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The Influence of Digital Knowledge Exchange on Advancing Irish Students Knowledge and Adoption of Sustainable Grassland Management Innovations

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The Influence of Digital Knowledge Exchange on Advancing Irish Students Knowledge and Adoption of Sustainable Grassland Management Innovations

Abstract

Ireland's researchers and agricultural advisors emphasize good grassland management as a hallmark of good farming. Formal structured agricultural education and training is a major model of agricultural extension that helps farmers become more innovative and adaptable. Our purpose was to explore the perspectives of Irish higher-level agricultural science and agri-business students who engaged in virtual discussion groups. We employed a co-facilitation approach to help students bridge the gap between theory and practical application in grassland management. Participants were undergraduate students enrolled in two Bachelor of Sciences programs. Third and fourth-year students (n=182) had the opportunity to join non-credit virtual discussion groups focusing on grass measuring and budgeting. Of the 59 expressions of interest, three discussion groups were formed: dairy, dairy and drystock, and drystock only. Group assignments were based on student motivations, farm interests, and grass measuring experience, ensuring the program was tailored to support student learning and innovation. The groups were designed to facilitate learning and behavior change around best practices in grassland management. Participants acknowledged the value associated with opportunities to collaborate with peers as well as experts in the field in terms of developing their knowledge and skillsets with respect to grassland management. Evidence of behavior change regarding grassland management practices at farm level are presented which suggests virtual discussion groups can support increased adoption of (complex) grassland innovations. Recommendations for future delivery are discussed.

Keywords

Extension, Education, Adoption, Sustainability, Digital, Agricultural Innovations, Grassland Management

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Formal structured agricultural education and training is one of the major models of agricultural extension (Black, 2000) that helps farmers become more innovative and adaptable in their farming practices (Kaberis & Koutsouris, 2012). Moreover, the adoption of best practices at farm level is strongly linked to agricultural education (McKillop et al., 2018) with younger, more educated farmers more likely to adopt new innovations compared to their older peers (Corner-Thomas et al., 2015; Howley et al., 2012; Läpple et al., 2015).

The Covid-19 pandemic disrupted the education of 1.6 billion students in over 190 countries (United Nations, 2020) profoundly affecting higher level education worldwide (Das et al., 2021; Marinoni et al., 2020), including agricultural education (Azzi et al., 2022; Thapa et al., 2020). In response to pandemic-related restrictions such as social distancing and lockdowns, educational institutions rapidly transitioned to digital platforms (Pesci et al., 2023). This shift, while necessary, often compromised practical hands-on learning experiences, which are a vital aspect of agricultural education (Davis, 2020).

One model particularly impacted by this transition was the discussion group format. Discussion groups, widely used in agricultural extension (Dooley, 2020; Morgans et al., 2021; Prager & Creaney, 2017), promote peer-to-peer learning, enabling farmers and students to share knowledge and learn from each other (Holohan, 2020; Teagasc, 2023a). Typically, these facilitator-moderated groups meet in person on farms (Mulkerrins et al., 2022a) and are effective in supporting technology adoption as farmers are often influenced by the practices of their peers (Mulkerrins et al., 2022a; Šūmane et al, 2018).

While there has been extensive research that has focused on young farmers in different contexts (Beecher et al., 2022; Beecher et al., 2019; Deming et al., 2018; Flannery et al., 2022; McKillop et al., 2018), little attention has been given to the role of discussion groups in higher education, particularly in the context of virtual

or in-person discussion groups for university students studying agricultural subjects. This gap warrants further investigation.

Evaluation Framework

Discussion groups are participatory extension programs (PEPs) that provide continued education and personal development for farmers (Bradfield et al., 2020; Mulkerrins et al., 2022b). Participation in PEP's is linked to accelerated practice adoption (Nettle et al., 2022) and increased profitability (Hennessy & Heanue, 2012; Läpple et al., 2013).

