skills Test	Standard Deviation	Maximum Score	Score Minimum
VR Groups	85.6	7.3	98	72
Conventional Group	76.4	8.5	91	65

In addition to the results of the skill test, the results of the questionnaire regarding participants' satisfaction with the training method were also measured. The average satisfaction score of participants in the VR group was higher compared to the control group. This data shows that there is a significant difference between the two training methods in terms of satisfaction and effectiveness felt by the participants.

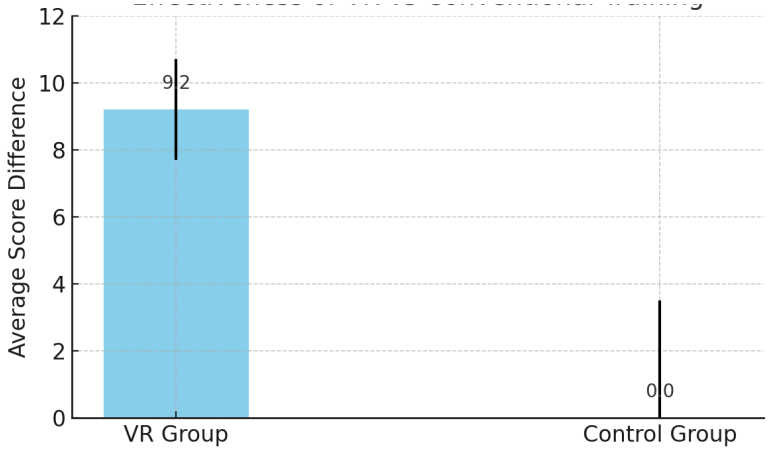

Figure 1. VR vs Cnventional Training

Data from the results of the skill test showed that participants who participated in the training using VR had a higher average score compared to the control group using conventional methods. The average score difference of 9.2 points shows that VR-based training is more effective in improving agricultural skills. The smaller standard deviation in the VR group showed that the participants' learning outcomes were more consistent, while the control group showed greater variation in participants' abilities.

Participant satisfaction data measured through questionnaires also showed that VR technology provides a more interactive and enjoyable training experience than conventional methods. Participants in the VR group reported that they felt more engaged in the simulation and were able to understand the material better. The average satisfaction score of the VR group was at 4.5 on a scale of 5, while the control group only reached 3.8. This shows that the use of VR not only improves technical skills, but also increases motivation and satisfaction in learning.

These findings are in line with previous literature suggesting that the use of immersive technologies such as VR can improve understanding and skills through more real and immersive learning experiences. However, differences in the level of technology adaptation between participants are also an important factor that affects the training results. Participants who were more familiar with the technology tended to show better results compared to participants who were using VR for the first time.

The study also collected data on participants' perceptions of the obstacles and challenges they faced during training. The results showed that participants in the VR group identified several challenges, such as the need for early adaptation to the use of VR devices, as well as potential visual fatigue after long-term use. However, the majority of participants considered that the benefits of VR in training were much greater than the challenges faced.

The control group that used conventional methods reported fewer technical challenges, but they felt that traditional training methods were less able to depict field conditions well. Participants in this group felt that learning through physical media and lectures could not provide an in-depth experience of the agricultural practices they were learning. This shows that although conventional methods are more accessible, they are not as effective as VR in facilitating interactive learning.

The following table summarizes the challenges faced by both groups of participants during the training:

Table 2. Groups of participants during the training

Challenge	VR Group (%)	Conventional Group (%)
Technology Adaptation	25	10
Visual Fatigue	30	5
Lack of Interaction	10	40
Time Restrictions	15	35

These results show that technical challenges in the use of VR do exist, but the benefits obtained are still considered more significant by most participants.

Perceptions of the training challenges revealed that VR groups took longer to adapt to new technologies, especially for participants who were not previously familiar with VR devices. This adaptation became one of the factors that affected the efficiency of training, although in the end, participants who successfully adapted quickly showed a significant improvement in skills. Meanwhile, the control group that used conventional methods relied more on theoretical knowledge and tended to develop less practical skills.

Visual fatigue reported by some VR participants is a concern, especially in longer training sessions. This indicates that the duration of VR use needs to be well regulated to avoid physical discomfort that can interfere with the effectiveness of training. Despite this, VR group participants as a whole still rated their learning experience as positive, with most feeling that the benefits of using this technology outweighed the disadvantages.

