Developing Virtual Field Trips for Agriculture

Suresh Krishnasamy[a,b], Millicent R. Smith[a,c], Edward Narayan[a,c], Ammar Abdul Aziz[a], Eleanor W. Hoffman[a]

Corresponding Author: Suresh Krishnasamy (suresh.krishnasamy@uq.edu.au)
[a]School of Agriculture and Food Sciences, Faculty of Science, The University of Queensland, Gatton QLD 4343, Australia
[b]Institute for Teaching and Learning Innovation, The University of Queensland, St Lucia, QLD 4072, Australia
[c]Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, St Lucia QLD 4072, Australia

Keywords: experiential learning, educational technology, blended learning, horticulture

Abstract

Field trips play an important role in teaching and learning, from stimulating students' motivations to allowing students to connect in-class concepts and the real world. Including field trips within an agricultural curriculum is essential as concepts are highly interdisciplinary, and knowledge application to a range of production systems and environments is critical. Despite their importance, many factors, such as high enrolments, present challenges to its successful integration. Virtual field trips (VFT) allow universities to leverage the affordances of technology to mitigate some of the associated challenges while maintaining quality course delivery. In this pilot study, an experiential learning activity was designed around a VFT application, and the student experience and outcome were investigated. The student experience measures indicated satisfaction with multimedia elements, although it is noted that improvements to the user interface would enhance the experience. Students had positive reflections on the learning experience, including an increased interest in the field of study but did not see VFTs as replacing actual field trips. Paired *t*-tests showed students' attainment of learning outcomes. This pilot implementation provides an activity design for other courses with similar challenges and highlights the value of VFTs to the curriculum for undergraduate agricultural courses.

Introduction

Experiential learning is defined as learning that is reflective, engaging and experimentative (Association for Experiential Education, 2022). Compared to other learning theories which focus on the learning of knowledge through cognition, experiential learning theory places experience as a central fulcrum of the learning experience (McCarthy, 2010; Sharlanova, 2004) and is associated with improved student motivation (Krakowka, 2012), improving thinking skills (Habib, Nagata, & Watanabe, 2021), increased perceived learning (Villarroel, Benavente, Chuecas, & Bruna, 2020) and improved student outcomes (Coker, Heiser, Taylor, & Book, 2016).

Across many disciplines, field trips are a quintessential experience-based learning activity (Djonko-Moore & Joseph, 2016; Zeichner, 2009) which enhances students learning by increasing student motivation due to "five key ingredients: student, teacher, content, method/process, and environment" which is in abundance in field trip activities (Larsen, Walsh, Almond, & Myers, 2016). The value of field trips and associated activities in teaching and learning are plentiful, ranging from stimulating students' interests and motivations in the subjects they are learning to providing a unique first-hand learning experience (experiential learning) (Tuthill & Klemm, 2002). It also critically allows them to see and connect in-class concepts to the real world. However, despite the educational benefits, putting together a field trip can be challenging due to a myriad of factors such as cost, large class sizes, the proximity of field trip locations to campuses, time constraints, and safety (Dolphin, Dutchak, Karchewski, & Cooper, 2019; Mead et al., 2019). These factors have also been greatly exacerbated by the prolonged impact of COVID-19, specifically with the travel and social restrictions that have been in place.

The increasing demand for equitable and accessible educational experiences has led to the search for a solution that not only offers experiential learning opportunities to students but also ensures that they are accessible to all. Virtual field trips (VFT) and similar applications enable universities to leverage technology's benefits and its safe learning environment to help students develop, practice, and refine their skills. As a result, students can enhance their confidence in applying those skills in real-world situations (Cliffe, 2017)

The study was a pilot implementation used to investigate the student experience and outcomes allowing the project team to suggest approaches to using VFTs in undergraduate agriculture courses.

Study Context

The study was carried out on a second-year undergraduate Horticulture course with an enrolment of 10 students. The course content covers the principles of propagation and establishment of horticulture crops, model production systems, and the maintenance of quality by appropriate post-harvest handling of horticultural products through the supply chain. Traditionally the course had a significant field trip component allowing students to see the horticultural concepts in action at nurseries in proximity to the campus. This teaching approach was impacted by COVID-19 and thus served as a good course for the study.

Methodology

Activity Design

Similar to other field trip studies, the implementation was designed to leverage Kolb’s experiential learning cycle (ELC) (Atchison & Kennedy, 2020; Kenna & Potter, 2019; Krakowka, 2012). Figure 1 illustrates how the four phases in the cycle are organised: (1) Concrete Experience; (2) Reflective Observation; (3) Abstract Conceptualisation; and (4) Active Experimentation (Healey & Jenkins, 2007; McCarthy, 2010). The following subsections provide a short description of activities involved in the stages, with Table 1 summarising the stage mapping and the student activities involved. The activity stages listed in Table 1 were carried out during a 2-hour timetabled workshop.