One of the criticisms of the evaluations of many PEPs is the absence of planned evaluations in the program design (Knook et al., 2018; Mulkerrins et al., 2022a). To address this, the research team incorporated the Kirkpatrick and Kirkpatrick's (2006) model (KM), a widely recognized framework for evaluating agricultural and extension education programs (Hansen, 2015; Murphrey et al., 2018; Wanjiku et al., 2010), into the initial program design. This model has been used in similar contexts, such as evaluating advisory services in Norway (Hansen, 2015), non-credit educational programs (McLean & Moss, 2003), and virtual reality use by university students during Covid-19 (Strong et al., 2022).

Kirkpatrick's model has four levels of evaluation: reaction, learning, behavior and results (Kirkpatrick, 1994). Previous agricultural studies have detailed each level and provided questions to guide evaluations (Gow et al., 2020; Hansen, 2015; Hur et al., 2023; McLean & Moss, 2003; Strong et al., 2022). Similar to Gow et al. (2020), this study, due to time constraints, addresses the first three levels of the KM– reaction, learning and behavior. Unlike other discussion group programs (Mulkerrins et al., 2022a, Prager & Creaney, 2017), this program did not provide financial incentives to the participants. Therefore, to gain a better understanding of why students participated, this study also explored students' motivation to join the program.

Purpose & Objectives

The purpose of this study was to explore the perspectives of higher-level agricultural science and agri-business students who engaged in online/virtual discussion groups. Using 'grassland management' as a case study, the groups were designed to facilitate learning and behavior change around best practices in grassland management. The specific objectives were:

1. To understand student motivation for joining non-credit virtual discussion groups;
2. To assess the program's effectiveness using the first three levels of the KM;
3. To gather recommendations for improving virtual discussion group delivery in the future.

Methodology

In the context of PEPs, it was deemed particularly important to understand the social context of a program when trying to extract lessons from a particular study (Knook et al., 2018), these are detailed in the following sections.

Case Study Context

Ireland's sheep, beef and dairy systems have a competitive advantage due to the cool temperate climate that supports high grass dry matter (DM) production over a long grazing season (O'Donovan et al., 2022). Research shows grazed grass is the cheapest feed for Ireland's grass-based, ruminant livestock systems (Finneran et al., 2012) and the farms that grow and utilize the most grass are typically the most profitable (Ramsbottom et al., 2015).

To capitalize on this advantage, extension programs often focus on key practices to increase pasture production and utilization (Mulkerrins et al., 2022a; Teagasc, 2023b). Researchers and advisors in Ireland subsequently emphasize good grassland management as a hallmark of good farming (Shortall, 2022). However, despite these efforts the adoption of improved grassland management practices, such as grass measuring and budgeting, remains relatively low (Creighton et al., 2011; McDonald et al., 2015; Mulkerrins et al., 2022a). Convincing farmers of the value of such innovations can be challenging (Regan et al., 2020) as these practices are often seen as complex and thus, limiting their adoption (Turner & Irvine, 2017).

Discussion groups have proven effective in increasing confidence with grassland practices. For example, Garvey et al. (2018) found Irish farmers in discussion groups believed in the benefits of grass measuring and budgeting and were more likely to adopt these practices through peer support. Mulkerrins et al. (2022a) also noted newer members of discussion groups were more likely to adopt grassland management technologies. Given the importance of grassland management and success of discussion groups in supporting learning amongst farmers, this study sought to explore how the same concept could be applied to higher education students in an online format.

Program Design

Given the knowledge intensive nature of grassland management, continued support and training are essential for practice change (Hall et al., 2019). This study employed a co-facilitation approach, similar to Mulkerrins et al. (2022b), to help students bridge the gap between theory and practical application in grassland management.

The discussion groups were facilitated by two Teagasc (the agriculture and food development authority in the Republic of Ireland) trained facilitators with 3-5 years of experience and CECRA certification. One facilitator, a lecturer at Mountbellew Agricultural College (MAC)/Atlantic Technological University

(ATU), was known to the students. Other MAC/ATU staff also participated, assisting students with pasture recording software (PastureBase Ireland, PBI). Although the students themselves decided on the timing and frequency of meetings for their group, almost all group meetings took place at 5pm or later. The rationale for this was to avoid clashing with their scheduled lectures as part of their respective majors. However, the later time sometimes clashed with other commitments and clashing with "milking" was commonly cited among some of the dairy students.