The lack of interaction perceived by the control group also suggests that conventional training methods are not always suitable for facilitating discussion and collaboration between participants. This is the reason why many participants feel that training with VR is better at creating a dynamic and participatory learning environment. The use of VR allows participants to interact with simulated agricultural environments directly, which cannot be achieved through traditional methods.

The relationship between the results of the skill test and the level of satisfaction of participants showed a positive correlation between the use of VR technology and the improvement of skills and motivation to learn. Participants who were more involved in VR simulations tended to have better learning outcomes, as seen from the higher average skill test scores. This correlation emphasizes the importance of an interactive learning approach in optimizing training results.

The study also found that technology adaptation plays an important role in determining training outcomes. Participants who adapted faster to VR devices were able to participate in the training more effectively and achieve better results compared to participants who experienced adaptation difficulties. These results show that familiarity with technology is a significant factor in determining the effectiveness of VR-based training.

Higher participant satisfaction in the VR group also reinforced the finding that more interactive and engaging learning methods can increase learning motivation. This motivation in turn has a positive effect on the learning outcomes of participants. This data shows that VR-based training not only provides benefits in terms of technical skills, but can also create a more conducive and motivating learning environment.

One of the case studies taken in this study involved horticultural farmers who participated in VR training related to the use of heavy equipment for land cultivation. Participants in this case study were given the opportunity to practice the use of tractors and tillage equipment in VR simulations. The results showed that participants were able to understand how to use the heavy equipment more quickly and safely compared to traditional training that requires physical equipment.

The group that took part in the VR training was able to complete the skills test in an average shorter time than the control group that took the conventional training. VR simulations provide a clear, real-time visualization of how the machine should be operated, so participants can easily understand the correct procedures. The training also allows participants to make mistakes in simulations without the risk of equipment damage or physical hazards.

This case study shows how VR technology can be used to provide a safer and more efficient learning experience, especially in the context of the use of potentially dangerous heavy equipment if operated by inexperienced people. In traditional training, the process of learning to use heavy equipment often requires intensive assistance, while in VR training, participants can learn independently with lower risk.

The use of VR in this case study shows that technology-based simulations can speed up the learning process and improve participants' understanding of complex technical procedures. Participants felt more confident in using the heavy equipment after going through the simulation, which ultimately contributed to the improvement of their skills in the field. Time efficiency is also one of the main advantages shown in this case study.

The increased effectiveness of training through VR can be attributed to the ability of this technology to provide a risk-free learning environment. Participants can try out different scenarios without worrying about making costly mistakes. This is in contrast to traditional methods that require high vigilance and the potential for costly errors. Simulations in VR can also be repeated, allowing participants to master the skills better.

VR technology in machine training also allows training providers to reduce operational costs. In traditional training, the use of physical equipment requires high costs for maintenance and the risk of damage. With VR, these costs can be reduced without compromising the quality of training. This effectiveness is one of the reasons why VR technology is so relevant in the context of agricultural training in Switzerland.

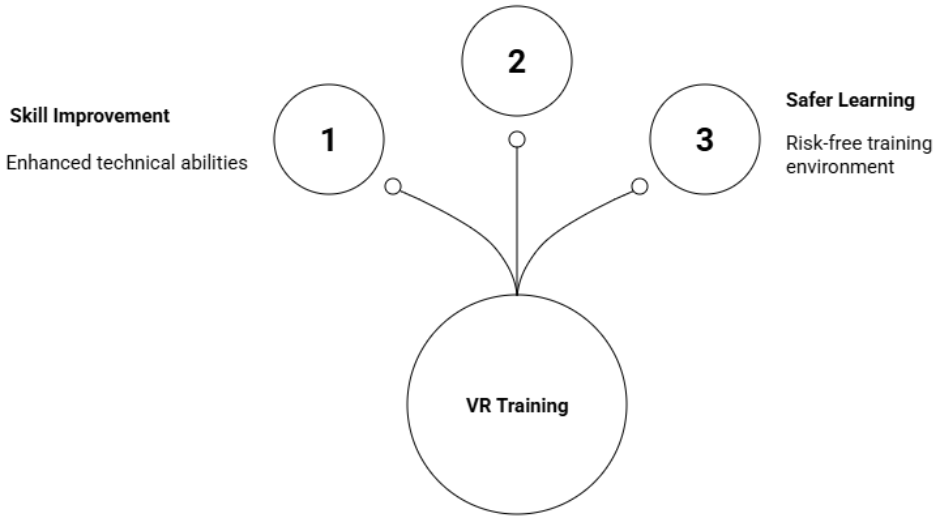

Figure 2. VR Training Improves Agricultural Skills

The relationship between the results of the case study and the results of the overall skill test shows that the use of VR is not only effective in improving technical skills, but also provides a safer and more efficient learning experience. The positive correlation between time efficiency and upskilling in case studies shows that VR training has great potential for wider adoption in the agricultural sector. This data supports previous findings that VR can be an innovative solution to overcome challenges in agricultural training.