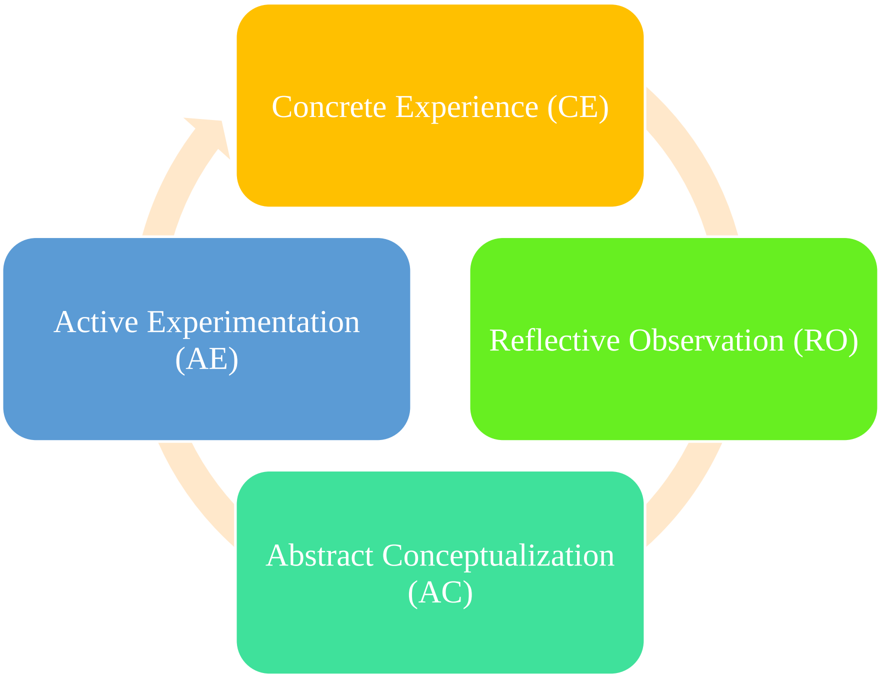

Figure 1. Illustration of Phases in ELC

Table 1. Summary of Stages – Mapping to ELC and Student Activity

Stage	Name (Mapping to ELC)	Student Activity
1	Prior Knowledge Discussion (AE)	**Group:** Explore the scenario using prior knowledge
2	Exploring Boomaroo Nursery (CE)	**Individual:** Explore virtual field application
3	"Return to Classroom" (RO)	**Group:** Review the scenario
4	Attempt Scenario (AC)	**Group:** Attempt scenario with groupmates

Stage 1 - Prior Knowledge Discussion (AE)

In this stage, students must use their prior knowledge to address a scenario and share it with their groups. The key aim of the stage was to allow students to bring their past experiences and knowledge to the forefront and actively test that knowledge. Thus, students were asked to select a resource from a list and share with their group how it could be used in the design of a nursery (see instructions provided in Figure 2). The ensuing discussions provided an opportunity for knowledge sharing and for students to better understand their groupmates and experiences.

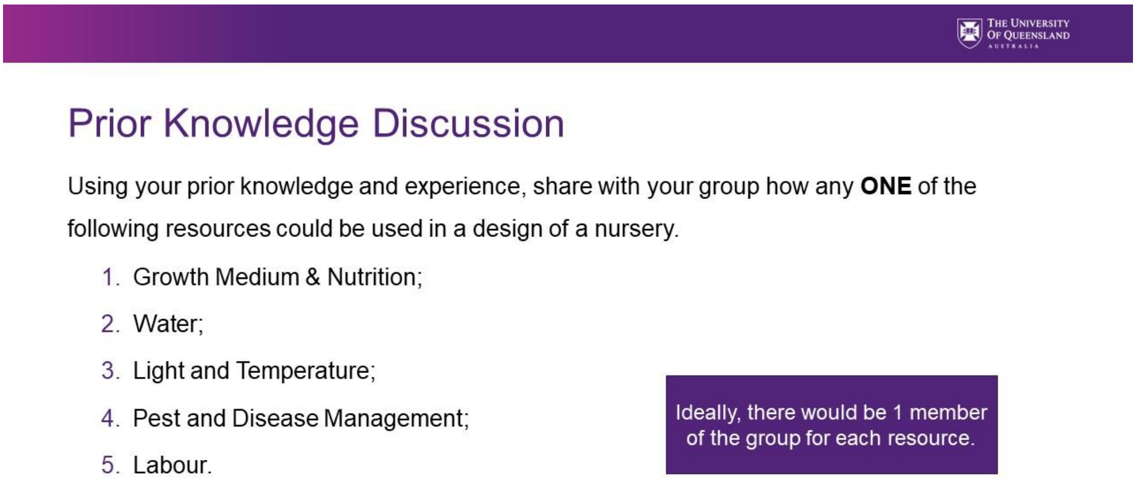

Figure 2. Instructions provided to students for Stage 1 to allow group discussion on resources required in nursery design.

Stage 2 – Exploring Boomaroo Nursery (CE)

In Stage 2, students were given time to engage in a self-exploratory journey with the VFT application (see Figure 3). This stage aimed to allow students to have a new learning experience, and thus, much of the scheduled time was allocated for this stage of the activity, allowing students to have free reign to navigate to different location spots in the Boomaroo Nursery facility. At each of these location spots, students had the option to explore the site by rotating 360º images, clicking on information hotspots and watching bite-sized videos where key members of the facility provide further information about the facilities and nursery operations. The VFT application was developed by an in-house software development team using the Prism360 platform which allows the aggregation of 360º images linked to additional interactive resources.