Target Population

As provided in Table 1, participants were undergraduate students enrolled in the Bachelor of Science in Agriculture and Environmental Management (SAGAG) or the Bachelor of Business in Rural Enterprise and Agri-Business (BRUAG). An email was circulated to all third and fourth-year students (n=182) outlining the opportunity to join non-credit virtual discussion groups focusing on grass measuring and budgeting using PBI. Of the 59 expressions of interest, three discussion groups were formed: dairy (n=16), dairy and drystock (n=15), and drystock only (n=28). Acknowledging the heterogeneity among young farmers in terms of innovation and practice adoption (McKillop et al., 2018), group assignments were based on student motivation, farm interests, and grass measuring experience, ensuring the program was tailored to support student learning and innovation.

Table 1

Socio-demographic Characteristics of the Case Study Students (n=26)

Characteristic	Details	Number of Students
Average Age (years)	22 (range 20-27 years)	26
Sex	Male	22
	Female	4
Stage in University	Third year	10
	Fourth year	16
Undergraduate Program/Major	SAGAG	17
	BRUAG	9
Farm students were focusing on	Home farm	24
	A farm they work on	2

Main enterprise of interest	Beef	11
	Sheep	6
	Dairy	9

Microsoft Teams was used for all group meetings, and an overarching 'Grass Discussion Group' included all students and staff (see Table 2). An introductory meeting was held to introduce the facilitators and outline the objectives, emphasizing student engagement in setting learning goals, a crucial element of successful discussion groups (Mulkerrins et al., 2022a). Supporting videos and newsletters were also provided through the platform.

Table 2

Grass Discussion Group (All groups, n=59 students)

26th February: Introductory Meeting 04th March: PBI Set-up/Support 18th March: PBI Set-up/Support 23rd March: Guest Speaker - Conversion from Beef to Dairy (New Entrant) 20th April: Guest Speaker - Teagasc Sheep Researcher 11th May - Final Group Meeting		
Dairy Discussion Group (*n*=16)	Dairy and Drystock Discussion Group (*n*=15)	Drystock Discussion Group (*n*=28)
11th March: Group Meeting	12th March: Group Meeting	15th March: Group Meeting
30th March: Group Meeting	30th March: Group Meeting	31st March: Group Meeting
15th April: Group Meeting	14th April: Group Meeting	16th April: Group Meeting

Note. Occasionally participants were added to more than one group to allow them to attend a meeting if they couldn't attend their initially assigned group meeting.

Research Approach

Building on the KM as an evaluation framework, a multidisciplinary team of agricultural scientists (including educators, advisors, facilitators, specialists and researchers) were consulted, and a qualitative survey was determined to be the most effective method of data collection. Braun et al. (2020) outlined many advantages of online qualitative surveys including; when a population are widely dispersed, hard to access and/or diverse; when a wide range of perspectives are sought or when a topic suits a 'wide angle lens'. Despite being underutilized (Braun et al., 2020),

due to the limited time available for the project, Covid-19 restrictions and large geographical spread of the target population, qualitative surveys were deemed a suitable data collection method for this study. Research shows that qualitative data collected through web-based surveys are comparable to telephone or postal survey data (Coderre et al., 2004).