The overall data shows that VR technology not only improves participants' technical skills, but also creates a more interactive and participatory learning environment. This

relationship emphasizes the importance of technological innovation in the agricultural sector, especially in training a workforce that is ready to face industry challenges. Safer and cost-effective VR simulations are a key factor driving increased training effectiveness.

Good technology adaptation plays an important role in the success of training, especially in the context of the use of VR. The relationship between the level of adaptation of participants and the training results shows that early introduction of technology to participants is necessary to ensure optimal results. This confirms that VR training requires an approach that is tailored to the participant's level of technological comfort.

The results of this study show that the use of virtual reality (VR) technology in agricultural training in Switzerland has a positive impact on skill improvement and participant satisfaction compared to conventional training methods. The group that used VR showed a higher average skill test score as well as a better level of satisfaction. The effectiveness of VR is seen not only in terms of improving technical understanding, but also in creating a more interactive and enjoyable learning experience.

The data also revealed that despite some technical challenges such as early adaptation and visual fatigue, the majority of participants in the VR group felt that the benefits of this technology far outweighed the challenges. The challenges faced by the VR group were mostly related to the lack of familiarity of participants with the new technology, but with adequate guidance, participants managed to overcome the barriers. The control group, on the other hand, showed more varied results, with some participants finding it difficult to understand the material through traditional methods.

Case studies taken from the use of heavy equipment in VR simulations also reinforce these findings. Participants who took part in the VR-based training were able to practice complex skills in simulations without facing real risks, ultimately improving their skills in a shorter amount of time. This study proves that VR technology can be an effective tool for providing technical training in the agricultural sector, which requires a combination of practical skills and theoretical understanding.

The increase in participant satisfaction in VR groups also reflects that a more immersive and realistic learning experience can motivate participants to be more actively involved in the training (Nizamani et al., 2025). This data shows the great potential of VR technology in creating a more inclusive and interactive learning environment, which can improve overall training outcomes.

This research is in line with several previous studies that have also found that the use of VR can improve learning effectiveness, especially in technical and practical training environments. A study Iatrou et al., (2025) found that VR has an advantage in creating immersive learning experiences, which allows participants to understand the material more quickly. These results support the findings in this study, where agricultural trainees who used VR showed significant skill improvements.

However, several other studies show differences in terms of technology adaptation. For example, research conducted by Bonatti et al., (2025) found that VR technology adaptation is more difficult for older participants, who often take longer to get used to the device. In this study, adaptation challenges were visible, but not so significant in affecting overall training outcomes. This difference may be due to the younger population of participants in the study, who are generally more familiar with the technology.

The study also shows that VR can provide an advantage in training that requires realistic simulation of field conditions, as found in a study (Grosboillot et al., 2024). The study stated that VR simulations can provide a better representation of conditions in the field compared to

traditional training methods. These results are consistent with the findings in this study, especially in case studies of the use of heavy equipment in agriculture.

Although the results of this study support most of the previous literature, there is still room for further research on the long-term impact of the use of VR in agricultural training (Parmaxi, 2023). Further research is needed to explore how VR can be more efficiently integrated into various agricultural sub-sectors and how this technology affects productivity in the field over a longer period of time.

The results of this study are a sign that VR technology has great potential to revolutionize the way agricultural training is conducted, especially in developed countries such as Switzerland. The significant increase in skills among VR trainees suggests that this technology can be an effective tool to overcome the limitations of traditional training. Not only does VR provide a safer and more efficient learning experience, but it also creates opportunities for farmers to learn in a more flexible and interactive way.

The challenges of technology adaptation found in this study also indicate that a more holistic approach is needed in implementing VR, especially for participants who are not familiar with digital technology. Although the results of this study showed relatively rapid adaptation by most participants, this factor remains an important concern in the future application of the technology. There needs to be more intensive guidance and better preparation to ensure all participants can make optimal use of VR technology.

The increased participant satisfaction resulting from a more immersive learning experience is also a sign that traditional learning methods may need to be updated to meet the challenges of education in the digital age (Parra-López & Carmona-Torres, 2026). The use of more innovative technologies, such as VR, can be a solution to increase the motivation and engagement of trainees in the long run. This is important, especially in sectors such as agriculture, where practical skills are essential.