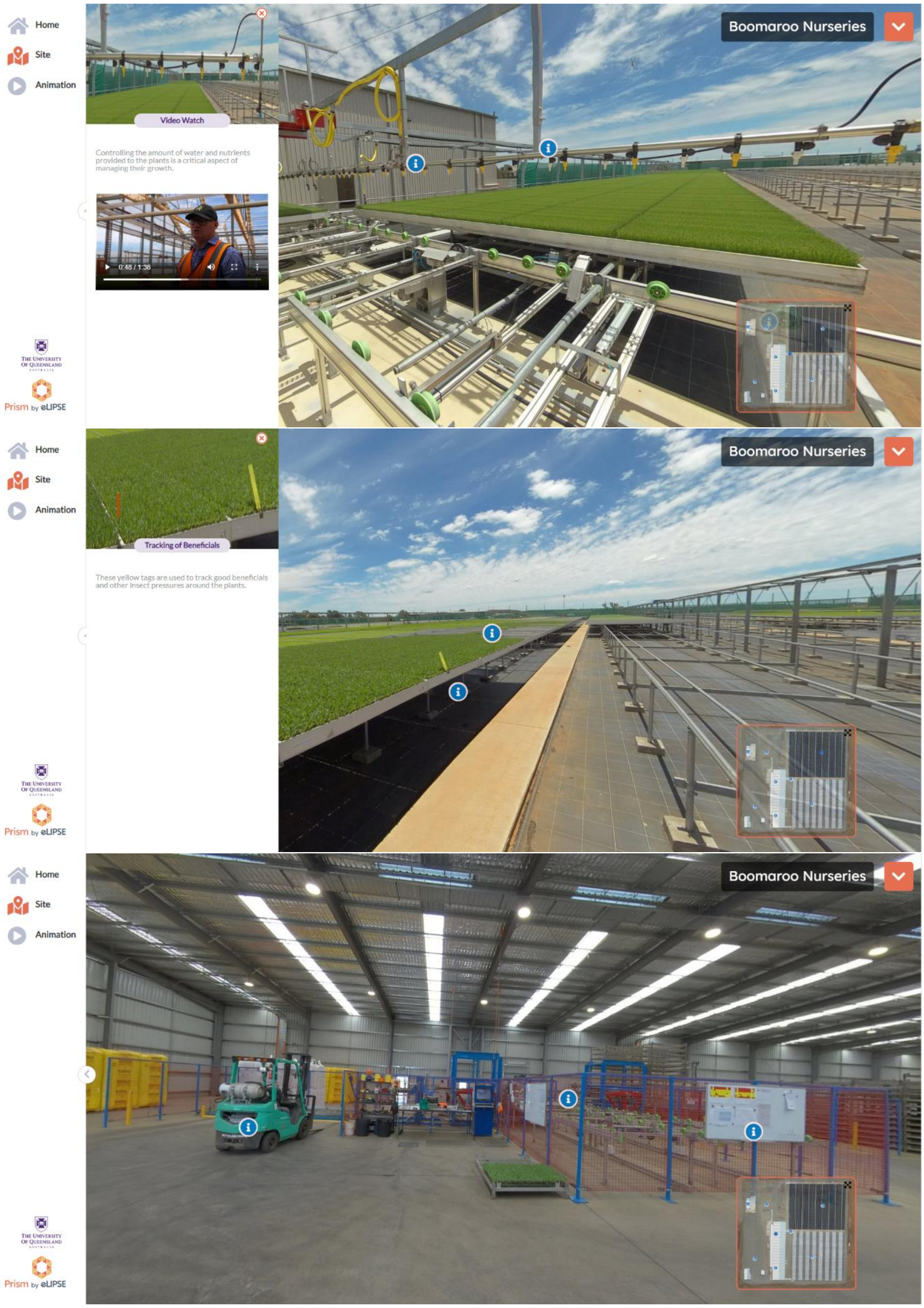

Figure 3. Collage of Screenshots from the VFT Application where the different panels show the different locations within the nursery. Note the information icons that students can click to find more information, video snapshots, information panels and a map of the entire nursery site.

Stage 3 - "Return to Classroom" (RO)

Stage 3, termed "return to classroom", is where students come together after their exploration of the VFT application. This stage aimed for students to compare their prior knowledge and experiences with what they had experienced during the exploration. This could reinforce knowledge or require them to resolve any inconsistencies. Within their groups, students were asked to revisit their chosen resource from Stage 1 and share how their exploration reinforced or contradicted their prior knowledge.

Stage 4 - Attempt Scenario (AC)

This stage allows students to consolidate their learning and combine their prior experience with the knowledge and experience gained through the session by attempting the horticulture scenario in their groups. The stage aims for students to test ideas and explore different possibilities before coming to a consensus on a group design for their nursery, forming the basis of the AC phase of the ELC. Group design ideas are then shared with the rest of the class, allowing others to critique and provide feedback (Figure 4). With that feedback, groups can refine their ideas and designs.