The surveys were developed by the research team with questions guided by the KM and its first three assessment levels – reaction, learning, behavior. The survey was created in Google Forms and after piloting, a link was circulated to all students who had participated in the groups. The data (n=26) were exported to Microsoft Excel, and similar to Mulkerrins et al. (2022a) the surveys were manually reviewed by three members of the research team. For ease of analysis, individual tabs were created within excel for socio-demographic data (see Table 1), the three levels of the KM being researched, and tabs for the questions focusing on the students' motivation for joining the program and their recommendations for future programs. Following Flannery at al. (2019 & 2022), thematic analysis was used to analyze qualitative data and both inductive and deductive approaches were used for coding and the identification of themes. For objectives one and three, an inductive approach was applied as the questions were open-ended, relating to students' motivation to join the program and their recommendations for future programs based on their experiences. Both open and axial coding were used to inductively identify codes and create subcategories within the datasets regarding motivation and recommendations for future programs. Objective two was analyzed using the first three levels of the Kirkpatrick Model (i.e. reaction, learning and behavior) and these levels provided the categories for deductive analysis of qualitative data relating to each level. The coding approach was refined and the categories identified were discussed between authors to ensure they were reflective of the patterns in the dataset. Similar to Agard and Roberts (2020) approach, photos from students (Figures 1-4) in this study provided another source of data to triangulate the findings, in particular the findings relating to levels two and three of the KM.

Limitations

The study does have limitations. This sample size (n=26) is relatively small, however, it is in a similar range to other qualitative studies focusing on pasture management and measurement (Hall et al., 2019; Regan et al., 2020). Focusing on a single case study may limit the applicability of the findings to other agricultural topics or disciplines.

Findings

Based on the evaluation framework and research questions, the findings are presented under the following headings:

1. Motivation to join the discussion group

2. Reactions to learning
3. Learning outcomes (knowledge, skills, attitudes etc.)
4. Behavior – extent of new skills and resources applied in practice

Motivation to Join the Discussion Group

Grassland management is a key feature of ruminant livestock production in Ireland. Students recognized grazed grass as "the cheapest feed available to farmers" and noted its strong relevance to their home farms, workplaces and future careers. Consequently "learning" and gaining "additional knowledge" were the primary motivation for joining the discussion group. They aimed to "improve grassland management skills" to "practice these things" on their "own farm" and become "more confident with making decisions":

> I believe that farmers are always going to learn off each other more so than possibly books or papers (not dismissing either) but it is common knowledge that farmers are peer learners. So, any possible chance to learn something new or beneficial to my home farm was greatly accepted. Knowing how other farms operate and possibly learning one new trick or trade from them is always worthwhile. (Student 3)

The facilitator(s) also motivated students. Students felt the facilitator(s) "encourage a lot of engagement" and "get the class going", fostering an inclusive environment: "I knew there would be a friendly and relaxed environment, therefore making learning easier". (Student 9) The opportunity to learn from "peers", "likeminded farmers" and "fellow classmates" was another motivation:

> I felt this was a great way to get involved with a discussion group of farmers around my own age and see how they get involved in their own farms or the farms they work on and learn from them. (Student 6)

Reactions to Learning

Overall, students had a positive reaction to learning through online discussion groups (see Table 3), describing it as "very worthwhile experience". Peer-to-peer learning was also identified as the strong point of the initiative for students. Additionally, the findings show (see Table 3) students also valued the contributions of the facilitators and the guest speakers:

> From farming at home, I know grass is the cheapest source of feed. So, I wanted to learn as much as I can about the best way to manage grass, and to receive the best advice from the lecturers and advisors. The guest speakers also gave a great insight into different types of farming. (Student 12)

Table 3

Students' Reaction to Learning Via Online Discussion Groups (n = 26)

Characteristic	*f	**%
1. Inclusion of guest speakers	25	96.15
2. That you decided to join the online grass discussion group initiative	22	84.62
3. Online discussion group format	20	76.92
4. Technical content discussed at the online discussion groups	20	76.92
5. Facilitation	19	73.08
6. Frequency of meetings	11	42.31
7. Timing of meetings	5	19.23

Note. * = The number of very satisfied responses to the respective items.
** = represents the number of participants that were very satisfied per each item.

Students recognized facilitated group learning built confidence as "[t]he more talking students do on everyday farming topics the more comfortable they will become when it comes to talking about the more technical aspects of farming like grass measuring". They expressed hope that in the "future that COVID isn't an issue" but noted that the program "ran off very well considering the restrictions". Their positive feedback included a strong recommendation for the program to "go ahead next year" and a desire for it to "continue for students who are finishing up their studies".