Overall, the results of this study are a strong indication that VR can play a role in addressing some of the training challenges faced by the agricultural sector today. With the right implementation, this technology can help farmers to be better prepared to face environmental changes and new challenges that arise in the global agricultural sector.

The main implication of the results of this study is that VR technology can be a very effective training tool for the agricultural sector in Switzerland (Thorsten, 2026). The use of VR in agricultural training allows farmers to learn in a more flexible, interactive, and safe way. The significant increase in technical skills among trainees suggests that VR can help overcome some of the limitations of traditional training, such as physical risk and high operational costs.

The increase in participant satisfaction using VR also has positive implications for agricultural training institutions and policy makers. With higher satisfaction levels, VR can increase farmers' participation in training programs, which in turn will contribute to an increase in overall agricultural productivity. The use of this technology could also open up opportunities for other countries to adopt similar training methods, especially in sectors that require complex practical skills.

The technology adaptation challenges found in this study suggest that additional training may be needed to ensure all participants can access and use VR properly. However, this challenge is also an opportunity for training providers to develop more inclusive training modules, which focus not only on technology, but also on assisting participants in adopting such technology.

This research also provides important implications for the development of VR technology in the future (Bittencourt et al., 2025). With empirical evidence on the effectiveness

of VR in upskilling, further research can be conducted to explore the potential use of VR in other sectors that also require practical training.

The results of this study show an increase in the skills and satisfaction of VR trainees due to the ability of this technology to create an immersive and realistic learning experience. VR allows participants to practice technical skills in simulations that are close to field conditions, which cannot be done with conventional training methods (Talwar et al., 2023). The ability to try and repeat scenarios without physical risk makes participants more confident and engaged in the learning process.

The higher level of satisfaction in the VR group is due to the interactive nature of this technology. Participants felt more engaged because they not only heard or saw, but also experienced the training experience through realistic simulations. This is inversely proportional to conventional methods that are often passive and lack motivation for participants to be actively involved in training.

The challenges of adapting to the technology found at the beginning of the training can be explained by the fact that not all participants are used to using digital devices such as VR. Nonetheless, these challenges can be overcome with proper guidance, allowing participants to feel more comfortable with new technologies. Participants who were more familiar with technology showed better training results, which emphasized the importance of technology familiarity in determining training success.

The increased effectiveness of training through VR is also influenced by the ability of this technology to provide real-time feedback. Participants can instantly see the results of their actions in the simulation, allowing them to immediately correct mistakes and learn more efficiently. This cannot be achieved with conventional training methods which often take longer to provide feedback.

The next step after this research is to develop more VR-based training programs in the agricultural sector, not only in Switzerland but also in other countries. With empirical evidence demonstrating the effectiveness of VR, more inclusive and accessible training programs can be designed to help farmers improve their skills. VR technology can also be integrated into agricultural education curricula in educational institutions, so that future generations of farmers are better prepared to face modern challenges in this sector.

Further research is also needed to explore how VR can be adapted for various agricultural sub-sectors, such as livestock, horticulture, and agronomy. Each sub-sector has different training needs, and VR needs to be tailored to deliver optimal training results. In addition, research on the long-term impact of VR on agricultural productivity is also important to learn more.

Training providers need to consider the challenges of technology adaptation and look for ways to make VR more accessible to all participants, including those who are less familiar with digital technologies. This can be done through the development of simpler and more intuitive training modules, as well as providing adequate technical support throughout the training.

Overall, this study opens the door for wider use of VR technology in the agricultural sector. With its great potential, VR can be an effective tool to improve farmers' skills and ensure the sustainability of the agricultural sector in the future.

CONCLUSION

The most important finding of the study was that the use of virtual reality (VR) technology in agricultural training significantly improved participants' skills and satisfaction compared to conventional training methods. These results show that VR is not only able to

provide a more interactive learning experience, but is also more effective in developing the technical skills required in agricultural practices. This technology allows participants to learn in a safe and realistic environment without any real physical risk, which is particularly relevant in training involving the use of heavy equipment or risky technical practices.

The more value of this research lies in the development of the concept of agricultural training based on VR technology which has not been widely applied in this sector, especially in Switzerland. This research contribution is an empirical demonstration that VR can be adapted for agricultural training with significant results. The limitations of this study lie in the limited sample population and technological adaptation that has not been fully measured in depth. Further research is expected to explore the long-term impact of the use of VR in agricultural training as well as overcome the challenges of technology adaptation for participants who are less familiar with digital devices.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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