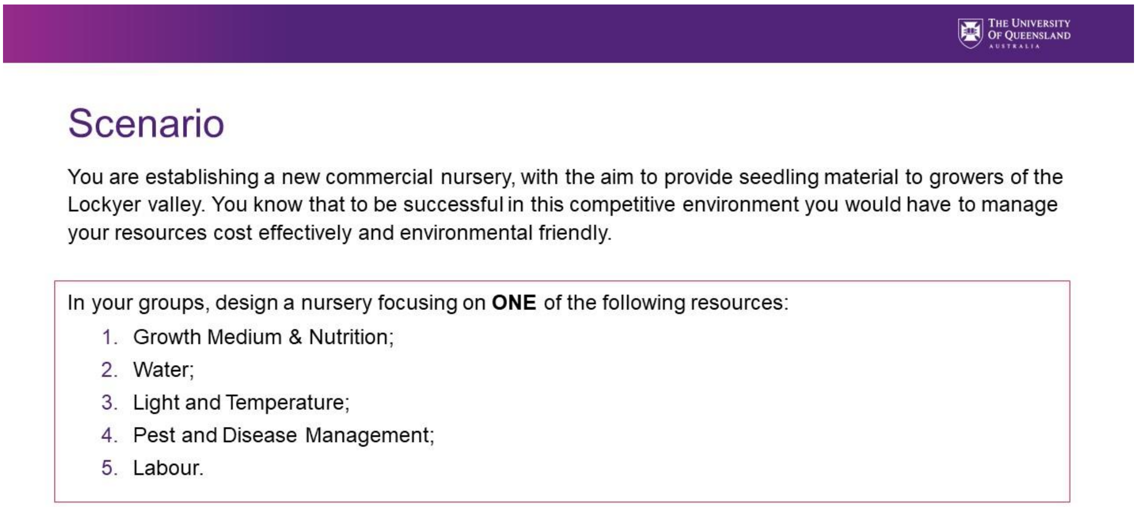

Figure 4. Activity Instructions provided to students for Active Experimentation (AE) Stage

Measures

The chosen methods aimed to examine the student's experience with the designed activity and the outcomes of their experiential learning. This involved the collection of both quantitative and qualitative measures through various instruments described below. The data were collected at three points: pre–activity, stage 3, and post-activity. Table 2 summarises the data collected at various points.

For all quantitative data, statistical analysis was performed using SPSS version 27.0. Details of the analysis done for the individual measures are described below. For qualitative responses, a thematic analysis was carried out using the framework outlined by Castleberry and Nolen (2018).

Table 2. Summary of Measures Used and Type of Data Collected

	Measures Used	Type of Data Collected
Pre-Activity	Demography Prior Experience ELSS (Pre)	Quantitative / Qualitative
Stage 3	Reflection on Learning	Qualitative
Post-Activity	ELS ELSS (Post) Reflection on VFT Experience	Quantitative / Qualitative

Experiential Learning Student Survey (ELSS)

The Experiential Learning Student Survey (ELSS) is a validated self-report instrument (Walker & Rocconi, 2021) that measures undergraduate students' perception of learning in an experiential learning context. The instrument is a 16-item, 7-point Likert scale (1=strongly disagree to 7=strongly agree) self-report instrument measuring four experiential learning student learning outcomes. Table 3 below lists the four student learning outcomes (SLO) and the pre- and post-test items. Attainment of the student learning outcome was determined using a paired sample *t*-test comparing student responses from the pre-experience survey and the post-experience.

Table 3. The 4 SLOs and Pre- and Post-Test Items

SLO 1: Students will value the importance of engaged scholarship and lifelong learning. **No. of Items: 4**	
Pre-Test	*Post-Test*
I often participate in activities that serve the needs of others.	I am interested in exploring the problems of society (i.e., the needs of others).
I think it is important for the university to use its resources for the benefit of society.	I think it is important for academia to use their resources for the benefit of society.
I often participate in academic activities/events that aim to help others.	I am interested in using the skills and knowledge that I have acquired from this course to contribute to the public good.
I typically like to explore more than usual when I am learning something new that interests me	I want to continue to develop relevant skills that are related to this experience.
SLO 2: Students will apply knowledge, values, and skills in solving real-world problems. **No. of Items: 5**	
Pre-Test	*Post-Test*
I can clearly describe a real-world problem related to this course to someone that knows little about the problem.	I can clearly describe a real-world problem related to this course to someone that knows little about the problem.
I have been introduced to more than one way to address real-world problem(s) related to this course.	I have been introduced to more than one way to address real world problem(s) that my faculty member/professor brought up in this course.

I feel confident in my ability to develop a logical, consistent approach to address a real-world problem related to this course.	I feel confident in my ability to develop a logical, consistent approach to address a real-world problem related to this course.
I can list many potential ethical issues for real world problems related to this course	I can list many potential ethical issues for real world problems related to this course.
I can draw conclusions from data that has been collected.	I can draw conclusions from data collected through this experience.
I am able to identify and apply information from this course to address and potentially improve real-world problem(s)	I am able to identify and apply information from this course to address and potentially improve real-world problem(s)
SLO 3: Students will work collaboratively with others. No. of Items: 3	
Pre-Test	*Post-Test*
I am often told I listen to and respect the ideas of others.	My classmates would say that I often listened to and respected the ideas of others.
I am often told I offer relevant questions and comments within a group setting.	My classmates would say that I was able to offer relevant question and comments within a group setting.
I meet obligations for group assignments on a timely basis.	I meet obligations for group assignments on a timely basis.
SLO 4: Students will engage in structured reflection as part of the inquiry process. No. of Items: 3	
Pre-Test	*Post-Test*
In the past, I have purposefully reflected on what I learned from problems I encountered during a learning experience.	I purposefully reflected on what I learned from problems I encountered during this experience.
In the past, I often reflected on what I have learned about myself from learning experiences.	During this experience, I reflected on what I have learned about myself from this experience.
I have thought about what it means to be a member of the broader community.	During this experience, I thought about what it means to be a member of the broader community.