When students were asked about their experience of learning in relation to grassland management most students preferred the online discussion group format compared to traditional lectures. They noted the online setting allowed them to "relax more", be "more interactive", and feel "more engaged". This "laid back approach" enabled them to 'ask more questions and have a greater understanding of grassland management". While students appreciated the program's success, a blended approach of online and face-to-face delivery was preferred by 23

participants, with two opting for all in-person meetings and only one preferring fully online sessions.

Learning Outcomes (knowledge, skills, & attitudes)

Students' attitudes towards learning aligned closely with their motivation for joining a discussion group. They recognized grassland management as the cheapest feed for ruminant farmers in Ireland, contributing to their eagerness to learn: "I think this was particularly important and beneficial because it sharpened me up with facts and figures that I'll need when applying for jobs in the agricultural sector". (Student 23)

While all students had some prior knowledge of grassland management, all (but one) reported an increase in understanding through program participation:

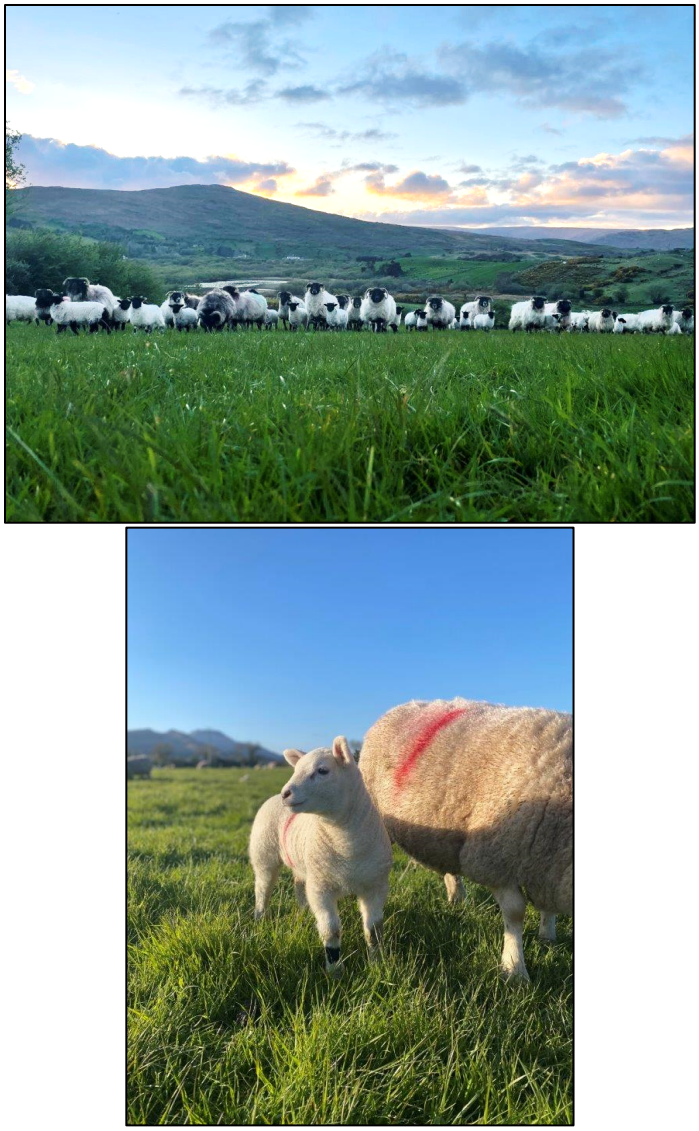
> My knowledge with regards to grassland management definitely improved through participating in the group. The guest speakers were very knowledgeable in their respective fields. There was a good balance and mix of discussion from different enterprises". (Student 23)

Students learned specifics such as "how much dry matter you need", that they had "a better understanding of grass covers", "the importance of paddock grazing and better utilization of grass" as well as "how to properly graze out paddocks". They also demonstrated that grassland management practices (Figure 1) can vary between livestock systems:

> My grassland general knowledge has definitely improved… I also learned that sheep farmers go into lighter covers to suit the sheep grazing technique better. I also learned that it was standard or acceptable for a sheep farmer to leave his flock in a paddock for 3 days without causing the grass plant any harm. I found these two points in particular very interesting as they are different to the techniques we were used to discussing in relation to cows. (Student 8)

Figure 1

Student Photos on What They Perceived as Good Grass Quality on their Sheep Farms



The results highlighted how students' improved knowledge and skills in grassland management helped them address various "situations" on their farms:

> Yes, my knowledge has improved. I've got a better insight into dealing with different grassland situations. For example, when our farm ran into a grass deficit towards the end of the first rotation, the

> group provided me with the knowledge and tips to deal with the situation. (Student 19)

Participation in the online discussion groups achieved one if its primary objectives, to enhance students' skills in measuring grass and becoming more familiar with Pasture Base Ireland. Additional comments provided further insight into their learning "Yes, I would say my knowledge on this area has greatly improved…seeing the data on Pasture Base relevant to my own farm, learning from the other group members and determining best practices from this allowed me to learn". (Student 1)

With regards to learning new grassland management skills, students specifically mentioned how group participation helped "resharpen" and/or develop their grass measuring and budgeting skills: "Yes, my skills have improved, I have a better understanding of grass covers and utilizing the grass available to me more efficiently". (Student 3)

Group participation helped students build confidence in their abilities and "decisions in relation to grassland management" including confidence with grass measuring and using Pasture Base Ireland: "I had never before measured grass or calculated the DM in a sample of grass…Because of the time spent teaching these skills I can now confidently measure grass and use the calculation showed to us in the group". (Student 8)

Behavior (extent of new skills and resources applied in practice)

Participation in the grassland discussion groups acted as a catalyst for change, providing students with the knowledge, confidence and motivation to make positive improvements. Fourteen students reported the group influenced them to create more paddocks or use more temporary fencing (see Figure 2) to improve grassland management: "Since starting the group I have set out all the farm in paddocks with temporary wires and water in each. There were six field divisions on the farm there is now 14". (Student 10)

Other practice changes included creating larger stock groups, measuring allocations with a GPS app, ensuring cattle grazed down to a 4 cm residual, and improving silage quality. Students also noted enhancements to roadways, water sources, reseeding, and selecting suitable grass varieties. The results indicated grass measuring and budgeting became more prevalent, with students stating they "began grass measuring since the discussion group began".

> Prior to this group I wasn't regularly measuring grass on my home farm. I had attempted to do it last spring but never stuck with it. I think the group meant I had to be accountable and have a cover for each meeting which is a good thing. I now measure grass weekly and make decisions based on the measurements. (Student 11)

Figure 2

Student Photos from Sheep, Dairy & Beef Farms Highlighting the Use of Fencing and "Strip Grazing"

Overall, three out of every four (77%) of students reported an increase in grass walks due to group participation. Six students reported no change in the number of walks they completed but "gained confidence from the meetings" reinforcing their practices were generally correct. Among measuring methods, cut and weigh was the most common (n=18) and two students provided photos (see Figure 3) as evidence. Workshops as part of the program spent a "significant amount of time" discussing and demonstrating different methods of grass

measuring and how to use PBI. In addition to the discussion groups themselves, the workshops also helped increase the students' knowledge and skills of grassland management.

Figure 3

Student Photos Demonstrating the Use of the Cut and Weigh Method

Other methods included the sward stick (*n*=4), a platemeter (*n*=1) or the "fist method" (*n*=3) with 9 students visually assessing paddocks. Some submitted photos without specifying measurement techniques, though they referenced grass measuring (see Figure 4).