Experiential Learning Survey (ELS)

The Experiential Learning Survey (ELS) is a validated self-report instrument (Clem, Mennicke, & Beasley, 2014) designed to measure students' perception of value of an experiential learning activity. The instrument is a 28-item, 7-point Likert scale (1=strongly disagree to 7=strongly agree) containing four subscales: Environment Authenticity, Active Learning, Relevance and Utility. Responses for each item of the ELS were summed to generate scores for the 4 subscales. Questions 3, 9, 15, 23, and 27 were reverse coded for consistency when scoring. Mean and standard deviation values for each subscale were determined.

Table 4. Subscale and Items from the ELS

Authenticity **No of Items: 5**
1. The setting where I learn helps me understand the material better.
2. I expect real-world problems to come up during this learning experience.
3. The environment I learn in does not enhance the learning experience. **
4. The learning experience requires me to interact with people other than students and teachers.
5. I expect to return to an environment like the one where this learning experience occurs.
Active Learning **No of Items: 7**
6. I am stimulated by what I am learning.
7. The learning experience requires me to do more than just listen.
8. The learning experience is presented to me in a challenging way.
9. I find this learning experience boring. **
10.I feel like I am an active part of the learning experience.
11.The learning experience requires me to really think about the information.
12.I am emotionally invested in this experience.
Relevance **No of Items: 9**
13.I care about the information I am being taught.
14.The learning experience makes sense to me.
15.This learning experience has nothing to do with me. **
16.This learning experience is enjoyable to me.
17.I can identify with the learning experience.
18.This learning experience is applicable to me and my interests.
19.My educator encourages me to share my ideas and past experiences.
20.This learning experience falls in line with my interests.
21.I can think of tangible ways to put this learning experience into future practice.
Utility **No of Items: 7**
22.This learning experience will help me do my job better.
23.This learning experience will not be useful to me in the future. **
24.I will continue to use what I am being taught after this learning experience has ended.
25.I can see value in this learning experience.
26.I believe this learning experience has prepared me for other experiences.
27.I doubt I will ever use this learning experience again. **
28.I can see myself using this learning experience in the future.

**Items that are reversed scored during analysis.

Reflection on Learning

The reflection on learning questionnaire is a self-report instrument comprising open-ended questions to understand the student learning experience. Modelled on Schon's Reflection-on-Action model (Wain, 2017), students were asked to reflect on their thoughts, feelings and learning during the experiential learning activity. The reflection questions were:

- List two (2) things that you know now that you did not know before the activity.
- How did you approach the learning activity and why?
- How did your relationship with your group mates influence your experience?
- After going through the activity, what are your thoughts about ways in which the agriculture industry needs to develop to best meet the needs of the community?

Reflection on VFT Experience

The quantitative aspect of this measure was a self-report instrument adapted from Klippel, Zhao, Oprean, Wallgrün, and Chang(2019), Patiar et al. (2020) and Patiar, Ma, Kensbock, and Cox (2017) measuring the student experience with the VFT application. This questionnaire consists of a 14-item, 5-point (1=strongly disagree to 5=strongly agree) scale containing three subscales: VFT Interface and Media, Learning with VFT and Perception of VFT. Responses for each item were summed to generate scores for the three subscales. When scoring, questions 10 and 12 was reverse coded for consistency. Mean and standard deviation values for each subscale were determined.

Table 5. Subscale and Items for Reflection on VFT Experience

VFT Interface and Media **No. of Items: 3**
1. The VFT application was easy to navigate
2. The multimedia (e.g., videos and floor plan) helped me engage with the VFT application
3. The interface of the VFT application was user friendly
Learning with VFT **No. of Items: 6**
4. The VFT application enabled me to accomplish the task effectively
5. The VFT application complemented course material
6. The VFT allowed me to see course concepts being used in the industry
7. The VFT application provided an appropriate learning opportunity
8. The VFT application added to the enjoyment of learning
9. The VFT application allowed me to gain knowledge that I previously did not have
Perception of VFT **No. of Items: 5**
10.I would rather visit an actual field site than experience a VFT**
11.I would rather experience a VFT than have no field trip experience.
12.VFTs can replace actual field trips**
13.I would like to see the use of more VFTs in my courses
14.I think both VFTs and actual field trips can be useful in agricultural courses

**Items that are reversed scored during analysis.

The qualitative aspect of the instrument was used to determine elements that they liked and whether the student perception of the VFTs and their use mirrored the reasons why VFTs were adopted. The questions were:

- What did you like best about the VFT to Boomaroo Nursery?
- What benefits do you think there are from using VFTs in place of actual field trips?
- Has the VFT experience helped you become more interested in this field and if so, why?

Research Ethics

Ethics for this project was provided for by Lancaster University and the University of Queensland Faculty of Science LNR Committee (2021/HE000888).

Results & Discussion

The results from the different measures were analysed and interpreted through the lens of the student experience and outcomes.

Demography

The session was conducted with 9 students (90%) out of the 10 enrolled. While the sample size is small, the response rate from the attendees at the session was 100% and an even gender distribution with 55% (*n*=5) female and 45% (*n*=4) male.