Figure 4

Student Photos Captioned "Audience While Grass Measuring" & "Left Side of the Picture was a Fully Grazed Paddock; Right Side is the Cover the Cows were Going into After Milking"

Many students found the PBI platform challenging, stating the group helped clarify its use. Discussion groups and workshops, along with "trial and error," supported increased usage of PBI:

> It gave me a great insight into appropriately managing the stocking rate, as well as being able to see the demand, and I could fiddle around with the numbers to ensure that grass never ran short. [Facilitator Name] was able to show me how to apply my stocking rate, my average farm cover and demand into the app and move the numbers accordingly so I didn't begin to reach a grass deficit. (Student 12)

Nineteen students reported setting up PBI accounts through group participation while seven already had accounts. Twenty-two students reported increased usage, whereas four noted no change, citing comfort with PBI due to regular use on their farms. Additional functions used included inputting slurry and fertilizer data and employing grass budgets and projected wedges for better management decisions.

Objective three sought to gather recommendations for improving virtual discussion group delivery in the future. In addition to advocating for a blended approach, students made several recommendations to improve online delivery. A key suggestion included adjusting the timing of meetings to avoid conflicts with "milking" and "feeding cattle", however, accommodating everyone's schedule is challenging. Students emphasized the importance of a reliable internet connection and suggested the option to record sessions, particularly when guest speakers were involved. This would benefit those unable to attend due to other commitments, such as tending to lambing sheep. Other recommendations included: incorporating more guest speakers, particularly model farmers relevant to specific enterprises, providing "extra notes or handouts" to help support what is being discussed, and utilizing more visual aids to enhance learning. "Get more pictures and situations from problems or good things people are doing on other farms as I feel that's where I learn the most, nearly copying or learning from others what we can do on our farm". (Student 16)

While facilitators and guest speakers kept their cameras on, three students suggested enabling all participants to turn on their cameras to foster greater interaction and engagement. One student remarked, "[a]lthough I wouldn't have liked it at first, I think it should be compulsory to have the cameras on from day one." Students acknowledged the need to work around timetables but recommended starting groups earlier and continuing through the summer and into the next year. They also suggested having a "set day" for meetings and sticking to schedules to maintain participation.

Discussion

Farmer discussion groups are a common participatory extension approach that focus on facilitating peer-to-peer learning which can support practice change (Mulkerrins et al., 2022a; Prager & Creaney, 2017). However, grass measuring and budgeting are complex technologies (Turner & Irvine, 2017) and their adoption is relatively low, even amongst discussion group participants (Mulkerrins et al., 2022a). This study illustrated the potential discussion groups could have in the agricultural education system, helping improve students' technical knowledge on a targeted subject area, whilst having a direct impact on improving their hard skills at adopting complex technologies at farm level (i.e. grass measuring and budgeting).

This study also highlighted discussion groups can play a role in helping students develop and strengthen their soft skills as the program encouraged them to share and exchange their knowledge and experiences with each other, the facilitators and the guest speakers in an open environment. These skills may be beneficial to students in their future college work and when they finish college and enter the professional workplace.

From an institutional perspective, this study demonstrated, the continued need for review and updating of education curriculum. Aligning the curriculum with the ever-changing needs and desires of students, as well as the skills demanded by an ever-diversifying professional workplace, may better prepare students for their careers in their selected discipline. Pilot initiatives like this grass group initiative could play a role in keeping agricultural curriculum in harmony with the needs and desire of students by developing, delivering and evaluating a potential subject area before a wider adoption of the chosen topic in the curriculum to all students. Students (i.e. 59/182 enrolled students) are willing and motivated to participate in non-credit programs to gain knowledge and skills they view as important to them. Therefore, incorporating the student voice to help develop the future direction of a curriculum is important.

The study also highlights the importance of flexible learning opportunities with regard to time and location but also in terms of mode of delivery. The findings suggest learners like to receive new knowledge and information in many forms such as visual, audio, reading material, hands-on learning, etc. This supports the VARK model of learning (Alkhasawneh et al., 2008) which suggests four sensory modalities for learning – visual, aural, read/write, and kinesthetic. Opportunities for experiential learning based on real-life scenarios was also highlighted by participants. This study identified the significant role discussion groups (blended between online and in-person) can play within an agricultural education system by providing increased opportunities for interaction and knowledge exchange. These opportunities can lead to increased levels of technology adoption adding to an

improved overall learning experience for students and to the development of both their hard and soft skills.

Conclusions, Implications, & Recommendations

The findings highlight the importance of peer-to-peer learning, creating a community of learners, and facilitating online/virtual meetings in grassland management. The discussion groups fostered a sense of belonging and collaboration among students, enabling them to share experiences and learn from and with each other in an experiential setting. This collective learning environment enhanced students' understanding of grassland management and promoted the application of best practices in their respective contexts.

This initiative was able to recommend to the institution the need and desire amongst students to further develop their knowledge of best practices relating to grassland management and the skills associated with it. Informed by this research, through programmatic review, grassland management now has a much stronger emphasis throughout the undergraduate programs. Additionally, an 'Advanced Grassland Module' was developed and incorporated as part of the curriculum.

The application of reaction, learning, and behavior (Kirkpatrick, 1994) provided a robust framework for evaluating the program's effectiveness. Engaging students in these discussion groups provided valuable insights into their motivation, learning experiences, and the effectiveness of the program. Data indicated these virtual groups fostered learning and behavior change, while key areas for improvement in future delivery were highlighted. Building on students' motivation to participate in the groups, the results related to the first stage of the KM showed a positive reaction to learning about best practices in relation to grassland management in an online setting. Students reacted positively to exchanging knowledge with their peers and highlighted the inclusion of guest speakers into the program as a strong point.

Furthermore, the study revealed students demonstrated increased knowledge and confidence in grassland management practices, as evidenced by their adoption of new skills and techniques. Many participants reported changes in their farming practices, such as implementing more efficient grazing strategies, utilizing technology for grass measuring and budgeting as well as adopting other best practices learned during discussions. These behavioral changes indicated the program not only imparted knowledge but also facilitated a noticeable shift in students' practices (behavior).

This study identified areas for improvement in the delivery of virtual discussion groups. Students suggested a blended approach, combining online and face-to-face interactions, as they believed this would enhance engagement and deepen their learning experiences. Additionally, recommendations include adjusting meeting times to accommodate farming schedules and increasing the use

of visual aids and guest speakers. These suggestions highlight the need for continuous feedback and adaptation in educational programs to meet the evolving needs of students and ensure effective learning outcomes.

Future research could explore the effectiveness of virtual discussion groups in different agricultural and extension education contexts (Lee et al., 2024; Seitz et al., 2022) and among diverse student populations to gain a more comprehensive understanding of their impact on agricultural education learning. Potentially, there is a place for an online/virtual discussion group for young farmers post-graduation to support applying new knowledge at farm level and developing skillsets. The further integration of education, extension, and advisory services in the delivery of agricultural education programs is needed. Students had a desire for more field experiences, therefore, a blended approach could make use of the college farm for instance, host farms, local farms, etc. to combine in-person and online elements of delivery.

The pedagogy was also an innovative approach to education delivery which can be applied across agricultural education programs. From an educator perspective, opportunities for continuous professional development (CPD) with regard to pedagogical approaches, specifically acting as a facilitator, are needed to support this mode of educational delivery i.e. discussion groups focusing on peer-to-peer learning. Incorporation of the student voice both within curriculum design and in the classroom was significant in ensuring young peoples' motivation for engagement in activities such as the discussion groups presented in this paper. This helps ensure students' needs and objectives are met and supports educators in terms of engagement, promotion of behavior change, and change in student mindset. Individual motivation for involvement in an agricultural education program or module can influence student readiness to engage and consider practice change (Flannery et al., 2022). Educators require the capacity to work with students from a variety of backgrounds, with different motivational regulations for agricultural education, in a constantly evolving agricultural environment. Hence, the significant importance of CPD opportunities to provide necessary support to educators who are typically technical (as opposed to pedagogical) experts in their field (Flannery et al., 2019).

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