77.8% of the students *"have not used VFTs prior to the activity and had no idea what it is all about"*. Following their responses, participants were asked to describe what they thought VFTs were. Summarising their descriptions, most of the students have a fairly good idea of what they are, with terms like "interactive" and "experience" being noted (Figure 5). This was important for the pilot implementation for two reasons. Firstly, prior experience has been found to influence the student experience (Mills, Ashford, & McLaughlin,2006), and thus the comparison with a previously used application termed "VFT" would not interfere with their perception of the current application. Secondly, having an idea of what they would be using reduces the cognitive load required to engage in the activity, which can lead to better outcomes (Buchner, Buntins, & Kerres, 2021).

Figure 5. A Word Cloud shows words students used to describe VFTs where the larger the word the more frequently it was used.

Student Experience

As the VFT application forms a significant component of their activity experience, their feedback on various aspects of the application was important in giving students a good learning experience. A summary of the descriptive statistics for the VFT experience items is given in Table 6.

The data indicates that while students were satisfied with the multimedia employed, the navigation and interface had much to be improved. Feedback from the students through their responses to the question, *"What would you change about the virtual field trip experience to enhance it for future students?"* was focused on the VFT application, with 7 of the 9 responses suggesting improvements to the clarity of the video and improvement to the software.

Reflecting on the students' perception of VFTs, they do not see them replacing in-person field trips. This aligns with best practice recommendations when designing and implementing VFTs (Klemm & Tuthill, 2003; Tuthill & Klemm, 2002) and is consistent with findings in similar implementations in other disciplines (Spicer & Stratford, 2001). However, a comparatively poorer score in wanting to see more VFTs in their courses despite indicating that they would rather experience a VFT than have no field trip experience is interesting to note.

Upon reviewing the feedback on the use of VFTs for learning, it was found that the subscale mean was a high 4.15 across all 6 items related to the students' learning experience, as outlined in Table 6. We see high mean scores for items related to applying concepts in the industry (M = 4.56) and how it allowed them to gain knowledge (M = 4.33). However, it is pertinent that they did not feel that they were able to accomplish the given task effectively (M = 3.67), which provides an element for consideration for activity design.

Table 6. Mean Scores for VFT Experience Subscale

Subscale and Items	Mean	S.D.
VFT Interface and Media – 3 items	**3.74**	**0.88**
The VFT application was easy to navigate.	3.33	0.71
The multimedia (e.g., videos and floor plans) helped me engage with the VFT application.	4.22	0.83
The interface of the VFT application was user-friendly.	3.67	1.32
Perception of VFT – 5 items	**3.82**	**0.72**
I would rather visit an actual field site than experience a VFT.	4.44	0.73
I would rather experience a VFT than have no field trip experience.	4.00	1.22
VFTs can replace actual field trips.	2.44	1.33
I would like to see the use of more VFTs in my courses.	3.78	1.09
I think both VFTs and actual field trips can be useful in agricultural courses.	4.44	0.73
Learning with VFT – 6 items	**4.15**	**0.49**
The VFT application enabled me to accomplish the task effectively.	3.67	1.00
The VFT application complemented course material.	4.22	0.44
The VFT allowed me to see course concepts being used in the industry.	4.56	0.53
The VFT application provided an appropriate learning opportunity.	4.11	0.60
The VFT application added to the enjoyment of learning.	4.00	0.71
The VFT application allowed me to gain knowledge that I previously did not have.	4.33	0.50

The findings from the VFT experience measure were corroborated using a measure of students' perception of the value of experiential learning activities through the ELS. Table 7 summarises the mean values for the individual subscales associated with aspects of experiential learning.

Table 7. Mean Scores for the ELS Subscales

Scale	Number of Items	Mean	SD
Environment Authenticity	5	5.73	0.60
Active Learning	7	5.21	0.52
Relevance	9	6.18	0.72
Utility	7	5.31	0.64

Results from ELS showed the relevance subscale with the highest mean score of 6.18, indicating that students found that the activity allowed them to internalise and reflect on their past experiences to connect new and old information. Conversely, the active learning and utility subscales, which measure the student's engagement level with the learning material and its connectivity to future applications, scored comparatively poorer. This is of concern as the activities were designed to engage students in active participation, and the scenario was intended for them to make that connection seamlessly. This poor score could indicate the poor alignment of design and implementation, which could be due to this being the pilot run and teething issues were to be expected.

Students' responses took two forms when asked to reflect on what they were thinking and feeling during the learning activity. One group of responses focused on various aspects of the application, such as *"the videos and summaries of each stage of the facility made it easy to understand what was going on and be able to clearly see the equipment."* This was unfortunate as the reflection questions were intended to get students to dig deeper rather than focus on surface elements. Another group of responses, however, focused on the deeper feelings such as *"The more I followed along the more I wanted to learn about the facilities. This was influenced by watching how one procedure in the nursery leads to the next and how production of the seedlings are developed."* Such responses were very encouraging but again highlight the students' range of engagement and experience.

Student Outcomes

The intended student learning outcomes (SLO) associated with experiential learning were defined by Walker and Rocconi (2021) as

- SLO 1: Students will value the importance of engaged scholarship and lifelong learning.
- SLO 2: Students will apply knowledge, values, and skills in solving real-world problems.
- SLO 3: Students will work collaboratively with others.
- SLO 4: Students will engage in structured reflection as part of the inquiry process.

Students' attainment of these SLOs was measured using the Experiential Learning Student Survey. Table 8 summarises the mean scores from the pre-and post-survey results along with the paired *t*-test results comparing them. All 4 SLOs showed an improvement in mean scores from the pre- to post-survey, with SLO1 having the highest mean difference of 2.83. This is indicative of students having attained the SLOs. The smallest mean difference was found for SLO4 followed by SLO3, both having differences of less than 1%.

The paired *t*-test result for SLO1 showed that there was a statistically significant improvement from the pre- (M = 23.33, SD = 1.75) to post- (M = 26.17, SD = 2.09) experience, t = 6.107, p = 0.000. The eta squared statistic (0.82) indicated a large effect size. The improvements for SLO2, SLO3, and SLO4 were not statistically significant. Since the duration of the activity did not appear to impact the achievement of the learning outcomes, the lack of significant improvement in student performance could be attributed to the design of the individual stages, which may not have adequately provided students with the opportunity to develop the targeted SLOs.

Table 8. Mean Scores and *t*-test Results for Student Learning Outcome Measures

Number of Items	Pre		Post		Mean Diff [Post-Pre]	t	df
	Mean	S.D.	Mean	S.D.			
SLO 1: Students will value the importance of engaged scholarship and lifelong learning.							
4	23.33	1.75	26.17	2.09	2.83	6.107**	8
SLO 2: Students will apply knowledge, values, and skills in solving real-world problems.							
6	31.83	2.46	33.67	3.68	1.83	1.444	8
SLO 3: Students will work collaboratively with others.							
3	16.33	1.39	17.00	1.68	0.67	0.883	8
SLO 4: Students will engage in structured reflection as part of the inquiry process.							
3	17.00	2.25	17.17	2.82	0.17	0.217	8

**. $p < 0.01$

From a cognitive perspective, when asked to list two things they knew after the activity that they did not know before the activity, all students could pick up elements from the VFT and gave varying examples of this effect. From an activity design perspective, this was a positive note that the examples given ranged from course content elements like *"Recommended media for organics, ability for return and reuse of trays*" to broad concepts like *"The value of mechanisation in this industry"* and *"The sustainability of nurseries in terms of water usage and how they recycle their water."*

In addition to the course curriculum, students were also prompted to reflect on how the VFT experience impacted their interest in the field. Moreover, they were asked to share their thoughts on how the agriculture industry can develop to better serve the community's needs. All students indicated that the virtual field experience had helped them become more interested in the field, as summarised in Table 9, which *"exposure to industry"* and the *"application of content in the real world"* two clear themes identified.

Table 9. Themes Identified in Increased Interested in Field

Theme	n of participants contributing (N=8)	Sample Quote
Exposure to Industry	6	Yes, very because I have learnt about a production/growing environment I knew little about and wanted to gain more knowledge in.
Application of content in real world	2	Yes, because I found very motivated when seeing the materials that I learn in lectures is applying to the real-world.

Implications for Practice

With reference to Figure 1 and Table 1 above and our findings, the following are some activity design notes for educators who would like to incorporate a VFT as part of their experiential learning activity. Overall, we recommend that the educator be specific in the scenario design such that students can make a clear connection between the course concepts and its applicability to the scenario task. Additionally,

- Stage 1 should be designed around a task requiring students to draw on their prior knowledge and is recommended to be attempted in groups. The key here is for students to not only see how their prior knowledge can address the scenario but also how the collective prior knowledge allows a variety of solution to be derived. We recommend the use of online tools (e.g., Padlet) to capture the discussion points.
- Stage 3 should be designed around a revisit to the task in stage 1 and requires students to reconcile difference between what they already knew and what learnt in the VFT. To maximum the benefits of the reflective experience, students should reflect on their learning individually before sharing their reflections with the group.
- Stage 4 is where students apply their aggregate knowledge to a novel situation. It is vital for the scenario task used to have explicit breadcrumbs from the preceding tasks.

Conclusion

As a pilot project, the findings are highly positive and provide confidence in the use of VFTs for experiential learning activities in undergraduate agriculture courses. The results also suggest that through experiential learning activities and VFTs, some university graduate outcomes such as having *a comprehensive and well-founded knowledge in the field of study*, *the ability to engage effectively and appropriately with information and communication technologies* and *the ability to interact effectively with others to work towards a common outcome*, can be attained. The pilot project also provides an activity design that other courses with similar challenges organising in-person field trips could employ regardless of disciplines.

Acknowledgements

The project team would like to acknowledge the collective efforts of Boomaroo Nurseries, the UQ Faculty of Science eLearning team and eLIPSE for their efforts in building the VFT application. Additionally, a special thanks goes out to Dr Robyn Cave, a horticulture lecturer in the course.

References

Association for Experiential Education. (2022). https://www.aee.org/
Atchison, J., & Kennedy, J. (2020). Being on Country as Protest: Designing a Virtual Geography Fieldtrip Guided by Jindaola. Journal of University Teaching & Learning Practice, 17(4). https://doi.org/10.53761/1.17.4.8
Buchner, J., Buntins, K., & Kerres, M. (2021). The impact of augmented reality on cognitive load and performance: A systematic review. Journal of Computer Assisted Learning, 38(1), 285–303. https://doi.org/10.1111/jcal.12617
Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? Curr Pharm Teach Learn, 10(6), 807-815. https://doi.org/10.1016/j.cptl.2018.03.019
Clem, J. M., Mennicke, A. M., & Beasley, C. (2014). Development and Validation of the Experiential Learning Survey. Journal of Social Work Education, 50(3), 490-506. https://doi.org/10.1080/10437797.2014.917900
Cliffe, A. D. (2017). A review of the benefits and drawbacks to virtual field guides in today's Geoscience higher education environment. International Journal of Educational Technology in Higher Education, 14(1). https://doi.org/10.1186/s41239-017-0066-x
Coker, J. S., Heiser, E., Taylor, L., & Book, C. (2016). Impacts of Experiential Learning Depth and Breadth on Student Outcomes. Journal of Experiential Education, 40(1), 5-23. https://doi.org/10.1177/1053825916678265
Djonko-Moore, C. M., & Joseph, N. M. (2016). Out of the Classroom and Into the City. SAGE Open, 6(2). https://doi.org/10.1177/2158244016649648
Dolphin, G., Dutchak, A., Karchewski, B., & Cooper, J. (2019). Virtual field experiences in introductory geology: Addressing a capacity problem, but finding a pedagogical one. Journal of Geoscience Education, 67(2), 114-130. https://doi.org/10.1080/10899995.2018.1547034
Habib, M. K., Nagata, F., & Watanabe, K. (2021). Mechatronics: Experiential Learning and the Stimulation of Thinking Skills. Education Sciences, 11(2). https://doi.org/10.3390/educsci11020046
Healey, M., & Jenkins, A. (2007). Kolb's Experiential Learning Theory and Its Application in Geography in Higher Education. Journal of Geography, 99(5), 185-195. https://doi.org/10.1080/00221340008978967
Kenna, J. L., & Potter, S. (2019). Experiencing the World From Inside the Classroom: Using Virtual Field Trips to Enhance Social Studies Instruction. The Social Studies, 109(5), 265-275. https://doi.org/10.1080/00377996.2018.1515719
Klemm, B. E., & Tuthill, G. (2003). Virtual field trips Best practices. International Journal of Instructional Media, 30(2).
Klippel, A., Zhao, J., Oprean, D., Wallgrün, J. O., & Chang, J. S.-K. (2019). Research Framework for Immersive Virtual Field Trips 2019 IEEE Conference on Virtual Reality and 3D User Interfaces, Osaka, Japan.
Krakowka, A. R. (2012). Field Trips as Valuable Learning Experiences in Geography Courses. Journal of Geography, 111(6), 236-244. https://doi.org/10.1080/00221341.2012.707674

Larsen, C., Walsh, C., Almond, N., & Myers, C. (2016). The “real value” of field trips in the early weeks of higher education: the student perspective. Educational Studies, 43(1), 110-121. https://doi.org/10.1080/03055698.2016.1245604

Mead, C., Buxner, S., Bruce, G., Taylor, W., Semken, S., & Anbar, A. D. (2019). Immersive, interactive virtual field trips promote science learning. Journal of Geoscience Education, 67(2), 131-142. https://doi.org/10.1080/10899995.2019.1565285

McCarthy, M. (2010). Experiential Learning Theory: From Theory To Practice. Journal of Business & Economics Research, 8(5), 91-100. https://doi.org/10.19030/jber.v8i5.725

Mills, A., Ashford, P., & McLaughlin, P. (2006). The value of experiential learning for providing a contextual understanding of the construction process. AUBEA 2006 : Proceedings of the 31st Australasian University Building Educators Association Conference, Sydney, NSW.

Patiar, A., Kensbock, S., Benckendorff, P., Robinson, R., Richardson, S., Wang, Y., & Lee, A. (2020). Hospitality Students’ Acquisition of Knowledge and Skills through a Virtual Field Trip Experience. Journal of Hospitality & Tourism Education, 33(1), 14-28. https://doi.org/10.1080/10963758.2020.1726768

Patiar, A., Ma, E., Kensbock, S., & Cox, R. (2017). Hospitality Management Students’ Expectation and Perception of a Virtual Field Trip Web Site: An Australian Case Study Using Importance–Performance Analysis. Journal of Hospitality & Tourism Education, 29(1), 1-12. https://doi.org/10.1080/10963758.2016.1266941

Sharlanova, V. (2004). Experiential Learning. Trakia Journal of Sciences, 2(4), 36-39.

Spicer, J. I., & Stratford, J. (2001). Student perceptions of a virtual field trip to replace a real field trip. Journal of Computer Assisted Learning, 17(4), 345-354. https://doi.org/10.1046/j.0266-4909.2001.00191.x

Tuthill, G., & Klemm, B. E. (2002). Virtual field trips Alternatives to actual field trips. International Journal of Instructional Media, 29(4), 453-468.

Villarroel, V., Benavente, M., Chuecas, M. J., & Bruna, D. (2020). Experiential learning in higher education. A student-centered teaching method that improves perceived learning. Journal of University Teaching & Learning Practice, 17(5). https://doi.org/10.53761/1.17.5.8

Wain, A. (2017). Learning through reflection. British Journal of Midwifery, 25(10). https://doi.org/10.12968/bjom.2017.25.10.662

Walker, J. P., & Rocconi, L. M. (2021). Experiential Learning Student Surveys: Indirect Measures of Student Growth. Research & Practice in Assessment, 16(1), 21-35.

Zeichner, K. (2009). Rethinking the Connections Between Campus Courses and Field Experiences in College- and University-Based Teacher Education. Journal of Teacher Education, 61(1-2), 89-99. https://doi.org/10.1177/0022487109347671